A BEHAVIORAL MODIFICATION ANALYSIS OF
THE EFFECTS OF MULTIMEDIA FIRST
AID TRAINING ON INJURIES IN
AN INDUSTRIAL SETTING

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

James Lee Sturrock, B.A., M.B.A.
Denton, Texas
May, 1987

Past research has shown a correlation between first-aid training and the reduction of injuries. This connection has been noted in off-the-job situations in addition to industrial studies.

This project is an extension of those past findings with three notable differences: total population training was studied as the intervention instead of just saturation treatment; attention was given to the effect that the half-life of training had upon injury reduction; and three randomly chosen small groups were studied to determine short range effects.

The theoretical bases from which the study hypothesis was developed originated in the Behavioral Science and Psychology literature. Discussions are developed around the mental structuring of accidental potential situations in the case of a person trained in first-aid principles.

Behavior Modification was one of the principles of change that offered a safer environment through first-aid training. Group contagion provided the setting for
development of a safer place to work because of socialization to a "safe attitude."

The intervention, American National Red Cross Standard Multimedia First-Aid Course, provided some of the mental developments toward modification of behavior. These were the modeling and rehearsal features of the course. A connection between group deviance and accident "proneness" led to a proposal that avoidance behavior was the resultant of the training.

Three methods were used to prove the hypothesis. Method One used a yearly tally of cumulative numbers of trained personnel. This was summed each year for eight years, then compared graphically with yearly injury frequencies.

Method Two used a yearly tally of currently trained employees. These were compared on a graph with yearly injury frequencies for eight years.

Method Three used a Solomon Four Case Study for a statistical look at three groups over five years. Method One supported the hypothesis, Method Two was the strongest proof, while Method Three was inconclusive.
TABLE OF CONTENTS

LIST OF TABLES ........................................ vi
LIST OF ILLUSTRATIONS ............................... vii

Chapter

I. INTRODUCTION ................................. 1
   Problem Statement
   Significance of This Study
   Hypotheses
   Limitations of the Study
   Delimitations of the Study
   Research Design
   Procedure for Collecting Data
   Procedures for Treating Data
   Background
   Summary

II. REVIEW OF LITERATURE ........................ 17
   Introduction
   Research Concepts
   Behavior Modification
   Group Contagion
   Modeling
   Rehearsal
   Deviance and Accidents
   Avoidance Behavior
   Aversive Contingencies
   Good Experimental Design
   Summary

III. PRESENTATION AND ANALYSIS OF DATA .......... 35
   Introduction
   Methodology
   Sample Size
   Procedures
   Evaluation Methods
   Data Presentation
   Analyses
   Summary

iv
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Per Cent Reduction of Accidents After First-Aid Training in Division I</td>
<td>10</td>
</tr>
<tr>
<td>II. Injuries by Years with First-Aid Training Given to All Employees in 1954 in Division II</td>
<td>11</td>
</tr>
<tr>
<td>III. Results of Pilot Study Made of Four Apprentice Classes where only the 1976 Class Received First-Aid Training in Division III</td>
<td>12</td>
</tr>
<tr>
<td>IV. Date of Group's Training and Inclusive Observation Dates</td>
<td>39</td>
</tr>
<tr>
<td>V. Solomon Four Case Study Section Design</td>
<td>49</td>
</tr>
<tr>
<td>VI. Slopes $m_3$ and $m_4$ and Resulting Angle $\theta$ with $m_3$ Using Cumulative Trained Numbers</td>
<td>52</td>
</tr>
<tr>
<td>VII. Slopes $m_3$ and $m_4$ and Resulting Angle $\theta$ with $m_3$ Using Currently Trained Numbers</td>
<td>54</td>
</tr>
<tr>
<td>VIII. Injuries Experienced by Case and Trained Groups</td>
<td>56</td>
</tr>
<tr>
<td>IX. Injuries after Combining Sections</td>
<td>56</td>
</tr>
<tr>
<td>X. Calculations made to Arrive at Cell Expectancies for Chi-Square Test</td>
<td>57</td>
</tr>
<tr>
<td>XI. Difference of Method One and Method Two when Comparing Per Cent of Untrained Population with Per Cent of Injuries Experienced Each Year</td>
<td>65</td>
</tr>
</tbody>
</table>
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Comparison of Per Cent Trained and</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>OSHA Recordable Frequencies</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Comparison of Per Cent Trained and</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>OSHA Recordable Frequencies</td>
<td></td>
</tr>
</tbody>
</table>
A deplorable fact in the chronicles of history is man's inhumanity toward man, evident mostly in frontpage newspaper articles today. A factor in our lives that is of less concern though, is our lack of attention to our own personal safety. Tofany reports that, "The loss of life in the United States from accidents during this century far exceeds that from wars, earthquakes, floods, tornadoes, and other natural catastrophes combined" (23, p. 40).

Attempts to alleviate this accidental carnage have had some successes. A notable one is the "Accident Potential Recognition Course" taught by the American Society of Safety Engineers. This course teaches employees to recognize potential accidents by applying their knowledge of eighty clues to accident potential situations. Industry, Occupational Safety and Health Administration, and insurance inspections annually spot many hazards. These efforts at hazard correction are primarily concerned with the environment, which is, for the most part, a passive item in an accident.

Human error or carelessness is often the factor that initiates an accident from a passive but potential situation. Little is known about the control of this human shortcoming
that often leads to pain, grief, or regret. If the human factor could be controlled, the pain, cost, and loss of productive output connected with every accident injury could be reduced.

An active effort to change human behavior to be aware of these potential situations might be more productive than the present environmental inspections. Even though the potential may be present, it usually has to be initiated by human effort. Therefore, more accidents might be prevented by changing behavior than those avoided because of inspections. This study is an effort to determine the effectiveness of one method to modify human behavior to respond to potential accident situations.

Problem Statement

The problem to be studied is the effect of Multimedia First-Aid training on injury occurrences in an industrial population.

Significance of This Study

There is great potential for cost savings if injuries can be reduced as a result of first-aid training. Dupont, the company with the best safety record of any industrial firm in the United States, has recorded injury costs for several years. Company officials estimate an average cost of $10,000 for each lost-workday injury (6, p. 49). The Company further reports that when total injuries decrease
so do "Occupational Safety and Health Act (OSHA) recordables" and "lost-workday injuries."

Recordable cases are those involving an occupational injury or occupational illness, including deaths. Not recordable are first-aid cases which involve one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, etc., which do not ordinarily require medical care, even though such treatment is provided by a physician or registered professional personnel. Lost-workday injuries are those days which the employee would have worked but could not because of occupational injury or illness. . . (13, p. 30).

The experience of Worker's Compensation Insurance, which is paid by a company retrospectively in proportion to its accident experience, is another way of figuring costs. Experience generated by Worker's Compensation claims in Canada has shown that indirect costs related to a lost-workday injury range from four to fifteen times direct costs (1, p. 4; 7, p. 11; 14, p. 7; 17, p. 1).

Total work accident costs for 1976 were $16 billion with 2.1 million disabling injuries and seventy thousand permanent impairment cases (18, p. 84). All accidents cost the United States $51.1 billion in 1976. About one million productive person years were lost in 1976 due to work accidents alone. Injuries to United States workers in 1976 had the same effect as if all industry had been shut down for one full work week (23, p. 40).

Work accident costs were down in 1983 from the above 1976 figures. Total costs in 1983 were $33.4 billion with
a cost per worker of $330. Total time lost in 1983 was 80 million days. A steady decrease in accidents nation-wide is shown in the reducing death rate from 15.4 per 100,000 workers in 1930 to 4.8 per 100,000 workers in 1983 (13, pp. 24, 28). Just a 30 per cent reduction in accidents would be roughly a $10 billion saving to our nation's industries or 24 million worker days.

Hypotheses

$H_1$--Total population training in Multimedia First Aid has a significant effect on reducing injuries on the job.

$H_0$--There is no difference between trained and untrained groups in the frequency of occurrences of injuries.

Limitations of the Study

A limiting factor in this study is the behavior modifying bias stated at the beginning of each first session: "This course is given to you because we have found that people who have been trained in Multimedia First Aid have fewer injuries than those who are untrained." This takes on a modeling effect from the trainer with an intentional communication of expectancies (19, p. 182).

Delimitations of the Study

Delimiting factors are: (1) the size of groups, which have been held to a maximum of twenty people because of Red Cross requirements and (2) the fact that everyone cannot
attend at the same time from the same work group because of operating necessities.

Research Design

Test of which hypothesis is accepted or rejected is determined by a correlation between increasing numbers of trained personnel and increasing or decreasing numbers of injuries. Additionally the Solomon Four Group Design gives the effect of having all possible situations that can be studied at one time. The time intervals selected have little or no effect on the outcome since all trainees are selected randomly and the time intervals are selected by random number generation. Selection of groups are by departments which are randomly chosen. The original three trial groups are selected from class records, then matched groups are chosen from the same departments and the same jobs. Since very few people can be absent from any department at any given time, each individual becomes a random selection.

The Solomon Design will be used during three randomly selected time periods to prevent time-bias. During the periods studied ending comparisons will be made between first-aid trained and untrained personnel to see who had the most injuries. This will be done with $X^2$ tests, using only those who had been included in the design of the program.

Procedure for Collecting Data

Data will be collected over a period of time that
includes from two years before the training period for each group to two years after each group completes training. Data will be gathered from Safety Department frequency reports derived from OSHA standard, ANSI #Z16.1 (15, p. 81). The data will be collected with no mention of names of employees.

