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A Comparison of Concurrent and Removed Component Procedures for Teaching Toothbrushing Skills to Preschoolers

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A COMPARISON OF CONCURRENT AND REMOVED
COMPONENT PROCEDURES FOR TEACHING
TOOTHBRUSHING SKILLS TO PRESCHOOLERS

by

Timothy Ian McKinley

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
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A COMPARISON OF CONCURRENT AND REMOVED COMPONENT PROCEDURES
FOR TEACHING TOOTHBRUSHING SKILLS TO PRESCHOOLERS

Timothy Ian McKinley, M. A.

Western Michigan University, 1981

The study compared the use of a removed component program to a concurrent training program in teaching toothbrushing skills to preschool children. The removed component program separated three response components from the terminal toothbrushing response and taught them separately out-of-the mouth before requiring them in-the-mouth. The concurrent training program required the three response components but did not train them separately in or out of the mouth. The removed component program taught the skills faster than or equal to the concurrent program, with a significantly higher percentage of correct responses.

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Timothy Ian McKinley

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CHAPTER 1

Introduction

Dental disease is the most widespread health problem in the United States today. Of the people in the United States, 99% have at least one cavity while over 80% have some form of gum disease (National Dairy Council, 1978). The National Dairy Council in 1978 reported that 50% of all 2 year olds have one or more cavities and that, by the age of four, 90% of all children have some form of dental disease (National Dairy Council, 1978).

The primary cause of the two most common dental diseases, tooth decay and gum disease, are the bacteria in plaque (American Dental Association, 1977); these bacteria, when combined with sugar, produce dextran. Dextran is a sticky substance that attaches itself to the tooth surface and enables plaque to stick to the tooth longer. Plaque, when combined with sugar, also produces acids which eat away at the tooth enamel, destroying it. The destruction of the enamel eventually leads to the loss of the tooth (National Institute For Dental Research, 1972).

The frequency and effectiveness of brushing and flossing are directly related to the prevention of dental disease (Loe, 1970). In order to prevent plaque build-up which may lead to gum disease or the loss of teeth, daily brushing and flossing has been recommended (Mosby, 1980).

Numerous studies have shown that behavioral techniques can increase and maintain the occurrence of toothbrushing skills. Green-

berg (1977) demonstrated that a behavior modification procedure was more effective than a lecture, "informal" learning activities, and no instruction procedures in reducing plaque scores. The behavior modification program in the Greenberg study did not directly teach any dental skills. The study dealt with the maintenance and increase of dental skills already acquired. Another study (Martens, Frazier, Eskin, and Proshek, 1973) demonstrated how a behavior modification procedure could be used effectively to reduce plaque by reinforcing the occurrence of clean teeth. Other studies have also shown that contingency management is effective in increasing the frequency of brushing and the reduction of plaque scores (Cohen, 1976, note 1; Horner and Keilitz, 1975; Iwata, Keigles, Lund, and Weisenberg, 1978; Snow, 1974; and Talsma, 1970).

There are very few studies which describe or investigate the precise training and/or sequencing of toothbrushing skills. "The Toothkeeper" program, which included films, lectures, and modeling of toothbrushing skills, was evaluated by Smith, Evans, Suomi, and Frieders (1975). Smith, et al., found that the use of the program actually increased the plaque scores for the experimental group. Horowitz, Suomi, Peterson, Vogelsong, and Mathew (1976) demonstrated that supervised brushing along with instruction (modeling on a one-to-one basis) decreased plaque scores 14%. Training consisted of 10 consecutive sessions (30 minutes each) in which 12 to 15 students were taught about plaque, brushing, and flossing. This training was followed by daily supervised brushing sessions (15 minutes each) every day for 92 days. A study done by Tsamtsouris, White, and

Clark (1979) demonstrated that instructions and supervision were important variables in the establishment of effective toothbrushing "habits". The instructions consisted of modeling toothbrushing on a large mouth model and in the mouth, and having the subject brush his own teeth. Training was done only once during the study. The results of the study showed that just the one training session increased the amount of plaque removed when brushing. The results were based on plaque tests taken two weeks following instruction, then 6 weeks after instructions, and then 22 weeks after instructions.

Horner and Keilitz (1975) broke toothbrushing into 15 behavioral steps, of which only three dealt with applying of toothpaste, putting equipment away, and other responses which did not actually involve "brushing". These authors showed significant results concerning the acquisition of the entire sequence of steps but did not measure the level of plaque on the subjects' teeth, leaving the question of how effective the procedure was in the removal of plaque from the teeth.

Poche, Munn, and McCubbery (1980) dealt specifically with the actual toothbrushing components. A component is a response which is part of a complex response, that can be created in contexts other than the context of the complex response (Engelmann, 1980). Poche, et al., (1980) broke the brushing sequence into 16 steps, each involving the manipulation of the brush in different locations. Along with location they required three other components: 1) holding the brush at a 45° angle with the tooth surface, 2) using a soft scrub motion, and 3) brushing for a minimum specified duration. All train-

ing occurred in the context of the mouth. Training consisted of modeling the brushing of a specific location including the other three components, then leading (experimenter and subject do it together), and then requiring the subject to produce the behavior that was modeled. A physical prompt was given when the subject responded incorrectly. When the subject demonstrated a new step, praise was given and a star was placed on a chart showing where the subject was in the program. They (Poche et al., 1980) ran the program on four preschoolers, ages three to four. Three of the four children mastered all of the 16 steps along with the three components during training, which lasted approximately 20 to 25 days.

It has been shown that teaching the component skills of a complex response operation helps the learner acquire the complex operation faster than when the component skills are taught at the same time. Gagne, Mayor, Garstens, and Paradise (1962), Case (1975), and Carnine (1978) demonstrated that preteaching the component skills increased the rate of learning while decreasing the training time needed for mathematical operations. These studies dealt with the acquisition of physical responses. A study by Walls, Sienicki, and Crist (1981) demonstrated that training generic physical responses necessary in vocational operations prior to the training of specific tasks saved time and reduced the number of errors during training. Carnine and Engelmann (1980) and Engelmann (1980), discussed a removed component program which involves removing the key components of complex physical responses and training them separately before requiring them in a complex response. Once the components are trained to a specified

level of mastery, the components are then taught as they occur in the complex response. This study separated the specific responses (components) required to correctly brush teeth and taught them outside of the mouth prior to requiring them together in the mouth. The study tested the effectiveness of the removed component program and compared it to a concurrent training program teaching toothbrushing skills.

CHAPTER 2

Method

Experimenter/Trainer

The experimenter/trainer for the study was a graduate student in psychology. The experimenter had worked for over two years at the preschool, had previous experience teaching in the direct instruction format, and had previous interactions with all the subjects. The experimenter/trainer had also written the removed component program and a script based on the chaining program written by Poche et al., (1980).

