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ABSTRACT

This study evaluates two approaches to changing dental care behaviors of seventh graders. After receiving instruction in brushing and flossing, students in one experimental group were confronted with inconsistencies between expressed beliefs and actual oral hyginene behaviors, as demonstrated with photographs of their own mouths. Data analyses indicated that when a measure based on photographs was used, these students' plaque scores (measuring oral cleanliness) measured at one, six, and twelve weeks after treatment, were significantly lower then the control group or the group receiving instruction only. Scores of students who participated in verbal rehearsals of correct oral hygiene procedures also revealed immediate improvements, but these changes were not maintained. When clinical measures of plaque and gingivitis scores obtained in the field were used, no significant differences were found between the mean scores of the control group and any of the three treatment groups. (Author/JS)

Comparative Effectiveness of Three Approaches To Changing Dental Hygiene Behaviors of Seventh Graders

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Comparative Effectiveness of Three Approaches To Changing Dental Hygiene Behaviors of Seventh Graders[1,2,3,4]

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In the field of public dental health education, a persisting problem is that of transforming information about oral health care into oral health care behaviors which individuals will engage in at home on a continuing basis. Many dentists and dental researchers believe that dental caries (cavities) and gingivitis (inflammed and/or sore gums) could virtually be eliminated if people would brush and floss their teeth properly, even once every 24 hours (Mandel, 1966; Lang, Cumming, and Loe, 1973). When subjected to the scrutiny of researchers, however, programs designed to teach dental health care skills have not generally produced the results hoped for in terms of improved oral health. The reason for this situation appears to be the failure to provide for change in behaviors which are well established in most individuals, and which are out of the control of the teacher or other health service worker.

Several previous studies of attempts to improve oral hygiene have produced rather impressive changes in subjects' knowledge of and/or attitudes toward dental health (e.g., Boffa & Kugler, 1970; Robinson, Mobley & Pointer, 1967; Stolpe, Mecklenberg & Lathrop, 1971). Rarely have such efforts produced evidence of improved brushing and flossing habits, however. In cases where improvements in oral hygiene scores were observed, moreover, the scores have usually reverted to pre-treatment levels as soon as instructional programs were terminated (Dennison, Lucye & Suomi, 1974; Lindhe & Koch, 1967; Podshadley & Shannon, 1970; Stolpe, Mecklenberg & Lathrop, 1971).

Most attempts to improve oral hygiene have relied heavily on lecture-demonstration approaches or, at best, on such an approach combined with practice sessions in brushing and flossing. In a few cases where significant improvements in oral hygiene have been sustained over longer periods of time, however, direct attempts were made to change behavior patterns. In a study of second graders, for example, Martens et al. (1973) used toys and other tangible rewards in a prolonged and intensive behavior modification program which produced improvements for up to six months after termination of the program.

The difficulty of changing long-standing behavior patterns is not a problem unique to dental research, of course, and it appears that other effective approaches to improving oral health care might be found among behavior change approaches which have been applied in other areas. The study reported here investigated two such theoretical approaches, specifically, those described by Rokeach (1971) and by Meichenbaum (1971). Both appeared to offer promising models for our work, although the dental hygiene situation, as might be expected, required some special considerations and certain interesting adaptations of procedures. The following paragraphs describe these two approaches and the manner in which they were modified for the task at hand.

(1) Belief Consistency Approach. This method was based on Rokeach's approach to behavior change whereby individuals are made aware of inconstancies within their value-attitude systems. Rokeach presented to his subjects for ranking a list of 18 rather broadly defined values, that is, a group of phrases describing states of being or modes of behavior which he perceives as fundamental to the development of situation-specific attitudes and behaviors. Once such rankings were made, inconstancies within the rankings could be pointed out which would, he hypothesized, give rise to feelings of dissatisfaction, changes in one's values, and, ultimately, to the need to change the behaviors which reflect those values. Since this method produced impressive long-range changes in the attitudes and behaviors of college students with reference to

the civil rights movement, it was anticipated that it might also prove effective for changing health care beliefs and behaviors.