Procedures for Treating Data

All data will be from primary sources. Data will be analyzed to determine injuries to individuals. Findings will show either an injury or no injury for each group of the design. Using a period of time from 1977 to 1985, a comparison will be made between per cent of population trained and OSHA recordable injury frequencies.

The Solomon Four Case Study will involve three classes of employees randomly chosen by date to prevent selection bias. Each person in each class will be matched randomly with three other persons from their department to fit all four categories of the Solomon Study. Data will be compared to determine if, in fact $H_0$ is false and $H_1$ is true.

Background

Safety oriented first-aid training creates an awareness of the cause and effect of accidents making those who take it more safety conscious and less accident prone. The individual becomes a small safety system in whose sphere of influence accidents are less likely to happen at work, at home, or on the highway (8, p. 48).

T. D. Lafferty, Director of Training, St. John Ambulance Association and Brigade of Canada (St. John), gave the above
hypothesis as a result of studies in Canadian industries. St. John and the Workman's Compensation Board (WCB), Ontario, encountered some statistics in the 1960's that seemed to suggest a relationship between first-aid trained individuals and a reduced accident rate. This is not too surprising when one considers psychological studies reported by Suchman about social deviance matching with higher accident rates. Suchman relates MacIver's statement: "... the occurrence of accidents ... is an unerring signal that something or someone is not functioning properly" (21, p. 13).

Modeling is considered the most effective form of behavior modification by Bandura (4, 5), Kraut (11), and Sundel (20). This form of behavior management is considered less disturbing than others because it involves free choice (3, 9, 12, 16, 24).

When behavior modification is viewed from a social learning standpoint it becomes more of a cognitive nature and less mechanistic. Rewards, to be effective, should be contingent upon the desired behavior. Contingency rewards such as being included in a group recognized as being "safer" because of unique skills can result in avoidance behavior in cases of potential situations. The only way a contingency reinforcement can be used is when the person is aware of its purpose.

Intriguing data from a statistical review of past training prompted a study of Canadian industries that had
trained employees in first aid. Lafferty asked for and received financial backing from the WCB of Ontario and the Ontario Industrial Accident Prevention Association to perform such a study. Drs. Neil Agnew and Gary Miller of the Department of Psychological Services, York University, were engaged to study, as a pilot group, the city of Orillia, Ontario. St. John personnel had previously given first-aid training to 5,514 people from a total population of 23,000. Since this represented more than 25 per cent of the population, it was deemed to be a significant sample. Fifty-two per cent of those trained were employed in the local businesses and industries. Agnew and Miller found no significant decreases in nonindustrial accidents, but did conclude:

... in industrial settings, first-aid trained employees can have significantly reduced accident rates, perhaps as much as 30-40 per cent under optimal conditions (2, p. 1).

Further studies by Agnew and Miller were done at Bell Canada, where 60 per cent of the male employees had voluntarily taken first aid; at Ontario Northland Railway, where first-aid training was required of certain people; at Company A, studied for a four month period in 1972; and at International Nickel Company in the first eleven months of 1972. All of these studies showed significantly fewer accidents for first-aid trained personnel than would be expected from accident record data in the past (8, p. 49).

The Orillia study, FACTS I (First Aid Community Training for Safety) was followed by FACTS II studies by
Agnew and Miller in industries in the cities of Guelph and Cambridge in the Spring of 1973. This study matched each trained subject with a non-trained control subject. The study included 298 trained and 298 non-trained subjects. The results showed the trained subjects had eighteen accidents while the non-trained subjects had thirty-eight accidents. Using a multiplying factor of four for indirect costs of an accident combined with direct costs, Agnew and Miller found a savings of $6.97 for each dollar spent on training (1, p. 5).

St. John instituted a new multimedia Safety Oriented First-Aid (SOFA) course in 1974 and used it in a third FACTS project (18). This project was launched in the Peace River District of Alberta consisting of 11,000 square miles and involved 10,200 people trained in SOFA. Dr. Robert Hunt of Grand Prairie Regional College made an extensive report of the public sector, industrial sector, and motor vehicle accidents. Hunt reported that the overall rate of accidental injuries was reduced by 20 per cent, industrial safety programs which used total training achieved a 55 per cent reduction in accidents, and motor vehicle accidents were reduced by over 26 per cent (18, p. 2). Hunt also hypothesized that:

... the greater the number of first-aid trainees in a setting, the greater the expectation of dynamic interaction. From an accident prevention point of view, this contributes not just additively, but multiplicatively, to the density of the safety climate (10, p. 64).
The Electrical Reduction Company of Canada Limited (ERCO) Plant at Long Harbour, Newfoundland began a program of voluntary SOFA training in April, 1975. Nearly 100 per cent of the workers took the course with remarkable results. Almost immediately, accidents were reduced. The study group of Chesley Belbin, Glen Noonan, David Powell, and Graham Moores from Memorial University noted a decrease of 84 per cent in accidents of which 42 per cent were attributed to SOFA (7, p. 15).

Other studies in Canada showed decreases in accidents with 42 per cent for DOW Chemical and 100 per cent reduction of lost-time injuries at FMC Canada Ltd. The University of Toronto noted from 39 per cent to 67 per cent decreases in accidents in its departments that were trained compared to a .05 per cent decrease and a 60 per cent increase in untrained departments (8, p. 49).

The results from Red Cross Standard Multimedia First-Aid training in a multi-divisional company in the United States are shown in Tables I, II, and III.

TABLE I

PER CENT REDUCTION OF ACCIDENTS AFTER FIRST-AID TRAINING IN DIVISION I

<table>
<thead>
<tr>
<th>Department</th>
<th>Per Cent Reduction of Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>73</td>
</tr>
</tbody>
</table>
These two departments were fairly large construction groups, but represented a small per cent of the total population. Little additional information is known except that the results were positive.

Division II noted a remarkable decrease after first-aid training was given as shown in Table II.

### TABLE II

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Employees</th>
<th>Lost-time Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>1,142</td>
<td>5</td>
</tr>
<tr>
<td>1953</td>
<td>2,441</td>
<td>17</td>
</tr>
<tr>
<td>1954</td>
<td>1,105</td>
<td>5</td>
</tr>
<tr>
<td>1955</td>
<td>922</td>
<td>0</td>
</tr>
<tr>
<td>1956</td>
<td>676</td>
<td>0</td>
</tr>
<tr>
<td>1957</td>
<td>573</td>
<td>0</td>
</tr>
<tr>
<td>1958</td>
<td>582</td>
<td>1</td>
</tr>
</tbody>
</table>

The pilot study results shown in Table III were used to justify a total-population training program. This pilot study was conducted for only six months but did show remarkable results. Because the results were greater than some of those reported in the Canadian studies, attention was drawn to the effectiveness of first-aid training in reducing injuries. Another pilot study followed this one with results even better than those shown in this table. The latter results prompted the total population program.
TABLE III

RESULTS OF PILOT STUDY MADE OF FOUR APPRENTICE CLASSES WHERE ONLY THE 1976 CLASS RECEIVED FIRST AID TRAINING IN DIVISION III

<table>
<thead>
<tr>
<th>Class</th>
<th>Number In Class</th>
<th>Number Injuries</th>
<th>Per Cent Incident*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>35</td>
<td>12</td>
<td>34%</td>
</tr>
<tr>
<td>1974</td>
<td>37</td>
<td>13</td>
<td>35%</td>
</tr>
<tr>
<td>1975</td>
<td>35</td>
<td>16</td>
<td>45%</td>
</tr>
<tr>
<td>1976</td>
<td>51</td>
<td>10</td>
<td>19%</td>
</tr>
</tbody>
</table>

*The number of injuries divided by the number of people.

The drop in injuries between the groups were as follows:

1976 vs. 1975—57% decrease
1976 vs. 1974—44% decrease
1976 vs. 1973—43% decrease

All of the above studies indicate strong evidence of a positive correlation between first-aid training and decreases in accidents.

Summary

This study is an effort to determine if behavior modification can effectively reduce injuries by causing participants in a multimedia first-aid course to avoid injury by being aware of potential accident situations. The Multimedia First-Aid Course referred to is an eight-hour course in first aid by the American National Red Cross presented in three mediums; (1) short sections of film showing skills, (2) skill practice sessions, and (3) work sessions in a
programmed instruction workbook. The cost savings to the nation's industry should be of such a magnitude to easily pay for training all employees.

Using the above discussion as an introduction, the remainder of this study will be concerned with a review of literature in the second chapter, treatment and the results of treatment of the data in the third chapter, and a summary and conclusions in the fourth chapter.
CHAPTER BIBLIOGRAPHY


CHAPTER II

REVIEW OF LITERATURE

Introduction

The decision to engage in a research design involves considering the kinds of research, the methods to use, the resources that are available, and the items that will be involved. A review of the literature, in the case of the researcher that is familiar with the proposed subject, must include first the rationale for a particular kind of design. This sets the stage for structuring the design of the experiment. If the design appears to fit the situation to be studied, then the researcher needs to search the literature to find support (or lack thereof) for the main hypotheses and generally to support the methods used in the design of the experiment.

This chapter will begin with a look at Research Concepts, followed by sections on: Behavior Modification, Group Contagion, Modeling, Rehearsal, Deviance and Accidents, Avoidance Behavior, Aversive Contingencies, Good Experimental Design, and Summary.

Research Concepts

"A social intervention is an action taken within a social context for the purpose of producing some intended
result" (2). The chapter on "Evaluation Research," in the above quoted book, gives Babbie's reasons for carrying out research projects in an evaluative form. Many situations require that a value be placed on the work done. This is especially true of research projects where one wishes to attach credibility to the efforts made. Human curiosity alone would cause evaluation or else the researcher would never know the outcome of the experiment. There must be a way to operationalize, observe, and recognize the presence or absence of what is under study.