Subjects

The parents of all children ages three to five at the preschool received a notice of the study along with an informed consent form. The first 20 informed consent forms returned determined the subjects who would participate in the study. Of the original 20, eight left the school prior to training and so were not included in the results. The remaining 12 subjects' names were placed in a bowl and one by one (each one returned after selection) were randomly placed into three groups: removed component, concurrent training program, and the control group. All the subjects were enrolled in the preschool for at least one year and had one year of Distar training in math, reading, and language. They were experienced in receiving structured instructions and leaving their room for instruction, and they knew the trainer by name. Statements made by the subjects to the trainer indicated that each subject had brushed their teeth

at home at least one time.

Setting

The study was conducted at a university affiliated preschool. Staffing consisted of graduate and undergraduate psychology students. Distar math, reading, and language programs were conducted daily. Three settings were used during the study. An infirmary containing a sink, a mirror, and a dental chair was used for all plaque tests and for the skill assessments which occurred just prior to the plaque tests. A small bathroom in the subjects' room was used for the skill assessments which did not occur prior to a plaque test or a training session. The bathroom contained a small sink and a mirror. An eight by eight foot square room was used for all training sessions. The room contained a small desk and two two-way mirrors, from which all reliability data for training and skill assessments were taken.

Apparatus

A dental chair, a penlight (Butler Mirolite), mouth mirrors, and disclosing fluid (Trace) were used for all the plaque tests. Child-sized soft bristle toothbrushes (Lactona) were used for all of the skill assessments and training sessions. During training, a hollow, hard plastic ball that was cut almost in half was used to simulate the mouth. A stopwatch and a clipboard were also used during the training sessions.

Plaque Tests

During the study plaque tests were taken at least once a week. The plaque tests were done by senior level dental hygiene students

who had previously worked with over one hundred children. The students were enrolled in a community college and were participating in the study as a lab experience for a required class.

All the tests were done on the same day of the week and during the same two hour block, 8:00 to 10:00 a.m. No snacks or training ever occurred during this one block of time. Each subject was brought separately into the infirmary. Three drops of disclosing fluid were put under the tongue. Then the subject was instructed to swish it around the mouth, lick the teeth with the tongue, and spit out into the sink.

The plaque tests, divided each tooth into four areas: facial, lingual, interproximal, and occlusal. The facial and lingual surfaces were scored as having either no plaque, one-third or less plaque, or more than one-third plaque accumulation. A scoring system was set up which assigned three points for more than one-third accumulation, two points for one-third or less, and one point for both interproximal and occlusal plaque accumulation. The total plaque score that a subject could receive was 180 and the lowest was zero.

The criteria set for stable baseline data regarding plaque tests were three consecutive tests with not more than a 5% difference between them.

Skill Assessments

In order to assess each subjects' brushing skill, a skill assessment test was given prior to each training session and once a month for those subjects who were not in training. The skill

assessment test scored three different components of toothbrushing: location (16 areas of the teeth), motion (circular scrub), and angle (45° angle between flat part of bristles and tooth surface). For each of the locations, motion and angle were scored. Each component was assigned a score of one, making the total possible score equal to 48. The same vocal-verbal instructions were given during the tests. These were: "Pick up the brush and brush your teeth as best as you can." After they initially stopped brushing, another prompt was given. This prompt was: "Do you do anymore?"

The skill assessment was used to determine when training could begin and set the criterion for the end of training (three consecutive days at 100% correct).

The criterion for a steady state regarding the skill assessment test was three consecutive tests with not more than a four point difference. Training began only when the skill assessments met these criteria.

Reliability Measures

Because of the possible biasing effect of having only one trainer who was not blind to the study's hypothesis and the subjects assignment into groups, the implementation of the independent variables was measured. A script of each program was written and put on a data sheet which contained special blocks to record both the instructor's responses and the subjects' responses. While training, the instructor would record when a script line was followed and record whether the subject responded correctly or incorrectly. At least twice during training an independent observer would observe a

training session from behind a two-way mirror. The observer recorded the skill assessment, trainer responses, subject responses, and session length. The observer could not be "blind" to the conditions because of the need to have the observer record the implementation of the independent variables. The observer was trained to identify the three components prior to baseline conditions and was retrained twice during the training conditions.

Reliability for the independent variables was calculated by adding all of the agreements and dividing by the agreements plus the disagreements then multiplying by 100. One hundred percent reliability was obtained for the independent variables.

Reliability checks on the plaque tests were taken at least once a month. These were done by having two dental hygienists independently (blind to the other's scoring) conduct back-to-back plaque tests on the same subject. Reliability was calculated by adding all the agreements and dividing by the agreements plus the disagreements, then multiplying by 100. The mean reliability score for the plaque tests was 87%.

Reliability measures for the skill assessments were taken by having the subjects brush while looking into the two-way mirror and having an independent observer score the test at the same time as the instructor. Reliability was calculated by adding all the agreements. Then dividing by the agreements plus the disagreements. The mean reliability percentage obtained was 94%.

Experimental Design

A multiple baseline design across subjects was used in order

to demonstrate the replicability of the results and demonstrate that the results were caused by the implementation of the two independent variables: the removed component and concurrent training programs. The sequencing of training was as follows: in phase "a" there was one subject in each of the removed component and chaining programs, in phase "b" there were two subjects in each of the programs, and in phase "c" there was one subject in each of the two programs.

Subjects were randomly assigned to groups and phases. The first two subjects selected were in the first phase, subjects four, five, seven, and eight were in the second phase, and subjects 10 and 11 were in the third phase. Subjects three, six, and nine were put into the control group.

Subjects began a phase only when their skill assessment scores had achieved a steady state and ended training only when they had achieved 100% on their skill assessment tests on three consecutive training sessions.

Two different training procedures were compared: removed component and chaining. Both procedures taught the same skills and used the same consequences for correct responding.

The Concurrent Training

The concurrent training program was similar to one used by Poche et al. (1980) with two changes. The lead (experimenter and subject respond together) was not used during training, and duration was not taught. The program taught the toothbrushing in 16 steps, each step corresponding to a specific location in the mouth. The instructor modeled the correct method of brushing at one location, then

asked the subject to do the same. When incorrect, the instructor would physically prompt the correct response and then ask the subject to try again. This would continue until two consecutive correct responses occurred. The criterion for a correct response contained three skill components: 1) location, 2) angle, and 3) motion. The Poche et al., (1980) study included a fourth criteria, duration. Instructions given for each step were as follows: "Put the brush here, tilt it (up or down), and move it around and around." The steps were taught in the order specified in the Poche study, et al. (1980). See Appendix A for a representation of the order of training.