Since the subject population for the dental health study consisted of seventh graders rather than college students, however, and since the relationship of Rokeach's global values to brushing and flossing seemed less clear than its relationship to civil rights activities, it was decided that some other set of values might provide a more useful instrument. Considering the adolescent's overwhelming concern with developing identity in relation to the peer group, it appeared that a system of values related to personal characteristics might be appropriate. To develop such a list, more than 200 seventh graders outside our sample were surveyed concerning personal characteristics they believed to be important for people their age. From their responses, a list of 12 frequently mentioned personal characteristics were distilled. These were: considerate of others, friendly, good at sports; good looking; good personality; good with girls/good with boys; honest--doesn't lie or cheat, mature--acts grown up; neat, clean, well-dressed; not conceited or stuck up; popular; and smart--good in school. This list was then used as the basis for discussion and ranking of beliefs about personal characteristics and, ultimately, the identification of inconsistencies within this system of values.

(2) Behavior Rehearsal Approach. Impetus for this method came from the work of Meichenbaum and others (Meichenbaum, 1971), primarily in the areas of desensitization and modification of impulsive learning styles. Basically this approach consists of efforts to utilize a natural tendency to give oneself sub-vocal instructions on behavior. Individuals are trained to "talk to themselves" in a manner which facilitates goal attainment and to use imagination to increase generalization of such "healthy talk" to behaviors in appropriate situations.

In the dental hygiene situation, the assumption was made that, once proper brushing and flossing skills were available to students, the failure to perform

these activities is impulsive, but might be rectified by training in verbal self-instruction. Thus, subjects in this group imagined themselves in the evening routine at home and practiced with us "talking themselves through" the oral health care behaviors which they had learned.

Method

Subjects

Subjects for the study were 171 seventh grade students whose parents had agreed to their participation in a federally funded study of preventive dentistry. The consent rate was greater than 98% in the three schools involved. All available volunteers were randomly assigned to a control group or to one of three experimental groups. (The original sample included 33 additional subjects who received experimental treatments but who were excluded from analyses because of orthodontic work in progress or absences which prohibited assessment within a reasonable time period.)

Procedure

Prior to experimental treatments, baseline measures were obtained on all subjects through examination by a dental hygienist following the use of a disclosing dye to reveal dental plaque. (Plaque is the substance, formed on the teeth by the action of bacteria on starches, which appears to be a necessary pre-condition for dental caries and which can be removed by proper brushing and flossing.) Color photographs (transparencies) of each subject's teeth were also made at the time of the hygienist's examination. Subjects then participated in the experimental activities described below.

Group 1. Students assigned to the "Control Group" (N=44) were not contacted again until the first post-treatment assessments were conducted, that is, ~~twenty-four~~ twelve weeks after the baseline measures were obtained.

Group 2. Students in the "Instructional Group" (N=39) participated in two instructional sessions of 20-30 minutes duration conducted by a dental hygiene teacher. Working with two students at a time, the teacher gave a brief explanation of plaque control followed by a brushing and flossing demon-

stration on a model. Students then practiced the technique using disclosing tablets to observe plaque and guide its removal. They were given brushes, toothpaste, dental floss, and disclosing tablets to use at home. A second session, conducted three weeks after the first and of the same structure and duration, focused on perfecting brushing and flossing procedures, along with individual feedback on special problem areas in the mouth.