According to Babbie, measurement is vital and causes the following actions to be taken: (1) specify outcomes— if a certain result is desired, it must be measurable; (2) measure experimental contexts—complimentary measures with proper control group designs allow a decision that the program resulted in the desired outcome or caused outside effects; (3) specify interventions—interventions need to be measured to make sure the intervention is constant for the population; and (4) specify other variables—precise measurement of the variables must be made to see for whom the intervention worked.

True experimental design contains: (1) one control and one experimental group, at least, (2) two sets of observations, and (3) most typically, subjects are randomly assigned to the observational group, according to Denzin (6). He also suggests that internal validity is based on events
that occur before and after the study has begun. Historical facts may be important if the study extends over several years. A Solomon Four Case Study satisfies these criteria because it involves four study cases, before and after observation, and uses two sets of observations.

Concern for experimental design includes not only what variables are to be considered but also what program length would allow proper study. It is not always easy to determine the proper elements of a good program design. True ethical questions occur too. Are people who are not given a safety intervention being risked to injury by someone else? Did the intervention work or fail and what consequences are important? Weiss (22) ends the discussion about the ethical role of intervention. She counters the objection that withholding service is unethical in that if the treatment is of no value it is wasteful to give it.

Phillips (14) compared internal validity with external validity. Internal validity asks the question, "Did the experimental treatment make a difference?" Questions posed by external validity are of the kind that suggest generalizability or personal applicability. For instance, to what populations, settings, treatment variables, and measurement variables can this effect predictably be generalized? All experiments move from the context of being a discovery to that of verification as do most life experiences.
Rossi and Freeman (16) determined that evaluation research has three parts: (1) program conceptualization and design (discovery phase), (2) program implementation through monitoring and accountability (learning phase), and (3) program utility by deciding where it impacts and where it can be used (evaluation and application phases). A successful program, according to Rossi and Freeman, must be feasible and manipulative.

Population diversities are eliminated when only one population is used. Total population intervention can provide definite evaluative information only when variables are kept to a minimum. Rosenthal quotes Homans when he says, "All scientific inquiry is subject to error, and it is far better to be aware of this, to study the sources in an attempt to reduce it . . . than to be ignorant of the errors concealed in the data" (15, p. 281).

Behavior Modification

B. F. Skinner made behavior modification known to the world by his work on operant conditioning. Others built hypotheses about behavior modification years before Skinner, but none really got the attention of the world that he did with his manipulation of the environment.

Behavior modification has several names and many definitions. Definitions range from those given by "believers" to those given by "unbelievers." The "believers"
are those people trained as "behaviorists," while the "unbelievers" are those who are not enamored with the prospect that outward responses tell all. Most people can agree, though, that behavior modification is a tested and proven technique even though they may not believe it is the universal panacea. Ullman and Krasner said, "Behavior Modification as teaching and learning is part of the normal environment" (21, p. 265).

The other side of the coin is voiced by Bandura, "External regulation of behavior is thought of as manipulation to the point of abhorrence" (4, p. 6). Even Packard has voiced concern that "people shaping" has inherent possibilities of being evil (13). Arguments aside, there are many examples today of successful modification of individual behavior, most of which are with the individual's knowledge and permission.

Group Contagion

Many cases of behavior change are the results of conforming to a friend's wishes or to the norms of a favored group. This change in group behavior is known as group contagion. The latter speaks to the condition of contagion within the work group, as March and Simon noted in their factor labeled "Behavior of Adjacent Individuals" (9, p. 56). Sartain and Baker suggest that the interaction between individuals in any participative endeavor should increase
productive output (17, p. 419). Safety concern may be brought about as a result of being included in a group "that is doing something about safety" (actively participating in something important because of the costs involved). Social reinforcement is used here to enforce shared values and norms.

The cumulative effect of building safety attitudes as the trained group increases in numbers is the result of people beginning to "talk" safety and listening to other safety awareness concerns. Ullmann and Krasner (21, p. 257) mention the reinforcing properties of group inclusion and teaching machines (programmed instruction is one form) as two forms of behavior modification techniques.

Others note that social reinforcers are powerful tools (10, p. 118; 20, p. 85). It is not always easy to reinforce properly to form a habit or break one. Mowrer states that socialization is always an uphill struggle and there is continuous danger of regressing to lower, easier forms of adjustment which have existed before (12, p. 450). Stated differently, March and Simon discuss group pressure as a factor of motivation:

The strength of group pressure increases as the uniformity of group opinion increases . . . the more interaction within the group, the greater the uniformity of opinion within the group. . . ." (9, pp. 59-60).
Modeling

A fairly successful way to modify behavior is by using modeling behavior as an example set by the "teacher" for the "student." Modeling occurs when a person patterns his behavior after someone else's behavior. Schein notes that modeling is part of the role of the mentor as a positive role model, "setting an example of how to get things done" (15, p. 178). Bandura discusses modeling with:

Indeed, research conducted within the framework of social learning theory demonstrates that virtually all learning phenomena resulting from direct experiences can occur on a vicarious basis through observation of the other person's behavior and its consequence for them (3, p. 118).

Experimental expectancy can be part of a modeling effect that the experimenter sets. Often this occurs without the experimenter realizing personal bias; therefore, a very strong effect can be contrived when the experimenter intentionally communicates expectancies. Sometimes an intervention can be effectively made by simply stating the expected outcome. Therefore an intentional bias may have tremendous effect on the outcome of an experiment.

Gray wrote, "Behavior management . . . relies on contingency . . . rewards and punishment should be contingent (dependent) upon desired behavior, but in order for this to work people must have awareness that contingency works" (7, p. 177). Margolis and Kroes concur that contingency and awareness go together (10, p. 118). Sundel and Sundel
suggest implied pressure from contingency of reinforcement (20, p. 27). An example of the foregoing is the statement "People who have been trained in Multimedia First-Aid Training have fewer injuries on the job." The implication that risk taking will be avoided and thereby prevent injurious accidents involves modeling, expectancy, and contagion. Reinforcement contingency is implied and left to the imagination of the amount of force that group norms may exert.

With awareness, modeling as a teaching technique can be very effective. Kraut proposes that modeling consists of four major learning activities:

1. Modeling, in which trainees watch films of model persons behaving effectively in a problem situation;
2. Role playing, in which trainees practice and rehearse the effective behaviors demonstrated by the models;
3. Social reinforcement, where trainer and trainees use praise and constructive feedback; and
4. Transfer of training is encouraged to enable classroom behavior to be effectively utilized on the job (8, p. 325).

Bandura uses a social learning viewpoint that behavioral modeling by others provides vicarious reinforcement. Implied here in Bandura's theory, is a more cognitive, less mechanistic, view of behavior. Social learning suggests a different paradigm for the process of attitude change: (1) behavior change in the learner through the medium of modeling and (2) attitudinal change following behavior modification. The principle of Skinner's that behavior is
determined and maintained by its consequences certainly holds even in a purely cognitive sense (1, p. 5:19).

The present study is based on a program that relies entirely on a modeling environment. This intervention is the Standard Multimedia First-Aid Course designed by the American National Red Cross. In this course all four of Kraut's learning activities are demonstrated. Some of the vicarious learning resulting from the supportive environment is set up by a built-in biasing statement at the beginning of the program. This statement, "You are given this program because we have found that people who have been trained in Multimedia First-Aid Training have fewer injuries on the job," relies on reinforcement of the group to reduce injuries.

Rehearsal

Learning is useless if recall of acquired knowledge is not possible. Recall is mentioned by Bandura when he proposes that, " . . . behavior may be governed to some extent by imaginal mediators which represent previously observed behavioral events and environmental setting" (3, p. 41). Learning and subsequent recall are often the results of rehearsal, and as Bandura notes:

Rehearsal operations effectively stabilize and strengthen acquired responses. The level of observational learning can therefore, be considerably enhanced through practice or overt rehearsal of modeled response sequences, particularly if the rehearsal is interposed after
natural segments of a larger modeled pattern. Of greater impact is evidence that covert rehearsal, which can be readily engaged in when overt participation is either impeded or impracticable, may likewise enhance retention of acquired matching responses (3, p. 139).

Most teachers or instructors are concerned about the effectiveness of their presentation, and how their modeling affects the class. Bandura covers this with:

It is evident that observers are not equally affected by the action of others with whom they may come into contact, nor are performers equally influential in evoking the types of behaviors in which they themselves are engaged (3, p. 198).

Credibility of the instructor may present a barrier to efficient learning. Bandura tells how to control this concern:

Under conditions where advocates of innovations have no rewarding nor controlling power, they must first establish their value by demonstrating in areas that engender little or no resistance, that the practices they advocate yield highly favorable outcomes. After they have thus enhanced their credibility and modeling potency, they are in a more favorable position to attempt modifications that conflict with existing traditions and vested interests (3, p. 201).

He then proposes a way to attract attention to give the needed effect to modeling:

Anticipated rewards can influence to some degree what people will pay attention to (3, p. 224).

Imagined rewards that students connect with learned first-aid skills often add to the credibility that the instructor enjoys.
Deviance and Accidents

Suchman pursued the subject of effectiveness of social reinforcement by hypothesizing that rejection of social constraints would result in a higher incidence of accidental injuries. He tested by analyzing the frequency of accidental injuries among representative samples of 1,067 high school and 495 college students. Social factors such as "I'm wild" to represent a role being played were looked at to determine what amount of group reinforcement was active.