The Removed Component Program

The removed component program was based on procedures described by Carnine and Engelmann (1980). The terminal toothbrushing response was broken into three components: location, angle, and motion. These components were taught separately in a different context (location and angle were taught on the plastic ball and motion was taught on a thumbnail) until a level of mastery was obtained and then separately practiced in the mouth. When all three components had been sufficiently mastered they were combined and taught in the mouth.

The training was presented in 28 steps in which eight angle positions, two motions and 16 locations were taught.

The sequencing was defined by the specific angle required to correctly brush a given location. By breaking the 16 locations down into common angle requirements we were able to identify eight groups:

- 1) top outside left-top inside right and top outside center
- 2) bottom outside left-bottom inside right and bottom outside center
- 3) bottom inside left-bottom outside right
- 4) top inside left-top outside right
- 5) bottom chewing surfaces
- 6) top chewing surfaces
- 7) top inside center
- 8) bottom inside center

See Appendix B for a representation of the order of training.

Two motions were taught during training. The circular scrub motion was taught and required for groups one to four and the back and forth motion was taught and required for groups five to eight.

Procedures

Baseline began with each subject receiving a dental check and toothcleaning from trained dental hygienists. The dental checks were taken in order to show any pre-post effects, but because of the long baseline period and financial limits, had to be dropped as measures of the independent variables.

Baseline conditions lasted for five months for two subjects, six months for four subjects, seven months for two subjects, and nine months for the control group.

Training Sessions

Each training session began with a skill assessment test. The training sessions were all scheduled to be 10 minutes long. A session ended early only when the subject had completed all the train-

ing available for that session. A session lasted longer than 10 minutes only if the subject was in the middle of a training step and was stopped as soon as two consecutive correct responses occurred. The instructor measured and recorded the training time in order to compare the total training time of the chaining and removed component programs. A stopwatch was used to measure the time. The sessions were run between 8:00 and 9:00 a.m. and between 3:00 and 4:00 p.m.

When a subject finished training but had not responded at a 100% level, that subject received five minutes of training per day until they responded at the 100% level. This training consisted only of giving the subject feedback on what areas were missed during the assessment.

CHAPTER 3

Results

Skill Assessments

Figure 1 represents the skill assessment test scores across all subjects and phases of the study. The skill assessment tests were taken over a period of 8 months. Pre-training averages were 8 (17%) for the removed component subjects and 6 (16%) for the concurrent training program and control subjects. Subject four's score increased 12 points during baseline when she demonstrated that she could brush all four chewing surfaces.

Each subject in the removed component and concurrent training programs acquired all the skill taught, scoring 48 (100%) for at least three consecutive training sessions. The average post-training scores for the removed component and concurrent training programs were 42 and 44, respectively.

Training

Figure 2 represents the acquisition of the skills during training. The scale was based on the 16 areas of the mouth. Before an area was considered taught, the subject had to brush that area of the mouth correctly (correct location, angle, and motion) for at least two consecutive trials.

The average number of training sessions to criteria were eight for the removed component subjects (individual totals: 6; 8; 8; 10) and 12 for the concurrent training program subjects (7; 9; 15; 18). The acquisition curves of the removed component group were artifacts

Figure 1. Skill assessment scores before and after training.