Group 3. Students in the "Belief Consistency Group" (N=42) received exactly the same instruction on the same schedule and with the same dental hygiene teacher as those in Group 2. Then, three weeks after the second instructional session, each student met with a research assistant for the first of two "motivational" sessions. In the first of these sessions, students rank ordered the list of twelve personal characteristics for importance. The research assistant then discussed these values and rankings with the student and attempted to relate good dental hygiene to one of the values -- usually "neat, clean, well-dressed", "good personality", or "friendly". If this value had not been ranked very high on the list, its relationship to some value which had been ranked high was pointed out. Then the students were asked to rate their level of satisfaction with the rankings they had just made and, separately, with their present brushing and flossing habits. Dissatisfaction was thus aroused both in relation to the value system and in relation to the dental behaviors reflecting certain values. In a second session three weeks later, students reviewed the value rankings and discussion of the previous session. In order to allow each student the opportunity to confront his own belief-behavior inconsistencies, the research assistant showed to the students the actual baseline photographs of their teeth stained with the plaque-disclosing dye. The level of hygiene revealed in the photographs was discussed, and specific suggestions for improvement were made.

Group 4. Students in the "Behavior Rehearsal Group" (N=46) also received the same instruction on the same schedule and with the same teacher as those in Group 2. Three weeks later they also met individually with the

same research assistant who worked with Group 3. In the first of their motivational sessions, Group 4 students developed a list of activities which described the daily routine of some 30-minute to one-hour period during which they thought they would be most likely to clean their teeth at home. They were given a chart for recording brushing and flossing, wrote this activity into their daily routine, and then described the routine in detail to the research assistant. Then students were asked to mentally rehearse the routine again, this time trying to imagine themselves actually acting out each step of the routine. A second session three weeks later involved review of the first session, discussion of experiences, and repeated rehearsals. In this session more emphasis was placed on visualizing the specific behaviors involved in brushing and flossing.

Behavioral Measures

In both dental practice and research, the plaque score and the gingival index are generally considered to provide reliable measures of personal dental hygiene (Arnim, 1963; Lang, Cumming, and Loe, 1973; Loe, 1967). Most plaque indices involve the use of a dye such as erythrosine (as used here) to disclose plaque on the teeth, thereby facilitating assessment of the amount of plaque in terms of pre-established criteria. Since qualitative changes in gum tissue are related to brushing and flossing, dental hygiene behaviors can also be inferred from assessment of gingival condition in terms of specific clinical criteria. As part of an effort to gather information about the reliability and validity of scoring procedures (these data will be reported in more detail elsewhere), two approaches to obtaining plaque scores were utilized; one involving clinical assessment of the amount of plaque by a dental hygienist working in the field and another involving the comparison of photographs of the subjects' teeth with criterion photographs selected to represent varying levels of oral cleanliness. The gingival index was obtained only by clinical assessment.

Clinical Assessment. Before beginning experimental treatments and again six weeks after completion of experimental treatments, all subjects were examined for plaque and gingivitis. A dental hygienist trained in the Kobayashi and Ash method of scoring plaque (Kobayashi and Ash, 1964) and the Löe and Silness method of gingival assessment (Löe, 1967) conducted the examinations. The examiner's test-retest reliability averaged about .85 for subjects reexamined within four hours. The plaque score involved assessment of two surfaces on six specific teeth, while the gingival index involved assessment of the gums adjacent to those same surfaces. Plaque scores for each surface ranged from 1 (cleanest) to 5, and gingival scores ranged from 0 (no inflammation) to 3. Total mouth scores were obtained by averaging the surface scores for each subject.

Photographic Assessment. Color transparencies of each subject's teeth were made under carefully standardized conditions at the time of the clinical examinations described above and, in addition, at posttest intervals of one week, six weeks, and twelve weeks after the final experimental treatment sessions. The twelve central anterior surfaces were then scored by two raters using a five-point scale for the amount of dental plaque. Assessments were made by comparing the projected transparencies with five criterion pictures selected according to the method described by Evans et al. (1968). Interrater reliability for the two scorers was .95. With reference to both types of assessment it souuld be noted that for half of the students in each group all four assessment periods were scheduled in the morning, and for the other half in the afternoon; this was necessary to insure that there was no experimental bias due to after-lunch plaque accumulation.