Suchman quoted MacIver when he stated, "... the occurrence of accidents ... is an unerring signal that something or someone is not functioning properly ..." He quoted Patterson who theorized that individuals who have frequent accidents are in a form of deviant behavior by saying, "Repeated accidents may thus be a symptom of individual deviance from a group norm of safe behavior" (19, p. 14). This hopefully does not describe post-adolescent behavior, but might be the reason some people are repeat injury statistics. Concentration reducing thoughts may cause on-the-job injuries.

Bandura's earlier work had this to say about deviance:

Psychopathology is inferred from the degree of deviance from social norms that define how persons are expected to behave at different times and places. Consequently, the appropriateness of symbolic, affective, or social responses to given situations constitutes one major criterion in labeling "symptomatic" behavior. Departures from normative standards that do not inconvenience or interfere with
deviations that produce rewarding consequences for the members of a society, as in the case of technological inventions and intellectual and artistic innovations, may be actively promoted and generously rewarded. On the other hand, deviance that generates aversive consequences for others elicits strong societal disapproval, is promptly labeled abnormal, and generally is met by coercive pressures to eliminate it (3, p. 3).

Bandura (4) discusses change through modeling by noting that it is a process of observational learning:

(1) Attentional Processes determine what is observed and extracted. (2) Retention Processes are patterns represented in memory either imaginal or verbal, to guide performance, and rehearsal serves as a memory guide. (3) Motor Reproduction Processes convert symbolic representations into appropriate actions which are cognitive at first then later become motive. (4) Motivational Processes adopt modeled behavior if it appears to result in a valued outcome.

Learning by response to consequences according to Bandura has three useful functions: (1) it imparts information and serves as a guide for future action in a cognitive manner, (2) serves as motivators through incentive value to anticipate prospective consequences, and (3) reinforces through awareness. Avoidance through awareness is an example.

Avoidance Behavior

A reason for not having accidental injury situations arise is that these potentially harmful situations are avoided through awareness. This awareness is best learned through modeled behavior. Avoidance is not very widely
discussed in literature as being cognitively developed. Bandura, Blanchard, and Ritter (5) describe basic change processes that occur during social learning procedures as the result of avoidance behavior. They also state:

There is some reason to suppose that the degree of attitudinal and behavioral change may be partly determined by the effective and social consequences of the behavior being modified and by the method of influence used to bring about the change (5, p. 197).

This could mean that real or perceived pressure to conform to a group norm might very well elicit avoidance behavior. Margolis and Kroes develop this notion with, "Avoidance uses the undesirable event to increase the frequency of desired behavior . . . also the threat of the event is used prior to the target behavior. The avoidance guideline is operating whenever the situation presents an implied or overt threat contingent on the individual's behavior" (10, pp. 120-121).

A further development on this theme was espoused by Mowrer when he defined avoidance learning in two ways: (1) passive avoidance learning is when you learn to avoid by not doing something, and (2) active avoidance learning is when you control your own avoidance behavior purposefully (11, p. 28). The situation where injury is avoided by recognizing dangerous situations can be either of the above or both simultaneously.
Aversive Contingencies

Bandura delves further into the realm of avoidance behavior with the following remarks:

A great deal of human behavior is, in fact, modified and closely regulated by natural aversive contingencies without any ill effects. On the basis of negative consequences, people learn to avoid or to protect themselves against hazardous falls, flaming, or scalding objects, deafening sounds, and other hurtful stimuli; they change their clothing to remain comfortable in sweltering or frigid temperatures; and they engage in a considerable amount of behavior that is supported almost entirely by removal of irritants. In instances where certain activities can have injurious effects, aversive contingencies must be socially arranged to ensure survival (3, p. 294).

Injury potential in most environments, especially those of industries, would certainly include the thought of survival. Bandura continues his line of thought on aversive contingency behavior:

As Mowrer has previously noted, human behavior is frequently activated not by immediate physical discomforts, but by anticipated aversive effects (3, p. 385).

Nothing less than a look into the future could change this anticipation to knowledge; therefore, most safety programs include a large amount of "what if?" practice sessions. Bandura continues with:

Through representational mechanisms, future events can be converted into current stimuli that are functionally similar to physical stimuli in their capacity to evoke adaptive courses of action (3, p. 386).
Lest one expect people to stand still for mistreatment for the sake of behavior modification, Bandura disclaims this with a note on routine learning and routine reinforcement's power:

Instructional influences can be equally powerful in regulating responsiveness under aversive contingencies. Simply exposing subjects to punishing contingencies proved to be an extremely inefficient way of altering behavior, whereas instructions about the appropriate behavior and its consequences immediately produced stable and discriminated avoidance behavior (3, p. 574).

Good Experimental Design

A good experimental design should include the following features:

1. At least one control and one experimental group.
2. Two sets of observations.
4. Before and after intervention history.
5. A program length that allows before and after comparison.
6. Evaluation, then application to the work place.

Good design alone is not enough if the reason for observed actions are not known. In this research effort, change is expected of people who are trained in first-aid principles, not necessarily to alter a bad habit, but rather to prevent an undesirable action. Modeling correct behavior, learned expectances, group norms against deviance, and the resulting avoidance behavior explain why a person who learns
first-aid skills might be involved in fewer injury-causing accidents than others who are not trained. The training in this particular case involves modeling, rehearsal, social reinforcement, awareness, group inclusion, and teaching machines. The above factors provide a strong base for expected change in behavior.

Summary

The setting for this experiment is the Texas Eastman Company, a chemicals and plastics manufacturing plant with more than 2,300 employees. Many of the employees are subject to potential harm from the injuries common to any workplace. This size population is certainly large enough to embody all of the Behavioral Modification principles mentioned in this chapter. Chapter III will present data gathered over twelve years to determine which hypothesis is true.


CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

Introduction

This chapter presents the results of some of the experimental data gathered over a period of twelve years. The program itself has been beneficial because it developed a safety awareness in those who participated in the course. This awareness has been felt in communities some distance from Texas Eastman Company's Longview plant.

The best example of this awareness and other beneficial effects that go beyond this study are the citations of use of the "Heimlich Maneuver" to save lives. Thirty-five cases have been verified involving Texas Eastman Company employees both on and off the job since this technique was first taught in 1978. More occasions of use of this life-saving technique have been reported, but not all are verifiable. The chance of perpetrating false notions of proper use has prevented relating all cases that were reported. These numbers were reported over a time period of less than seven years, thereby involving one per cent of the plant population in such a short period of time.

The Heimlich use figures are not part of the study data of this report. Its use might have added to the expectations
of those who had not taken the course at the time of reported use of the "Heimlich Maneuver." Most reports were published in the "Texas Eastman News" with pictures and a lengthy report giving all details of the incident. Some people who either used the technique or had it used on them were very good spokespersons for the entire program afterwards. This attitude of usefulness of the program probably added to the effect that will be reported in this study. Since it cannot be verified other than in an anecdotal way, it was not included.

Following the Introduction will be sections on: Methodology, Sample Size, Procedures, Evaluation Methods, Data Presentation, Analyses, and Summary.

Methodology

The main purpose of this study was to afford a look at a total population treatment of the effect of first-aid training on injury reduction. The intent was to compare the trained personnel's injuries with those of the untrained people. The study hypothesis proposed that trained people would have fewer injuries than those who were untrained. Conversely, the null hypothesis held that there should be no difference between the two groups under study.

A problem that needed to be solved was that the trained and untrained population was continually changing, thereby making it difficult to have a static group to study. The
end result of this problem was to look at the group when it was totally trained. The comparison then would be between the expected and the actual injuries. The only way to determine what constituted the expected number of injuries for the two groups under study was to use the per cent trained and untrained at the time in the study being used for comparison. This meant using cumulative training percentages to arrive at the expected injury numbers to satisfy restrictions set by the null hypothesis to not bias the study.

It took much longer to complete the total population training (never reached 100 per cent) than originally estimated due to the changing nature of the workforce being studied. Because of these factors it was decided to compare, over the life of the project, the reduction (or the increase) of injuries to the increase of trained population.

An equally important look at the data included using those employees with current first-aid skills (three-year half-life) as the compared population for the trained group. This comparison might also give enlightenment as to the effectiveness of first-aid training to reduce injuries.

This training time along with completing required courses took nearly eight years. Four years had already passed before the subject was chosen as dissertation study material; therefore, a period of twelve years could be studied. The actual time chosen coincided with the beginning
of the total population training program in 1977. Much of this same type of training had been done previously, as noted in the first and second chapters, but none were designed to study the effect of total population training. The only thing to be gained in this study over the others was the chance to study the possibility of cumulative action of training to reduce injuries as mentioned in Chapter I. Eight years is a long time to wait for results, so it was decided to do a statistical study while waiting for total training to occur. A Solomon Four Case Study resulted.

The time period chosen for the Solomon Study was selected by using random number charts. Three groups were chosen to prevent bias through selection. The groups were chosen after their classes were held, but before observations of two of the groups were completely finished. The times chosen were: Group 1—July (seventh month), 1981; Group 2—February (second month), 1980; and Group 3—September (ninth month), 1979.

This Solomon Four Case Study format required that observations be taken two years before the intervention and continuing until two years after. The dates chosen were the first classes that occurred in each of these selected months. This gave a random selection of inclusive time to be September 4, 1977 to July 9, 1983. The total time was almost six years, which is two three-year half-life training periods. The actual times used are noted in Table IV.
The first group trained was Group 3. This group consisted of sixteen people from four departments, two of which were operating departments and two were service departments. One of the concerns in this type of selection process is that there is an opportunity to train an entire class that has little chance of being injured. The strange thing about this first choice was that the two service groups had a better chance of being injured than the two operating groups. This chance was perceived to be great from the assumption that anyone in the "field" (operating areas) had more accident potential than others. This may or may not be true and is not a concern of this study, since everyone chosen is matched with three others in identical risk jobs.