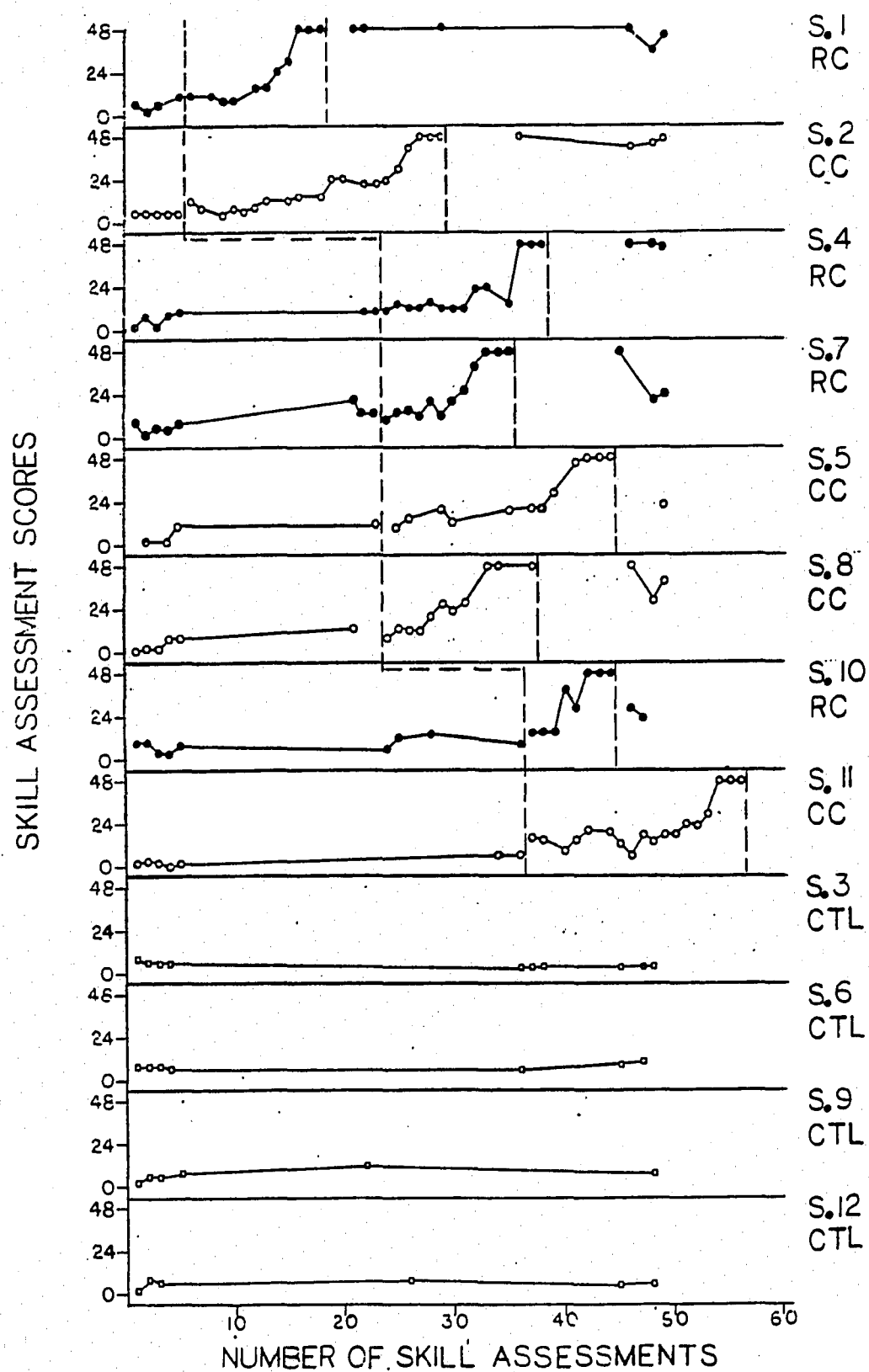
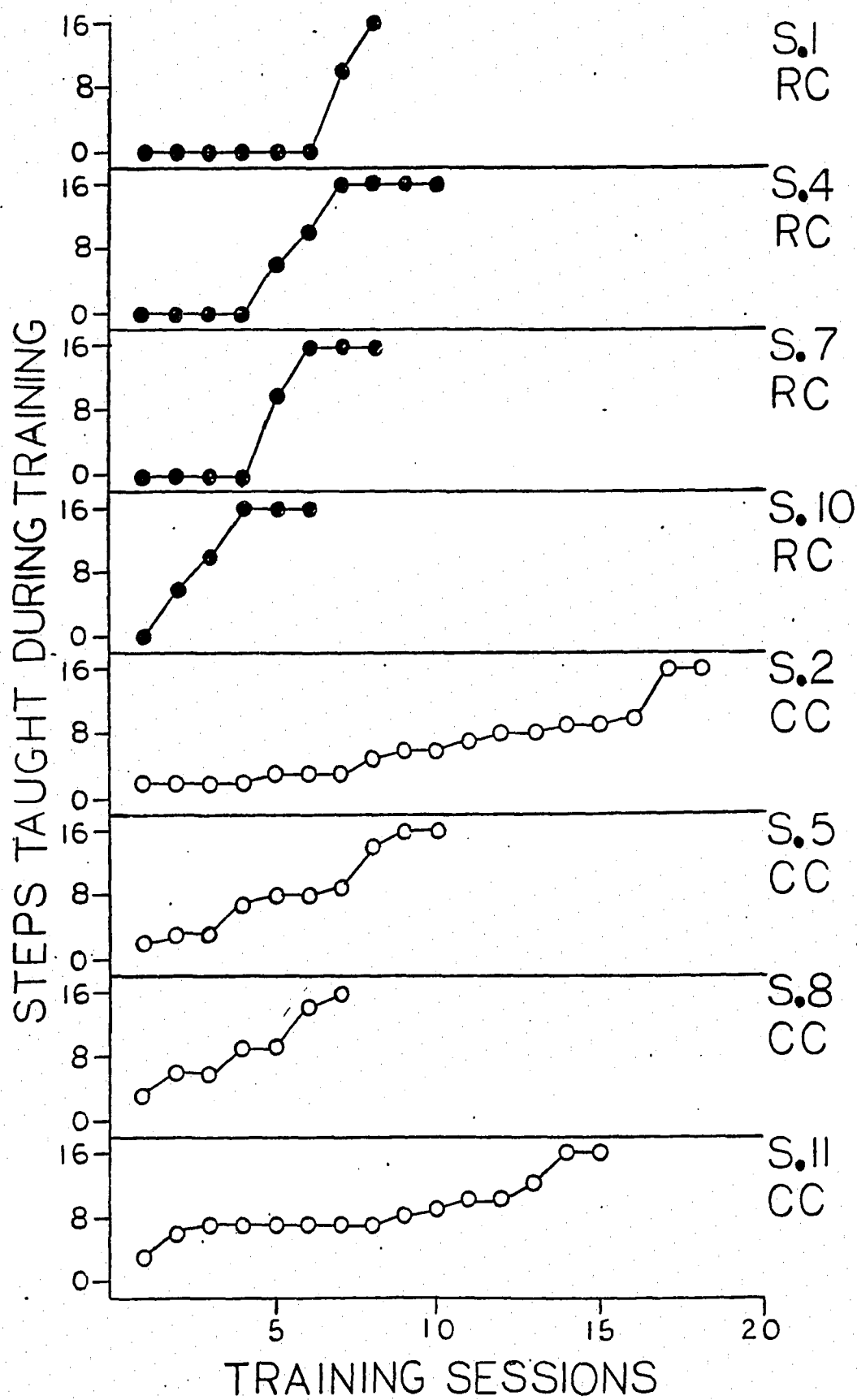


Figure 2. Steps taught across training sessions.



of the program. The subjects could not have demonstrated correct brushing of an area until they were three-quarters of the way through the program, because the motion component was not taught until then.

Figure 3 represents the cumulative minutes of training to criteria. Figure 3 is identical to Figure 2, except that Figure 2 represents sessions to criteria while Figure 3 represents minutes to criteria. The average number of minutes to criteria were 78 minutes for the removed component subjects (48; 82; 90; 91) and 121 minutes for the concurrent subjects (71; 87; 146; 181).

Table 1 shows the total number of trials, the number of errors, and the number of correct trials for all experimental subjects. A trial was defined as a response to an instruction given by the experimenter. A single response might consist of brushing all the teeth or just placing the brush on a specific location on the ball. The removed component subjects averaged 21 trials per session or 164 trials to criteria, while the concurrent subjects averaged 10.5 trials per session or 125 trials to criteria.

The removed component subjects averaged 18 correct trials per session (86%) with three errors (14%). The concurrent subjects averaged six correct trials (56%) and four errors (43%) per session. All sessions averaged 10 minutes in length.

Because all the concurrent program's responses required all three components and in-the-mouth practice, a separate percentage was calculated for the in-mouth training during the removed component program. The average percentage of correct responses during in-the-mouth training for the removed component subjects was 77%

Figure 3. Cumulative minutes of training to criteria.