Results

A one-way nonorthogonal least squares multivariate analysis of covariance was performed with five dependent variables and 3 covariates. Both the multivariate and univariate tests were inspected. The clinical plaque and gingivitis measures obtained six weeks after completion of treatments and the three

posttest plaque measures based on photographs were the variables of interest. Covariates were baseline scores for the three types of oral hygiene measures.

Insert Table 1 about here

Table 1 presents the correlations among all measures of plaque and gingivitis. The highest correlations were found between the clinical and photographic measures of plaque for scores obtained six weeks after treatment (r=.76) and for scores obtained at the baseline assessment (r=.70). Moderately high correlations were obtained both for clinical plaque measures at two time intervals (r=.63) and for photographic measures at four time intervals (r=.59 to .63). Baseline gingivitis scores were correlated at a lower level with both clinical and photographic plaque measures (r=.11 to .19), although the gingivitis scores from posttest assessment were moderately correlated for both plaque measures (r=.30 to .40). Baseline and posttest gingivitis scores were also moderately correlated (r=.47).

Using a procedure suggested by Finn (1974) planned contrasts of interest were tested rather than the traditional omnibus test of main effect. Thus, each of the experimental groups was tested against Group 1, the Control Group.

Insert Table 2 about here

Means and standard deviations of all plaque and gingivitis measures for each of the groups are shown in Table 2.

Analysis revealed no significant multivariate F values. Univariate tests, however, yielded significant group differences for the photographic measures of plaque when Groups 3 and 4 were contrasted with the Control Group. Group 3, which received the Belief Consistency treatment, had significantly lower mean scores than the Control Group at one week, six weeks, and twelve weeks after termination of treatment ($F=4.254$, $df=1/164$, $p<.05$; $F=3.083$, $df=1/164$, $p<.05$; $F=4.108$, $df=1/164$, $p<.05$). Group 4, which received the

Behavior Rehearsal treatment had a significantly lower mean score than the Control Group one week after termination of treatment ($F=5.188$, $df=1/164$, $p<.05$), although the later 6-week and 12-week posttests did not produce significant differences. Group 2, which received instruction only, did not differ significantly from the Control Group on any of the post-treatment measures. This last result replicates previous findings that the lecture-demonstration method produces no significant changes in dental hygiene behavior.

Insert Table 3 about here

The estimated means for the four groups on each of the plaque and gingivitis measures are shown in Table 3. The lowest estimated mean scores on all measures were obtained for Group 3, and inspection of the estimated means for the photographs reveals that these changes were sustained over a period of twelve weeks. In fact, scores for this group reached their lowest point at the final posttest assessment. The average estimated mean score based on the photographic measure at three posttest periods was 3.05 for Group 3, and 3.55 for the Control Group. The pattern of posttest measures for Group 4, reveals what appears to be a backsliding trend, with score increases at each subsequent time interval. These scores seem to indicate that while the treatment apparently had some immediate effect on the dental hygiene behaviors of Group 4 students, it was short-lived, with subsequent reversion to pre-treatment behaviors. The average of the estimated mean scores of Group 4 students for the three time intervals is 3.28. Group 2, which did not differ from the Control Group had a mean of 3.24 on the three photographic posttest measures; no directional trend was apparent in these scores.

Discussion

The results obtained in this study offer a clear suggestion that dental health care behaviors can be changed through procedures which focus on inconsistencies between one's expressed beliefs and actual behaviors. While

clinical implications of the changes reported may not be substantial, even such small changes can be viewed as important in light of the history of difficulty in altering dental care habits. While the changes reported here may not be large enough to represent changes in dental health, they do represent changes in behaviors which could eventually bring about improved health. It is quite possible, moreover, that the treatments described here can be modified to increase their effectiveness. In order to fully examine this possibility, additional data are currently being examined. Analysis of these attitudinal measures, self-reports of health care behaviors, and observational measures of participation -- all collected in this study but not reported here -- are expected to further explicate the various responses to treatments.