The second group trained was Group 2. This group originally included seventeen participants. Two participants

### TABLE IV

<table>
<thead>
<tr>
<th>Group</th>
<th>Class Dates</th>
<th>Inclusive Dates of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/6/81--7/9/81</td>
<td>7/6/79--7/9/83</td>
</tr>
<tr>
<td>2</td>
<td>2/4/80--2/7/80</td>
<td>2/4/78--2/7/82</td>
</tr>
<tr>
<td>3</td>
<td>9/4/79--9/7/79</td>
<td>9/4/77--9/7/81</td>
</tr>
</tbody>
</table>
were dropped from the study because they did not take Session 4 of the training. Two more terminated from the company before the observation period was over. This study group involved one operating department and three service departments.

Group 1 originally had thirteen participants; however, one terminated before the observation period was over and one did not complete the course. The participants involved in this group were from seven service departments.

These three groups provided forty subjects to match and study for four years in each case. The selection was accomplished choosing three groups of potential matches. One group was trained in the same month as the control group, while the other two groups did not receive training during the observation period. A true match could only be effected by comparing people in the same jobs and in the same environments. This was easy for most cases because there were enough people to use random number charts. Six cases involved departments that were mostly trained, thereby making selection easy, because the only ones left were the untrained personnel. This would normally present a problem; but matching was random because the original class was randomly selected, so therefore those left were also random choices.

The intervention used was the American National Red Cross Standard Multimedia First-Aid Course. In each case it was given to the participants in classes of no more than
twenty people. The classes were held two hours each day on four consecutive days. The last session included a twenty item written test with a grade of seventy considered to be passing. None of the eighty who took the course in this sample failed. Each first session class began with the biasing statement, "This course is given to you because we have found that people who have been trained in first aid have fewer injuries than those who have not been trained," which was designed to modify their behavior. The course then was given exactly like all other Multimedia Courses and was controlled by written script.

The difference between this intervention and some of those noted previously in the studies from Canada is the difference between the two courses. Canadian courses have accident scenarios built into the course which prompts thoughts of avoidance potential. Their studies also make known the tie between first-aid training and reduction of injuries. This attitude setting bias is so wide-spread that it would be hard to ignore as a behavior modifier. A goal of the Canadian course is to reduce accidents, while the primary goal of the Red Cross course is to teach life-saving skills. Both invoke avoidance thoughts, but only the Canadian studies have utilized these thoughts to present a case for accident reduction.
Sample Size

The size of the sample under the study involving the Solomon Four Case Study was 160 participants. The original pilot study done in 1976 included 158 people (see Table III, p. 12). This was deemed to be a significant portion of the population at that time to give a true statistical outlook. Because of the 1976 statistics, a six-month pilot of three departments was undertaken. The success of this effort to reduce injuries led to permission to train the entire plant in Multimedia First Aid. The population of the plant varied from month to month; therefore the statistical representation was different. The population of the plant was 2,313 at the beginning of the observation period in September, 1977, and was 2,729 at the ending period of July, 1983. The sample of 160 people in either case was a statistically sufficient number.

Procedures

The length of time of this study afforded an ideal opportunity to observe more than one aspect of the effect that first-aid training might have on accident reduction. The decision was made to look at two ways of determining a relationship between accident reduction and first-aid training. The procedures used in these cases involved tracking all OSHA recordable injuries to determine frequency of
occurrence of injuries. Lost-workday injuries were not noted, because they are included as OSHA recordables.

These procedures made it necessary to look at each period's "Quotidian Injury Analysis Data" sheet. This sheet was filled out by a member of the medical staff at Texas Eastman Company. Each entry contained the name of the injured person, the injured person's department number, OSHA number, date injured, date to medical, and date the report was received. Most reports did not involve OSHA recordable notations. Every visit to medical was recorded, so even treatment for colds and minor problems were noted. OSHA recordable notations included any injury that would probably require a physician's treatment at a later date. All lost-workday injuries are also OSHA recordables and were marked "LWD" in the margin.

The Quotidian entries were checked for OSHA numbers, then each OSHA entry was looked up in the First-Aid Class Roster Book. Each entry was then color coded to show: (1) if the injured person was trained before the injury, (2) if the injured person was not trained, or (3) if the injured person was previously trained but the half-life of three years had passed. A period of eight years was checked. The period chosen for the Solomon Study used only five years and ten months of this data.

The next step was to determine the total population present at any time during the period studied. Then the
number that had been trained at any point during that time could be totaled. A spreadsheet program was utilized to determine how many people were within the three-year half-life training period. From this information two lists of per cent trained were made. One list was made of all people who had ever been trained, while the other consisted of only those whose training was current (three years or less).

This spreadsheet also determined the per cent of error present in determining the currently trained from the cumulatively trained. This was necessary because of some transfers who returned later within the period under study. The error ranged from a low of .4 per cent to a high of 2.0 per cent.

Evaluation Methods

The three methods used to evaluate the effectiveness of the training in reducing injuries are described below.

Method One

One of the possibilities of the present study that was learned from the Canadian studies was the cumulative effect that total population training might have on the outcome. Only one of the studies noted in the literature was a total population effort. The present study was close to a total population program by the end of the observation period because everyone who had ever been trained was included in the count. A logical and perhaps the strongest proof of the
hypothesis presented was a comparison of how actual injury frequencies changed as trained population changed, as computed from the per cent of population trained figures.

Graphical solutions showing the comparison of the rate of change of the trained population with the rate of change of the observed frequencies of injuries were made. Those people trained in first-aid procedures should show the effect of training on injuries. A graph of Method One compared the per cent of total population trained in first-aid skills imposed on a graphical representation of OSHA Recordable frequencies by using a correction factor of .1 X the OSHA figures. This rendered the two quantities mappable. The next step included the comparison and thereby proved or disproved the hypothesis (6, p. 112).

A method of proof that shows a correlation between training and these injuries should include their respective mathematical relationships. Since these graphical solutions showed point-to-point line comparisons, the proof involved the locational relations of these line graphs for each year studied. The graphs then had a Y axis pertaining to frequencies and per cents while the X axis represented years (8, p. 91). Sure proof of line relationships employed a method of proof that took into consideration the slopes of the respective lines for each year.

Granville, Smith, and Longley proved that the direction of a curve is defined by dy/dx = slope of the line tangent
to the curve at point \( P(x,y) \). Let \( \theta \) = inclination of the tangent line. Then the slope = \( \tan \theta \), and \( \frac{dy}{dx} = \tan \theta \) = slope of the curve at any point \( P(x,y) \) (3, p. 42).

Smith, Gale, and Neely define the slope \( m \) of a line passing through two points \( P_1(x_1,y_1), P_2(x_2,y_2) \) as given by \( m = \frac{y_2 - y_1}{x_2 - x_1} \) (10, p. 17). They presented a theorem that was useful to this study.

Theorem: The angle \( \theta \) between two directed lines is determined by: 
\[
\tan \theta = \frac{m_2 - m_1}{1 + m_1 m_2}
\]
where \( m_1 \) is the slope of the line with the greater inclination (10, p. 18).

This comparative scheme depended on other connectives in theory. One of these was expounded by Rosenbach and Whitman:

If the two lines that correspond to the two linear equations of a system meet at one point, the system has only one solution, and the equations of the system are said to be consistent and independent . . . . If the two lines are parallel—that is, if they have no points in common, there is no solution and the equations are said to be inconsistent (6, p. 123).

Orthogonality was an important point to consider in this comparison. James and James defined orthogonal as: "Right-angled; pertaining to or depending upon the use of right angles" (4, p. 275). Several mentions were made of the integral based on the bounded interval \([a,b]\) where the orthogonal function is a unique solution of two lines that intersect. Kreyszig (5, p. 510) defined this relation as:
Two real functions \( G_m(x) \) and \( G_n(x) \) are said to be orthogonal on an interval \( a \leq x \leq b \), if the integral of the product \( G_m G_n \) over that interval is zero." Sokolnikoff and Sokolnikoff (11, p. 81) further developed this to include the following:

\[
\int_a^b u_i(x)u_j(x)dx = 0, \text{ if } i \neq j \\
\int_a^b u_i(x)u_j(x)dx = 1, \text{ if } i = j
\]

Dixon and Massey (1, p. 331) in their section on analysis of variance tied orthogonality and interaction together. They showed that direct measurement of relationships could be developed by comparing slopes of the representative lines of least squares. Interaction effects on the means and orthogonal contrasts were chosen to measure effects of the difference in slopes. Glass and Stanley (2, p. 408) noted this same line of reasoning between hypothesis testing and mathematical models. They presented types of interaction that were similar to slope and orthogonal intersections. According to Fisher (noted by Glass and Stanley) the geometric non-parallel line slopes reflect the presence of interaction. He described two types of interaction: ordinal, which in simplified form corresponds to parallel lines proving \( H_0 = 0 \); and disordinal which corresponds to intersecting lines with \( H_1 = 0 \).

If it can be shown that any two lines from any year interact in an orthogonal set, then \( H_0 \) can be rejected. A disadvantage to this method of proof is that direction
cannot be determined, only comparison of injuries and trained population can show differences.

**Method Two**

Another comparative check of the effectiveness of training was accomplished in a manner like Method One. This procedure observed only people who were currently trained as comparisons to the injured population. The problem studied in this method was the effect of the three-year half-life of training on the outcome of the injuries experienced. This was studied by collapsing the half-life population into the untrained population for a test in the same manner as in Method One. Graphical solutions would show matching behavior in this schemata if in fact half-life was a true condition of avoidance behavior. Training should have leading effects on the OSHA recordable frequencies.