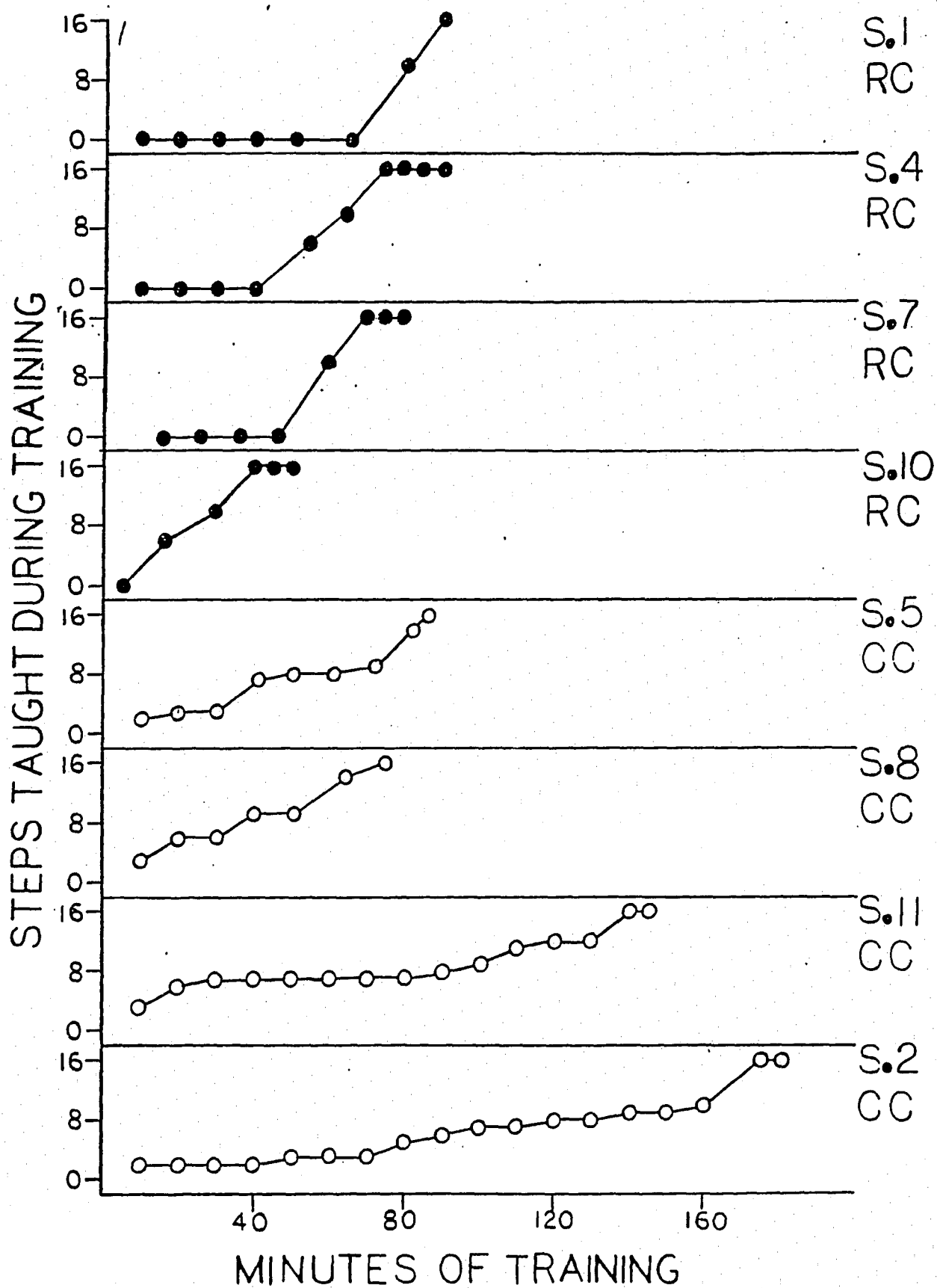


Table 1. Number of trials to criteria, correct trials and errors.

Table 1

TOTAL NUMBER OF TRIALS, CORRECT RESPONSES, AND ERRORS

Number of	Removed Component				Concurrent Training			
	S.1	S.4	S.7	S.10	S.2	S.5	S.8	S.11
Trials	180	174	167	136	173	90	91	147
Errors	20	26	28	15	80	34	29	76
Correct Trials	160	148	139	121	93	56	62	71
%Correct Trials	89%	85%	83%	89%	54%	62%	68%	48%

and 56% for the concurrent training subjects.

Plaque Test Scores

The plaque scores for all subjects were so variable that a steady state was never reached for any subject. Because of this, the plaque tests had to be dropped as a cue to begin and end training. Figure 4 represents the plaque scores for several representative subjects. The purpose of Figure 4 is to show the variability of the plaque scores.

Table 2 presents the averaged individual plaque scores along with their ranges for both pre and post training. For all but subject one, the plaque score ranges decreased as a result of training.

Figure 5 shows the mean plaque scores for both pre and post brushing checks for subjects in both groups, and for both baseline and post training conditions. The average plaque scores before training were 66 (37%) prebrushing and 56 (32%) postbrushing for the removed component subjects and 78 (47%) prebrushing with 72 (40%) postbrushing for the concurrent subjects. After training the average scores were 39 (22%) prebrushing and 16 (9%) postbrushing for the removed component and 50 (28%) prebrushing with 23 (13%) postbrushing for the concurrent subjects.

Figure 4. Plaque test scores.