The Behavior Rehearsal approach, while not so successful as the Belief Consistency approach, was more effective than instruction alone and deserves further comment. It appears that this approach might require a number of followup sessions to attain full effectiveness. Since the emphasis is on training a pattern of thoughts which will generalize to a pattern of behaviors, further repetition could make an important difference in the treatment. In the Belief Consistency approach, on the other hand, impact comes through the experience of conflict, and so long as this conflict is directly confronted, repetitions should be unnecessary. It is also unlikely that the Behavior Rehearsal approach could effectively be modified for use with groups, as is anticipated for the Belief Consistency approach. Such factors, of course, give the Belief Consistency approach a distinct advantage in situations where time is limited. Finally, it appears that a younger group, or an older one, might gain more from this approach than adolescents. Some of the seventh graders appeared extremely self-conscious in this approach. A few of the boys seemed particularly reluctant to discuss their personal home and health care routines with the female research assistant. In addition, some students simply balked at the idea of mental and verbal rehearsal which seemed "stupid" to them. These reactions might occur less frequently with adults or young children, but

with seventh graders the Belief Consistency approach again seemed clearly superior. Students in this treatment generally seemed to regard their sessions as meaningful and interesting.

In spite of the encouraging nature of the results reported here, the data raise certain questions which must be addressed. One such question is why the scores based on anterior photographs were significantly lower for Group 3 than for the Control Group, while the clinical scores based on a whole mouth sample were not lower. One explanation is that it appears to be easier to thoroughly clean the anterior teeth and the outer surfaces which appear in the photographs than to clean the molars and inner surfaces which comprise the larger part of the whole mouth sample. What this seems to mean, clinically speaking, is that while the Group 3 subjects apparently were brushing more, perhaps they were not brushing as thoroughly or flossing as well as might be desired. If this is the case, one could also conclude that the photographic measure is more sensitive to behavior change. Another possible explanation for the discrepant results obtained from the two measures is that the standards of the examining hygienist may have changed over time, that is, she may have expected lower posttest scores on the posttest measure and therefore she may have given lower scores (unintentionally, of course). While the examiner did not know which children were in experimental groups, she did know whether the clinical exams were being conducted before or after treatments. This phenomenon would have been reflected in both the gingival and plaque scores, and, indeed, there is some evidence for this (See Table 2). The scores based on photographs, however, could not have reflected such expectations since all pictures (baseline and three posttests) were randomly ordered for scoring within the same sessions. And, in fact, the photographic measure indicates increased plaque scores for Groups 1 and 2 at the 6-week posttest.

It should be recognized also that certain limitations of the research design may have minimized the observable effects. For example, it is possible that baseline scores may be artificially low, reflecting the students' initial

enthusiasm for the program and desire to demonstrate good oral health. While this initial assessment was carried out over a period of three weeks and students did not know exactly when they would be examined, the presence of the dental team in the schools may nevertheless have increased their awareness and influenced their behavior until after the first exam. This is particularly plausible in light of the observation that the majority of children appeared somewhat nervous or apprehensive at the time of their first examinations.

The possibility of a contamination effect which would decrease group differences must also be considered. Students from all seventh-grade classrooms in the three schools were randomly assigned to treatment groups, and there may have been influence in either a positive or negative direction exerted by members of one group on another.

Another possible flaw in the research design is more theoretical in nature. Students in Groups 3 and 4 were provided instruction in brushing and flossing before they participated in motivational activities. A more logical approach might have been to provide instructional activities after motivational activities. In this way, students would already be motivated to change their brushing and flossing behaviors at the time they were learning how to change them.

In conclusion, the data reported here seem to indicate that an approach which requires individuals to confront inconsistencies among their values and behaviors can effectively change behaviors and sustain these changes in areas where more traditional methods have failed. While it is readily acknowledged that the magnitude of changes reported here falls far short of that required to eliminate dental caries, the results are nevertheless encouraging. To attain any changes in home dental hygiene behaviors is difficult, especially when the subjects are 12- and 13-year-olds. Few at this age have been motivated by the experience of dental pain or the threat of losing their teeth; on the other hand, their generally poor brushing and flossing habits are already well established. If any progress can be made in this area, the approaches used should be explored further, both within the context of dental hygiene and in the other areas where behavior changes may be more easily accomplished.