**Method Three**

The Solomon Four Case Study compared two matched case sections that had been trained in Multimedia First Aid with two sections that had not received the training. Table V shows the manner in which they were observed.

Section I was the randomly selected class, while Sections II, III, and IV were the individuals matched with the members of the class. This selection and matching was done for three different Section I selections as noted previously. The dates selected for the classes included the
TABLE V

SOLOMON FOUR CASE STUDY SECTION DESIGN

<table>
<thead>
<tr>
<th>Solomon Four Case Sections</th>
<th>Observed Before</th>
<th>Intervention</th>
<th>Observed After</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0</td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

time range from September, 1977 to July, 1983 when before and after observation periods were calculated. The treatment of this data consisted of a Chi Square Test comparing Sections I and III with Sections II and IV in relation to injuries. This afforded a mid-program statistical look similar to the Chi Square Test in the original apprentice pilot study.

These three methods of evaluation were a logical extension of the way the training was developed. The first development was the evolution of the program from a skills presentation course given to Foremen to an injury prevention presentation given to everyone. The original presentations were made in 1975, followed by the non-biased presentations made to the Apprentice Classes in 1976, closely followed by the three-department pilot study late in 1976 and early in
1977. The latter was the first effort to introduce an intentional bias with the statement that later became part of the script in all Texas Eastman Company Multimedia Courses.

The original intention was to test the hypothesis through total population training only. It became apparent quickly that it would be too long before any success could be counted. The decision was then made to look at statistical representations of the effect of the first-aid training on injury frequencies. After searching the literature and finding the vast statistical evidence collected by St. John's Ambulance of Canada, the total population study became more important. There was no evidence that anyone had ever accomplished total training in an entire program. Only suggestions were made to study the cumulative effect that builds as former participants talk over their experiences.

The Solomon Four Case Study came about because of the need of a method that would show total trends through a shorter time period. This might show the same cumulative effect that total training might show.

Data Presentation

The data will be presented in the same order that it was presented in the previous section. This is not the chronological order of the original data collection. Method One will be considered first, followed by Method Two, then Method Three.
Method One--Total Population Study Using Cumulative Trained Numbers

Hypothesis.--$H_0$: There is no difference between trained groups and untrained groups in the frequency of occurrence of injuries.

$H_1$: Total population training in Multimedia First Aid has a significant effect on reducing injuries on the job.

Statistical test.--The test employed in this method was the orthogonality of the pairs of slopes. If the numbers substituted for the slope $m$ were not equal, then orthogonality existed. Graphical representation was the other method of comparison. This was designed to show a visual comparison to allow the affecting relationships to be seen.

Significance level.--There was no basis for levels of significance; the size of the angle $\theta$ denoted the magnitude of the difference of the two slopes.

Sampling distribution.--Related to the total population, the sample consisted of the portion of the population that experienced injuries.

Rejection region.--$H_0$ was rejected if the angle was not equal to 0.

Discussion.--The data related to Method One is shown in Table VI.
TABLE VI

SLOPES $m_3$ AND $m_4$ AND RESULTING ANGLE $\theta$ WITH $m_3$
USING CUMULATIVE TRAINED NUMBERS

<table>
<thead>
<tr>
<th>Years Of Line Graph</th>
<th>$m_3^*$</th>
<th>$m_4^{**}$</th>
<th>Tan $\theta$</th>
<th>$\theta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-78</td>
<td>0.64</td>
<td>-0.54</td>
<td>-1.80</td>
<td>60.99</td>
</tr>
<tr>
<td>1978-79</td>
<td>2.47</td>
<td>-1.03</td>
<td>2.27</td>
<td>66.25</td>
</tr>
<tr>
<td>1979-80</td>
<td>3.02</td>
<td>-0.57</td>
<td>4.98</td>
<td>78.64</td>
</tr>
<tr>
<td>1980-81</td>
<td>0.81</td>
<td>-0.49</td>
<td>-2.16</td>
<td>65.11</td>
</tr>
<tr>
<td>1981-82</td>
<td>0.03</td>
<td>0.46</td>
<td>0.42</td>
<td>22.98</td>
</tr>
<tr>
<td>1982-83</td>
<td>0.23</td>
<td>0.33</td>
<td>0.09</td>
<td>5.31</td>
</tr>
<tr>
<td>1983-84</td>
<td>0.05</td>
<td>-1.61</td>
<td>1.81</td>
<td>61.02</td>
</tr>
<tr>
<td>1984-85</td>
<td>0.05</td>
<td>-1.34</td>
<td>-1.49</td>
<td>56.13</td>
</tr>
</tbody>
</table>

*Slope of per cent trained.
**Slope of OSHA recordable frequencies.

Proof of intersection was contained in the figures in the angle $\theta$ column. The smallest angle was 5.31, representing the 1982-83 years; consequently $H_0$ can be rejected with a confidence level of 100 per cent. Therefore, total population training in Multimedia First Aid has a significant effect on reducing injuries on the job. A more revealing comparison is included in Figure 1 of the analyses section. That discussion will be made there.

**Method Two--Total Population Study Using Currently Trained Numbers by Collapsing Half-Life into Untrained**

Hypothesis.--$H_0$: There is no difference between trained and untrained groups in the frequency of occurrence of injuries.
$H_1$: Total population training in Multimedia First Aid has a significant effect on reducing injuries on the job.

**Statistical test.**--The test employed in this method was the orthogonality of the pairs of slopes. If the numbers substituted for the slope $m$ were not equal, then orthogonality existed. Graphical representation was the other method of comparison. This was designed to show a visual comparison to allow the affecting relationships to be seen.

**Significance level.**--There was no basis for levels of significance; the size of the angle $\theta$ denoted the magnitude of the difference of the two slopes.

**Sampling distribution.**--Related to the total population the sample consisted of the portion of the population that experienced injuries.

**Rejection region.**--$H_0$ was rejected if the angle was not equal to 0.

**Discussion.**--The data related to this method is shown in Table VII.

Proof of intersection was contained in the figures in the angle $\theta$ column. The smallest angle was 32.95 representing the 1980-81 years; therefore $H_0$ can be rejected with a confidence level of 100 per cent. Therefore, total population training in Multimedia First Aid has a significant
TABLE VII
SLOPES $m_3$ AND $m_4$, AND RESULTING ANGLE $\theta$ WITH $m_3$
USING CURRENTLY TRAINED NUMBERS

<table>
<thead>
<tr>
<th>Years Of Line Graph</th>
<th>$m_3$*</th>
<th>$m_4$**</th>
<th>$\tan \theta$</th>
<th>$\theta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-78</td>
<td>0.62</td>
<td>-0.54</td>
<td>-1.74</td>
<td>60.17</td>
</tr>
<tr>
<td>1978-79</td>
<td>2.30</td>
<td>-1.03</td>
<td>2.43</td>
<td>67.65</td>
</tr>
<tr>
<td>1979-80</td>
<td>1.19</td>
<td>-0.57</td>
<td>5.47</td>
<td>79.64</td>
</tr>
<tr>
<td>1980-81</td>
<td>-1.12</td>
<td>-0.49</td>
<td>-1.64</td>
<td>32.95</td>
</tr>
<tr>
<td>1981-82</td>
<td>-2.38</td>
<td>0.46</td>
<td>29.95</td>
<td>88.09</td>
</tr>
<tr>
<td>1982-83</td>
<td>2.53</td>
<td>0.33</td>
<td>1.20</td>
<td>50.17</td>
</tr>
<tr>
<td>1983-84</td>
<td>0.28</td>
<td>-1.61</td>
<td>-3.44</td>
<td>73.79</td>
</tr>
<tr>
<td>1984-85</td>
<td>1.28</td>
<td>-1.34</td>
<td>-1.53</td>
<td>56.79</td>
</tr>
</tbody>
</table>

*Slope of per cent trained.

**Slope of OSHA recordable frequencies.

Effect on reducing injuries on the job. A more revealing comparison is included in Figure 2 of the Analyses section. That discussion will be made there.

Method Three—Solomon Four Case Study

Hypothesis.—$H_0$: There is no difference between First Aid trained groups and untrained groups in the frequency of occurrences of injuries.

$H_1$: Total population training in Multimedia First Aid has a significant effect on reducing injuries on the job.

Statistical test—The data compared was from one population and the groups were carefully matched to eliminate differences, making the $X^2$ Test appropriate for goodness of fit (8, p. 214). This test was to determine if there was
a difference between First-Aid trained and untrained participants in receiving OSHA recordable injuries.

Since only four groups were being observed for one classification (OSHA recordables), the one-sample test was used. The $X^2$ was chosen because the hypothesis that was being tested involved an observed frequency compared to an expected frequency of occurrence based on the null hypothesis. Since $H_0$ stated no difference between groups, the expected frequency was based upon per cent trained of the total population. If $H_0$ were found to be true, then the per cent of observed frequency should be the same as the per cent of expected frequency.

Significance level.—Let $\alpha = .05$. $N$ varied according to the group under study.

Sampling distribution.—The sampling distribution of $X^2$ was computed from the formula: 

$$X^2 = \frac{(O_1 - E_1)^2}{E_1} + \frac{(O_2 - E_2)^2}{E_2}$$

and followed the Chi-Square Distribution with df = 1 (9, p. 46).

Rejection region.—$H_0$ was rejected if the observed value of $X^2$ was such that the probability associated with its occurrence under $H_0$ for df = 1 was equal to or less than $\alpha = .05$.