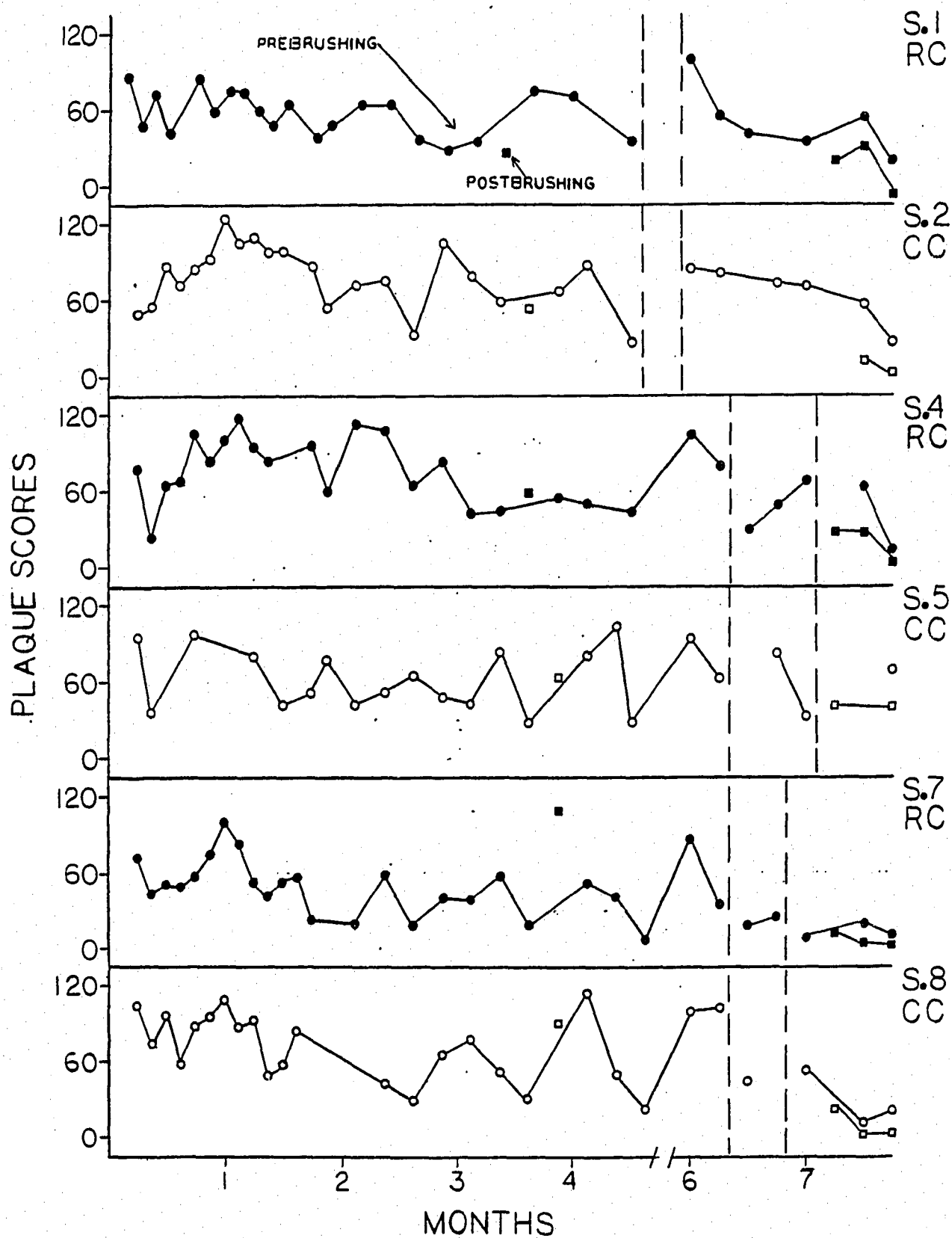


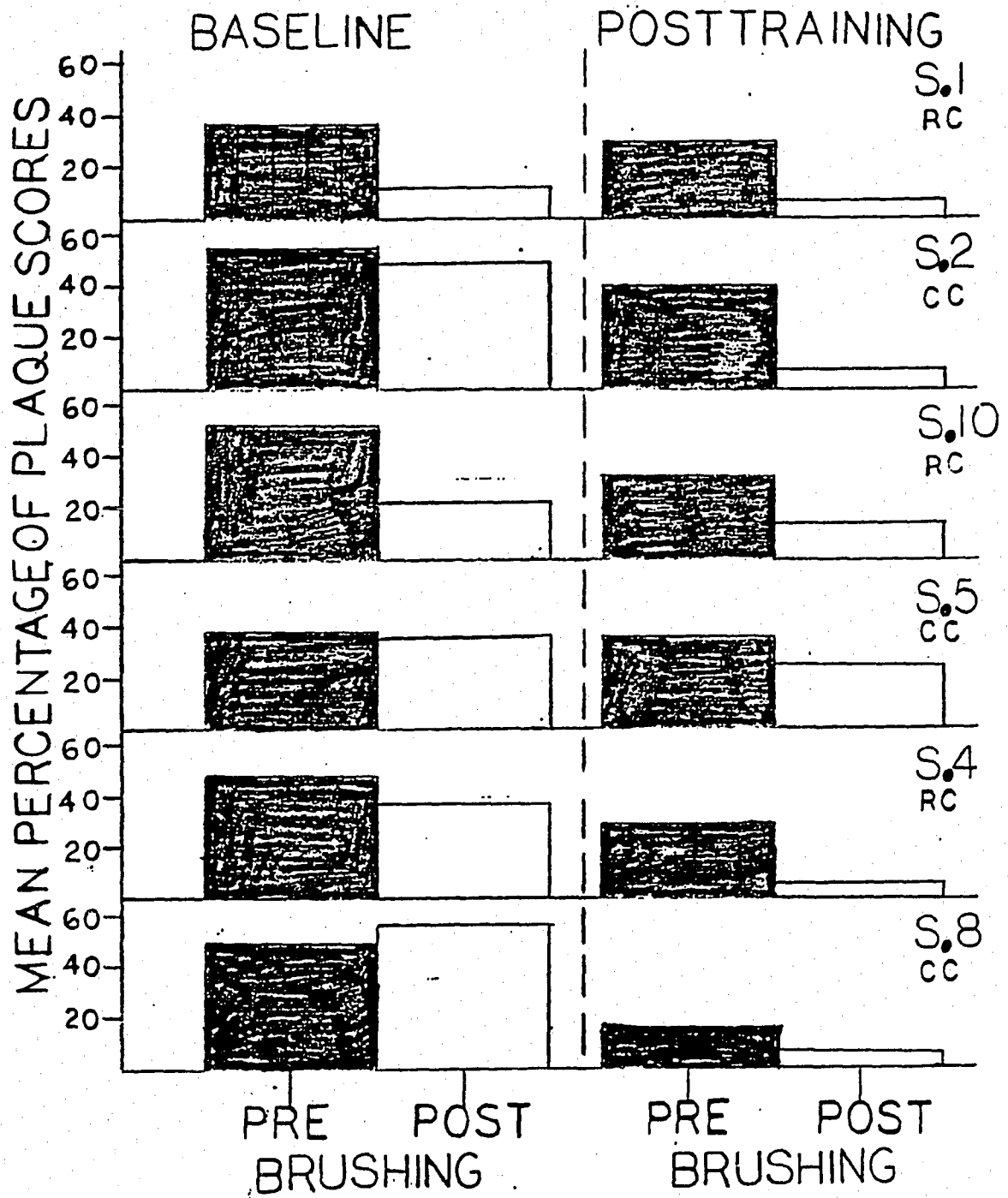
Table 2. Mean plaque scores and ranges before and after training.

Table 2

MEAN PLAQUE SCORE PERCENTAGES AND RANGES
PRE AND POST TRAINING

		Removed Component				Concurrent Training			
		S.1	S.4	S.7	S.10	S.2	S.5	S.8	S.11
PRE	Mean % Score	36%	46%	36%	51%	51%	39%	47%	57%
	Range	28 86	22 116	8 107	41 119	25 122	29 100	23 111	59 136
POST	Mean % Score	29%	27%	7%	31%	49%	37%	17%	34%
	Range	20 99	13 68	6 17	42 57	28 84	31 68	7 53	50 58

Figure 5. Mean plaque scores for pre and post brushing checks before and after training.



CHAPTER 4

Discussion

This study compared the use of two different training procedures for teaching toothbrushing skills. The removed component procedure broke the terminal skill into locations, angles, and motions. These components were taught separately in different contexts and in the mouth before they were required together as part of the complex response in the mouth. The concurrent training program recognized and required the three components but did not teach them separately in or out of the mouth.