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Footnotes

[1]The research upon which this publication is based was performed pursuant to Contract No. NIH-NIDR-72-2406 with the National Institute of Dental Research, National Institutes of Health, Department of Health, Education, and Welfare.

[2]~~Since additional data collected in this study are currently being analyzed and a more complete report is being prepared, this paper should not be quoted without permission of the author.~~

[3]Thanks are due to Dr. Daniel Juliano, State University of New York at Buffalo, who acted as statistician and provided considerable substantive advice throughout the course of this work.

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[5]Peter J. Drapiewski, a graduate student in the Department of Educational Psychology, State University of New York at Buffalo, who played a major role in the design and implementation of this study, died on June 25, 1974.

Table 1

Correlations within Groups for Measures of Plaque and Gingivitis

	Clinical Plaque Baseline	Clinical Plaque 6-wk	Clinical Gingivitis Baseline	Clinical Gingivitis 6-wk	Photo Plaque Baseline	Photo Plaque 1-wk	Photo Plaque 6-wk	Photo Plaque 12-wk
Clinical Plaque Baseline	1.00							
Clinical Plaque 6-wk Posttest	.63	1.00						
Clinical Gingivitis Baseline	.17	.16	1.00					
Clinical Gingivitis 6-wk	.39	.39	.47	1.00				
Photographic Plaque Baseline	.70	.56	.13	.34	1.00			
Photographic Plaque 1-wk Posttest	.54	.63	.19	.35	.63	1.00		
Photographic Plaque 6-wk	.54	.76	.11	.30	.63	.62	1.00	
Photographic Plaque 12-wk	.47	.58	.19	.39	.59	.60	.68	1.00

Table 2

Means and Standard Deviations of Plaque and Gingivitis Measures for Treatment Groups

	Group 1 Control		Group 2 Instruction Only		Group 3 Belief Consistency		Group 4 Behavior Rehearsal	
	$\bar{X}$	s.d.	$\bar{X}$	s.d.	$\bar{X}$	s.d.	$\bar{X}$	s.d.
Clinical Plaque Baseline	3.35	.34	3.26	.30	3.23	.49	3.31	.45
Clinical Plaque 6-wk Posttest	3.21	.50	3.18	.39	3.10	.56	3.14	.51
Clinical Gingivitis Baseline	1.10	.25	1.04	.30	1.10	.29	1.10	.31
Clinical Gingivitis 6-wk Posttest	.79	.31	.80	.39	.77	.36	.81	.38
Photographic Plaque Baseline	3. 1	1.14	3.12	1.02	3.35	1.19	3.52	1.15
Photographic Plaque 1-wk Posttest	3.58	1.07	3.24	1.15	3.07	1.32	3.17	1.11
Photographic Plaque 6-wk Posttest	3.58	1.09	3.35	1.03	3.12	1.25	3.32	1.30
Photographic Plaque 12-wk Posttest	3.50	1.10	3.14	1.22	2.99	1.39	3.34	1.12
	N = 44		N = 39		N = 42		N = 46	

Table 3

Estimated Means of Plaque and Gingivitis Measures for Treatment Groups

	Group 1 Control	Group 2 Instruction Only	Group 3 Belief Consistency	Group 4 Behavioral Rehearsal
Clinical Plaque 6-wk Posttest	3.21	3.18	3.10	3.14
Clinical Gingivitis 6-wk Posttest	.79	.80	.77	.81
Photographic Plaque 1-wk Posttest	3.58	3.24	3.07	3.17
Photographic Plaque 6-wk Posttest	3.58	3.35	3.12	3.32
Photographic Plaque 12-wk Posttest	3.50	3.14	2.99	3.34
	N = 44	N = 39	N = 42	N = 46