Discussion.—The three groups were each observed over a time period ranging from two years before the intervention
(first-aid training) to two years after the intervention. The number of OSHA recordables are noted in Table VIII.

**TABLE VIII**

*INJURIES EXPERIENCED BY CASE AND TRAINED GROUPS*

<table>
<thead>
<tr>
<th>Trained Groups</th>
<th>Date Trained</th>
<th>Solomon Four Case Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>1</td>
<td>7/81</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2/80</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>9/79</td>
<td>1</td>
</tr>
</tbody>
</table>

Since case sections I and III received the intervention, and case sections II and IV received no intervention, then I and III were combined and compared to II and IV combined as stated in the section on Evaluation Methods. After collapsing the sections as stated above the results are shown in Table IX.

**TABLE IX**

*INJURIES AFTER COMBINING SECTIONS*

<table>
<thead>
<tr>
<th>Group</th>
<th>Trained</th>
<th>Untrained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
The calculations for cell expectancies that were compared with the above noted observed injuries are shown in Table X.

**TABLE X**

**CALCULATIONS MADE TO ARRIVE AT CELL EXPECTANCIES FOR CHI-SQUARE TEST**

<table>
<thead>
<tr>
<th>Group</th>
<th>Group Size</th>
<th>Total Population</th>
<th>Group as Per Cent of Population</th>
<th>Per Cent Population Trained</th>
<th>Per Cent Population Untrained</th>
<th>OSHA Total Recordable Prior Year</th>
<th>Expected OSHA Group Recordable</th>
<th>Expected Trained Group Injuries</th>
<th>Expected Untrained Group Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44</td>
<td>2690</td>
<td>1.64</td>
<td>66.77</td>
<td>33.23</td>
<td>112</td>
<td>1.83</td>
<td>1.22</td>
<td>0.61</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>2539</td>
<td>2.05</td>
<td>55.5</td>
<td>44.5</td>
<td>123</td>
<td>2.52</td>
<td>1.40</td>
<td>1.12</td>
</tr>
<tr>
<td>3</td>
<td>64</td>
<td>2513</td>
<td>2.55</td>
<td>48.5</td>
<td>51.5</td>
<td>142</td>
<td>3.62</td>
<td>1.75</td>
<td>1.86</td>
</tr>
</tbody>
</table>

Group 1 was trained during July, 1981 when the per cent trained = 66.77 and the per cent untrained = 33.23, and observed from July, 1979 through July, 1983. With the premise of $H_0$ that there is no difference between trained and untrained experiences, then 66 per cent of the injuries should involve trained personnel while untrained participants would experience 33 per cent. Only one injury was recorded during this time period. According to Table X, the expected values for trained and untrained cells were 1.22 and 0.61 respectively. Both these expected frequencies were below the required level of five for each cell required by $X^2$ tests, thereby rendering the test invalid.
Group 2 was trained during February, 1980 when the per cent trained = 55.5 and the per cent untrained = 44.5, and observed from February 1978 to February 1982. Table X shows the expected injury values to be 1.40 for trained and 1.12 for untrained. Both were below the required level of five required for $X^2$ tests, rendering the test invalid.

Group 3 was trained during September, 1979 when 48.5 per cent were trained and 51.5 per cent were untrained, and observed from September, 1977 to September, 1981. Table X shows the expected injury values for trained and untrained to be 1.75 and 1.86 respectively. Both cells were below the necessary level, thereby making the $X^2$ test invalid.

Analyses

Method One

This method was the one for which the program was initially designed. It showed a good positive relationship between the increase in trained population and the decrease in OSHA recordables. A problem appeared when the two curves were compared in Figure 1.

The angles of difference in this method were greater on the average than in Method Two as shown in Table IX. This is misleading because the angle measured was not the one on the x axis, but rather the one on the upper side of the intersection of the two line graphs. What was notable about the structure of this chart was the great amount of
Fig. 1--Comparison of per cent trained and OSHA recordable frequencies.

Divergence shown between the two curves, even though the trained population was almost a logarithmic curve. The difference was due to the sharp drop in the injury curve, while the trained curve approached 100 per cent on its path to infinity.
An analysis of this method showed positive and great visual separation graphically. Degrees of difference were mathematically shown to be substantially rejecting $H_0$, while the chart showed decay in this relationship as the total population trained approached unity.

**Method Two**

This method showed very good results of the effect of training on the reduction of OSHA recordable injuries. As noted in the section on Data Presentation, there was overwhelming evidence of a direct relationship between Multimedia First-Aid Training and the reduction of OSHA recordable injuries. The comparison was more apparent when the graphical comparisons in Figure 2 were viewed.

The curve for the per cent trained showed a flat slope between 1980 and 1981. This was not due to a cessation of training; rather, the large groups trained in 1977 and 1978 were arriving at their half-life trained period. A steep negative slope in the line between 1981 and 1982 indicated that the bulk of the previously trained people were past the three-year half-life. The equally steep positive slope of the line representing 1982 to 1983 increases was because the major portion of the people who had never had first-aid training were only 2.4 per cent of the total population, and most of the training efforts for that period were in retraining. The slope of the line for 1983 and 1984 was again flat, but increased between 1984 and 1985.
Retraining consisted of only two hours of class time where students received a verbal update of the current skills, watched two films, and practiced mouth-to-mouth techniques on a dummy. Permission was received from the Red Cross Regional Field Director to present retraining in
this manner after he was shown evidence of testing that proved there was no difference in grades between two, four, six, and eight hour sessions.

The correlating factors on these two curves were apparent when it was noted that a decrease in trained personnel predated an increase in injury frequencies by one year. The increase in trained people lead the reduction of injuries by one year also. The analysis of this method showed that the mathematical proof that first-aid trained people have fewer injuries than those who are not trained was positive. Charting showed a direct tie between these two factors.

There was one factor that tended to weaken the proof that Methods One and Two showed good correlation between variables. This factor occurred in the time period of study after 1982. A major program to reduce injuries through awareness was put into effect by top managers. This was very effective and probably had more effect on the steeper reduction of injuries in 1984 and 1985 than did the change in trained personnel. This was, however, a training effect, affecting the entire population, and does hold to the hypothesis that people who are aware of the possible effects of injuries avoid more injury potential situations. This again proved Mr. Lafferty's, of St. John's Ambulance Service, Toronto, Canada, contention that a first-aid trained population coupled with a good program of injury potential awareness should return a net saving over injury costs.
Method Three

The initial $X^2$ test performed in 1975 included only fifty-one people in the control group, yet the results of the test were thought to be sufficient to begin two other programs. One of these programs was of a noted short term, but did show positive results. The other was the present study.

When the data were gathered, it became more of a historical nature because the total population figure was at 97.6 per cent. The fact that only five people of the 160 sample had OSHA recordable injuries was surprising at first. The test of goodness of fit was performed to verify that the expected cell numbers would fall short of the rule set up by the Chi Square Test. Noticing that the total population study was showing very good results, the original test data were checked again to determine differences in test methods. The data in 1975, it was discovered, included Lost-Workday Injuries and total injuries, but not OSHA recordables as a separate category.

It was decided to abandon the Solomon Four Case Study because total injuries include OSHA recordables, but also include colds, flu, and other illnesses not in the injury category. Even though the point curves of incidence of total injuries reflect the effect from OSHA recordables, the opposite is not necessarily true. The original test data compared to the Solomon Test data might be interesting.
Three of the five people that experienced OSHA recordables noted in this method were untrained, making the ratio of incidence equal sixty per cent for untrained and forty per cent for trained. With such a small sample of injuries to compare it would be stretching the bounds of good experimental design to conclude with any degree of confidence that $H_0$ is either rejected or accepted. The conclusion is that the test proved inconclusive due to a lack of data.

The most impressive statement that can be made from either method is to compare the per cent of OSHA recordables experienced to the per cent of untrained. The first attempt at this comparison was between OSHA recordable per cent in relation to the per cent of trained. Somehow the idea of showing how a small per cent of untrained people experience a large per cent of injuries told the story best. Table XI shows the comparisons for each year. Note that Method One gives the largest difference between untrained and injuries.

This is not surprising when in fact the untrained population in Method One never goes down. Method Two fluctuates each year and is quite slow getting to its lowest per cent in 1985. Method Two has three years that had per cent experiences lower than the per cent untrained. These years were 1979, 1980, and 1982. There is not any particular event to ascribe to these differences. With this exception the intervention shows a norm.
TABLE XI
DIFFERENCE OF METHOD ONE AND METHOD TWO WHEN COMPARING PER CENT OF UNTRAINED POPULATION WITH PER CENT OF INJURIES EXPERIENCED EACH YEAR

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Cent of Population Untrained</th>
<th>Per Cent of OSHA Recordable Experienced by Untrained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method One</td>
<td>Method Two</td>
</tr>
<tr>
<td>1977</td>
<td>74.4</td>
<td>78.5</td>
</tr>
<tr>
<td>1978</td>
<td>68.0</td>
<td>72.3</td>
</tr>
<tr>
<td>1979</td>
<td>43.3</td>
<td>49.3</td>
</tr>
<tr>
<td>1980</td>
<td>13.1</td>
<td>37.4</td>
</tr>
<tr>
<td>1981</td>
<td>5.0</td>
<td>36.1</td>
</tr>
<tr>
<td>1982</td>
<td>4.7</td>
<td>59.9</td>
</tr>
<tr>
<td>1983</td>
<td>2.4</td>
<td>34.6</td>
</tr>
<tr>
<td>1984</td>
<td>1.9</td>
<td>31.8</td>
</tr>
<tr>
<td>1985</td>
<td>1.4</td>
<td>19.0</td>
</tr>
</tbody>
</table>

The success of the program is evident when the per cent injuries of untrained people are greater than their respective population per cent.