Both programs were found to be effective in teaching toothbrushing skills to 4 and 5 year old preschoolers. The removed component program was found to be faster than or equal to the concurrent training program in teaching toothbrushing skills. The slowest acquisition times occurred with the concurrent program while the fastest times occurred with the removed component program. Since the concurrent program required fewer responses to reach criteria than the removed component program, the reason for the faster acquisition times with the removed component program may be found by looking at the percentage of correct response trials for both groups. The removed component subjects responded correctly 86% of the time while the concurrent training subjects responded correctly only 56% of the time. The low rate of correct responses in the concurrent training program was a problem. The responses required in the program were longer (10 per session) than

the responses in the removed component, so when the subject made a mistake, there was a higher response cost. With a 43% error rate, toothbrushing became more of an aversive event than a reinforcing event for the subjects. The subjects would want to quit before the sessions were through and would complain about having to go to the training sessions.

A reason for the low percentage of correct responses for the concurrent training subjects is the problem of ambient stimulus control. Toothbrushing is a complex operation which requires many different responses. Because these variations all occur in the same context, errors may occur after the training of the first responses. During training the response is made in the presence of many stimuli, all of which may acquire the function of evoking the response. Errors may occur when a new response is required in the presence of the same stimuli and an old response occurs instead.

The majority of the errors made by the concurrent training subjects occurred whenever a new response was required. For example, the first major errors occurred when learning step three (see Appendix A for a representation of where each step was located). Steps one and two required the same skills and were practiced for quite a few trials within the same stimulus context. Step three required the subject to change the orientation of the brush from the "toward position (bristles pointing towards subject) to the "away" position while using the same motion and angle. The errors that occurred in step three were failures to change the orientation of the brush. The way that the concurrent program is designed and written creates

these types of errors. The removed component program was designed to minimize these errors. All the initial training was done outside of the terminal context. Any errors which may have occurred during this training would not be likely to generalize to the terminal context, nor inhibit the correct response, or the learning of a new response. In this way the removed component program decreased the likelihood of any response errors.

The removed component program required more responses (21 vs. 10.5 per session) than the concurrent program but averaged fewer errors (three vs. four per session). The high percentage of correct responses allowed the subjects to proceed faster and obtain more reinforcement than the concurrent subjects. This may have made the program more enjoyable.

A reason for the high percentage of correct response for the removed component subjects compared to the concurrent subjects may be found by looking at the response requirements for both groups. As stated previously, brushing one area correctly included three different response components: location, motion, and angle. The chaining program taught and required all three components during every trial. The removed component program taught each component separately and required a specified level of mastery on each of them before combining them together. When they were combined, it was done one at a time. First location and angle were combined and a mastery level was obtained; then location, angle, and motion were combined. In the removed component program, when a correct or incorrect response occurred, it did not effect the production of any

other response component. This made it easier to shape the response components because there were no other responses that could interfere or accidentally be reinforced or punished. In the chaining program, when an error occurred, it was possible that it may have affected the other responses that occurred at the same time. If a child made an error regarding only the angle and was consequence for that error, the consequence may also have affected the other responses that occurred at that time. The same problem may occur when the child gets reinforced for doing the correct motion but at the same time makes an error on the correct angle. The angle response will be more likely to occur in the future and so increase the likelihood of errors in the future.

The chaining program may be best used when the subjects have the preskills necessary to brush the teeth and only need to have some corrective consequences placed on their toothbrushing skills. The removed component program should be used whenever the subjects have difficulties in producing any of the component skills. It is designed to teach all of the skills needed to successfully brush teeth. Because of its design and the high percentage of correct responses, it is more reinforcing for both the trainer and the subject and so it may be used with subjects who need the extra reinforcement in order to practice toothbrushing.

With the concurrent program, there was a lot of variability in the results from one subject to another. The range of acquisition times was 7- 18 sessions or 71-181 minutes. The number of errors ranged from 29-80 for the program. The removed component

program showed little variability in the results. The range of acquisition times were 6 to 10 sessions and 48 to 91 minutes (three subjects were within 9 minutes of each other). The total number of errors ranged from 15 to 28. The importance of a program showing consistent results is found when planning training for a classroom, a school, or at home. When the teacher can predict what is going to occur as a result of the program, it is easier to plan.

In this study, plaque test scores have been found to be highly variable. A steady state or stable condition did not occur for any subject. Individual scores ranged from 25-122 without training. They should be used as a dependent variable only when they can occur immediately before and after the implementation of the independent variable. When used in this way, they can be sensitive to changes caused by the independent variable. If not, there are so many other variables that could effect the score such as how the subjects breathe and what the subjects eat or drink that interpretation is very difficult.

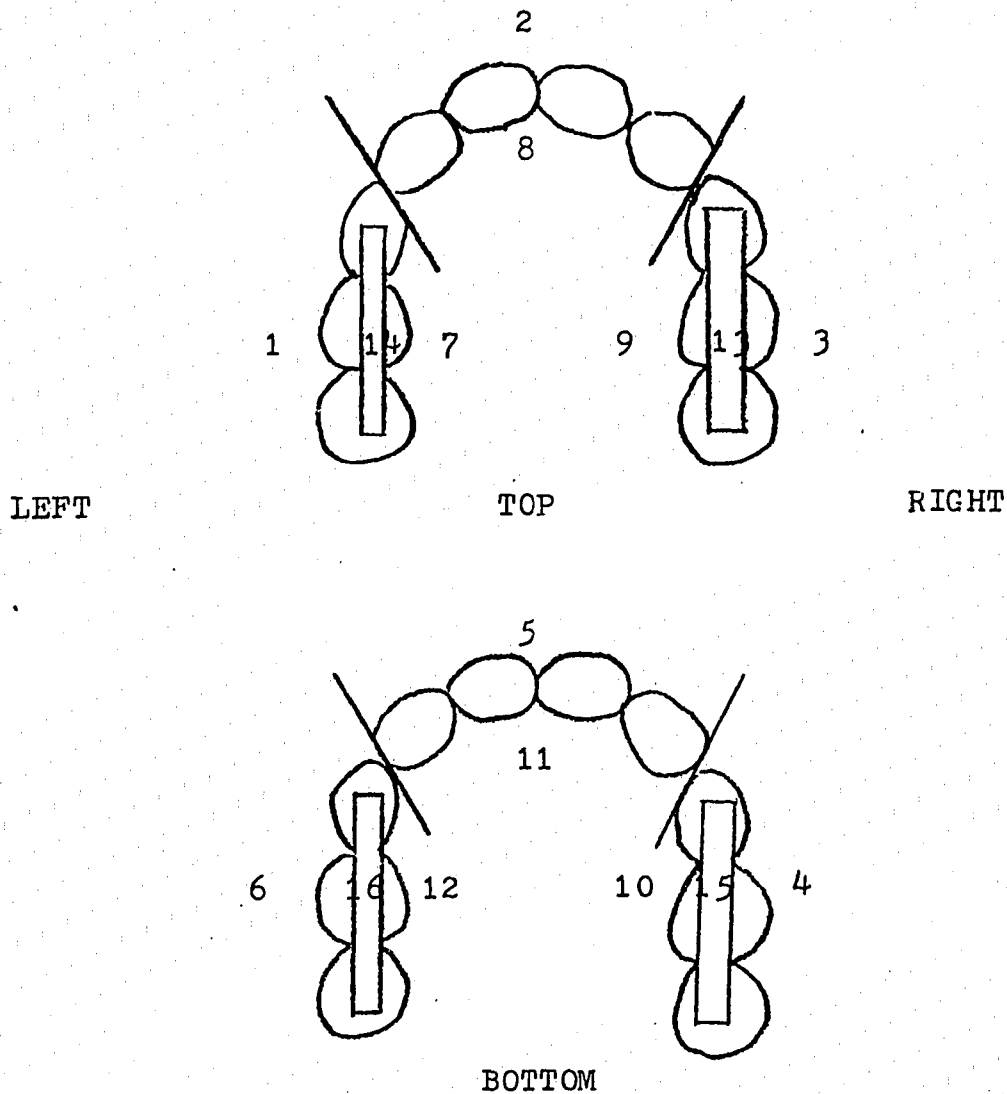
The removed component program has been shown to be either faster than or equal to the chaining program in teaching toothbrushing skills to 4 and 5 year old children. The study compared the results of only eight subjects, so caution is advised when attempting to extrapolate the results across other subjects or populations. Replication of the study would help to substantiate the differences between the two programs.

The removed component program was designed to minimize errors

so as to maximize the reinforcement given which increases the likelihood that the subject will brush even after training. By training the response components outside of the terminal context (the mouth), the removed component program reduces stimulus control errors. The first revision of the program has been written which further reduces the chances of errors caused by inaccurate stimulus control. The revision teaches the two grasp positions concurrently, along with their angles. These positions require two different push motions in order to contact the tooth surfaces. In the first program, they were not taught concurrently, and training was spaced several training sessions apart. This caused errors in that the subjects were placing the brush in the mouth at the right location, with the correct angle and motion, but were not touching the teeth. The new program may reduce these errors and speed up the training time even more. Future research on this possibility is needed.

The use of a removed component design to teach physical responses has been shown to decrease the amount of training time. Further research using the removed component design should be conducted with many different behaviors, such as flossing.

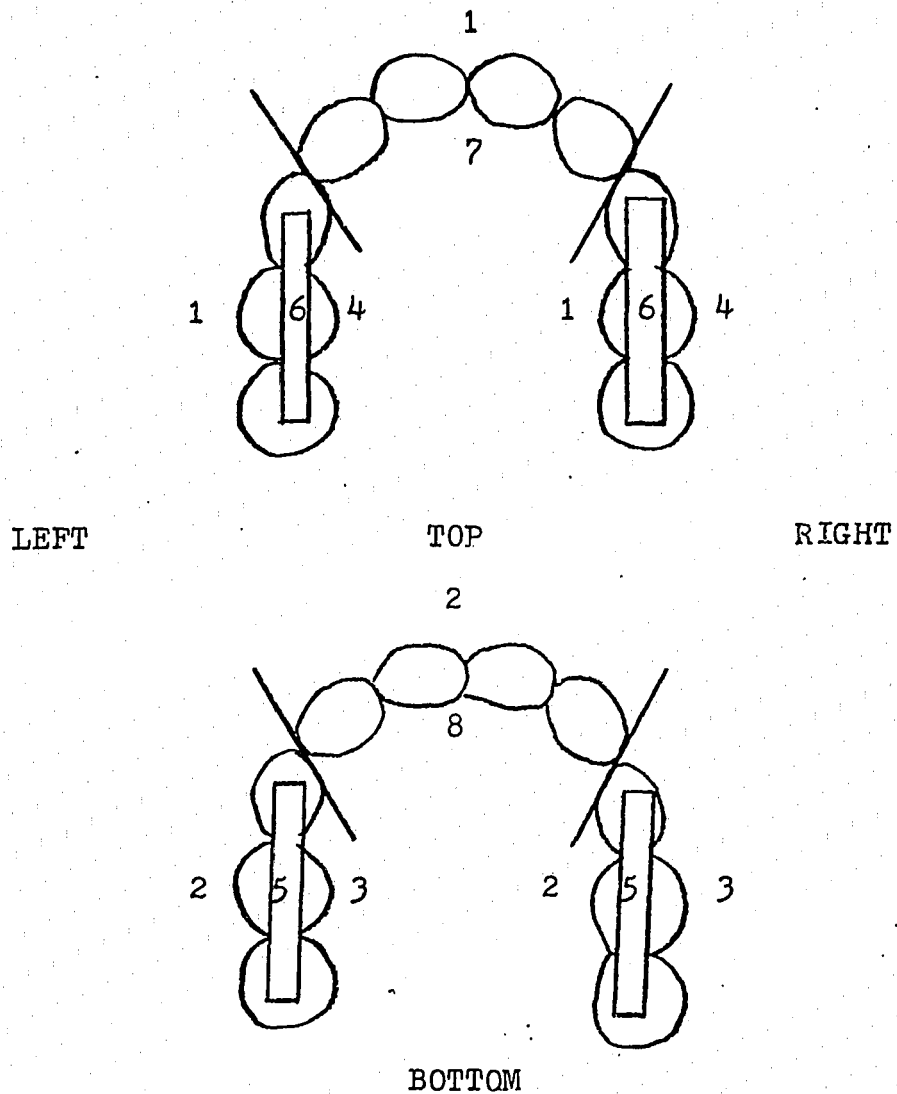
Concurrent Training Sequence of Training Steps



1. Outside top left
2. Outside top center
3. Outside top right
4. Outside bottom right
5. Outside bottom center
6. Outside bottom left
7. Inside top left
8. Inside top center

9. Inside top right
10. Inside bottom right
11. Inside bottom center
12. Inside bottom left
13. Upper right jaw
14. Upper left jaw
15. Bottom right jaw
16. Bottom left jaw

Removed Component Sequence of Training Steps



1. Outside top left-outside top center-inside top right
2. Outside bottom left-outside bottom center-inside top right
3. Outside bottom right-inside bottom left
4. Outside top right-inside top left
5. Bottom jaw surfaces
6. Top jaw surfaces
7. Inside top center
8. Inside bottom center

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