Summary

Of the three methods of hypothesis testing tried, the first method rejected $H_0$, the second rejected $H_0$ substantially and determined that $H_1$ showed a leading direction, while the third was inconclusive.

The rewards connected to this study were not all mentioned in this paper, because some are not measurable. Instructors in Multimedia First Aid probably received more non-monetary rewards that were truly meant than anyone in
any teaching field. It is hard to put a value on the feeling one gets when one of their students relates an incident where they saved a life or their life was saved because of the skills they learned in the instructor's class.

The next chapter will explore ways the conclusions found from this research can be put to use to benefit any company. It will also recommend further study.
CHAPTER BIBLIOGRAPHY


CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter will bring together all the assumptions, findings, and developments from this study. Conclusions will be drawn from this study, implications will be discussed, and recommendations offered for the population as a whole. Suggestions will also be made for some other studies that might be made to test some of the assumptions and findings that were only peripheral to this study.

Summary

Success of a program is always measured by the effect it has on its avowed goals. The goal for this program was a practical one. Cost savings were behind the decision to commit such a large amount of time and personnel to a project of this magnitude. The program was well into the second year before it was chosen as a research project. Many research projects are for the benefit of the researcher's goals. This was not only a practical experiment but definitely a multifaceted research experiment.

Initial intentions were to completely train all personnel in approximately three years. This was not accomplished because of scheduling complications: (1) employees
not attending class when scheduled, thereby causing rescheduling and (2) plant shutdowns causing employees to miss parts of the program for scheduled work.

Another problem of less magnitude but still influential was the changing nature of the population. It is always hard to see a problem before it crops up. Even when it is considered prior to the program, it is hard to guess what influence it will have on the program's outcome. The problem that this study had with changes in population pertained to scheduling new people and determining who had been trained at any time during the study.

The subsequent scheduling problems and the failure to ascribe to the original training scheduled completion date had an unknown effect on the program outcome. The known effects that these problems had are noted partly in Figure 2 in chapter III. This is where large groups of people were shown as untrained because their three-year half-life of training had passed. Had this not happened, part of these findings would not have been discovered. Without the lull in the program, the steep fall in the number of people who were trained might not have occurred. This would have prevented the comparison made in Method Two. The subsequent showing that training or lack of training leads injury results would probably not have been possible. This was an important result, not entirely unsuspected, but surprising in how much effect the half-life had on the injury
frequencies. Another surprise was how close the changed injury frequencies agreed with the lead of the change in population training.

The program began as a simple effort to give first-aid training to at least one person in each work area in order that they could render effective first aid if an emergency arose. The result by the end of the observation period was a population totally trained as first responders. As a direct result of the effectiveness of this training, other training was allowed that further improved the safety organizations within the plant site. The end result of all these programs was an organization with outstanding first-aid protection.

The present situation includes an organization that fulfills the requirements set by Mr. T. D. Lafferty:

The principle findings of the study confirmed that first-aid trained employees have fewer accidents and that reductions of 20 per cent to 30 per cent may be expected in the accident rate of companies where saturation first-aid training has been combined with an effective safety programme (3, p. 1).

The effective safety program mentioned was a dynamically changing one that was not stressed the same in all parts of the plant until 1982. Figure 1 in Chapter III graphically shows the dramatic down turn in injuries beginning at the end of 1983.

This decline in injuries can be shown to be a result of the first-aid training, particularly when compared to the
half-life that is collapsed into the untrained. It would be presumptuous to assume, however, that there were no other affecting factors in an observation period that saw OSHA recordable frequencies reduced by 76 per cent in eight years.

Drs. Agnew and Miller were very cautious to warn about relying only upon the effectiveness of the first-aid training for results. Their notation about concern for behavior change was found in their summary statement of the Orillia FACTS I study where they stated:

>We conclude that in order to modify unsafe habits, safety training must be supplemented by frequent and obvious reinforcing safety "signals" in the immediate environment (1, p. 1).

The safety signals mentioned would include knowledge that because everyone was being trained, then the "management" must be serious about safety. Later, the program of plant-wide emphasis on safety became a reinforcing safety signal. Both signals included behavior modifying factors that provided reinforcement from top managers and safety conscious peers.

This program produced a system that includes: (1) an entire population that can treat most injury situations in the first two minutes (fellow workers in proximity); (2) a smaller population (20 per cent of total) that can treat the most frequent life-taking situations (CPR trained) in the first four minutes; (3) approximately twenty people trained as Emergency Care Attendants who drive the ambulance,
rescue people, treat injuries, and transport them within ten minutes; (4) approximately twenty more people trained as Emergency Medical Technicians that can assist the ECA group and lend further expertise to treatment; and (5) a Medical Department consisting of two doctors, three nurses, and three Industrial Hygienists. In cases of life threatening situations, and because of the proximity of the first responder, the injured person has improved chances of recovery probably as much as 70 to 80 per cent.

Conclusions

There are two major conclusions that can be drawn from this study.

(1) There is a definite relationship between the increase in first-aid trained personnel and the decrease in injury frequency.

(2) There is a direct affecting measure between currently trained population increases or decreases and injury frequencies.

The latter item needs further testing since it was a secondarily arrived at conclusion in this study.

With the above conclusions in mind, several other conclusions may be made.

(1) The objective of behavior modification development that is evident in contagion is not a proven item in this study. Two groups would have to be compared in a controlled
atmosphere to determine differences. They would have to be matched and observed under control to determine interval differences.

(2) The intervention had the greatest effect on reduction of injuries of any program in effect at that time. This was not true after the time that a plant-wide concentrated effort was made to improve safety records. This agreed with Mr. Lafferty's and Drs. Agnew and Miller's contention that a program needed not only the training but also a concentration of "safety signals" to be complete (1, p. 1; 3, p. 1).

(3) Another cogent point is that there are many influences that build up the pressure to avoid injury and thereby build awareness. The biasing statement was the most consistent pressure-causing device in the program. It was also the only behavior-changing item that every trainee received that was on the order of biasing their viewpoint about accident awareness.

(4) Since tracking of this program showed important results over years, the same results could have been tracked monthly. Had this been done then the stress to be safer on the job that was so successfully carried out later could probably have pinpointed trouble trends and reduced injuries much quicker. An ongoing tracking system would probably pay handsome dividends.
(5) The final point is, that with all these items of program possibilities available, there is a definite program that could be recommended for industries that need to reduce injury frequencies. Safety program vendors and researchers can also learn from this study.

Recommendations for Industry

Industrial accident and safety programs should consist of the following parts:

(1) A totally trained population of first responders who have as a minimum of training the Red Cross Multimedia First-Aid Course or its equivalent.

(2) Some portion of the population trained to take care of first-aid cases requiring advanced techniques. EMT or ECA training should take care of all situations.

(3) One person for each thousand employees trained as a Paramedic who is able to administer drugs at the accident site at the bidding of a doctor.

(4) Two people at each worksite on each shift or crew trained in Cardio Pulmonary Resuscitation to provide skills necessary to sustain life in case of heart attack.

(5) A well-trained group of Safety Inspectors who are able to handle fire, rescue, and advanced first-aid cases. This group should be radio dispatched and well versed in the use of all resources in case of accidents.
(6) A medical department and dispensary established unless the facility is in the immediate vicinity of a hospital or clinic.

(7) A comprehensive safety recognition program that teaches each employee to recognize potential hazards.

(8) A program to create awareness through a concentrated effort to provide safety signals at frequent intervals.

(9) A periodic program of positive recognition to reward safe actions and injury-free work periods.

(10) A continuous program of publicity about the safe side of the program, never mentioning injuries except in the form of statistics.

(11) A continuous tracking system that researches statistics to find trouble spots that need immediate attention.

The above eleven items might appear to be a rather expensive way of handling the problem of work injuries. McGowan made similar suggestions but only implied total training (4, p. 59). The real question is what would it cost if the injuries were not reduced?

Vendors of first-aid programs should take advantage of the value that is added to a skill program when accident scenarios are included. This adds realism and some amount of practice in a safe atmosphere to give confidence to new trainees. Tests should have some questions that require the
students to answer in their own words. This requires some amount of transition to a realistic viewpoint in their own mind of what to do in the tested situation.

Because of the close relationship that occurred between the instructors in this study and the American Red Cross, this recommendation is for Red Cross programs. Marketing efforts aimed toward industrial and business areas would probably be more successful if they were aimed at the interest of this customer rather than to the public as a whole.

The tremendous success of the St. John programs attest to their attention to this particular type of customer. They developed programs that addressed the problems in industrial settings and printed pamphlets that advertised the programs as cost-saving devices. Businesses have little need for the same programs and attitudes prevalent in most public first-aid courses. Red Cross is no longer the sole supplier of such programs, and if the needs of large businesses are not met, then Red Cross could very well become the minority supplier of such programs.

The American Red Cross could develop a clearing house to collect, study, and disseminate statistics of the effect of first-aid training on reduction of injuries, both on and off the jobsite. This would be a benefit to anyone desiring information about the effects of first aid as well as being a source for research on the effectiveness of training
Agnew and Miller first called for such a common source of information gathering and storage to be set up in Canada (1, p. 10). Hunt repeated this request in his study (2, p. 61). Perhaps Red Cross could set up an international clearing house since the organizational structure is existing now.

Recommendations for Further Research

This field of study has a large number of possible research topics for individual or institutional research. Some of the topics that this program suggests are:

1. A research design to compare trained and untrained percentiles to lost-time injury frequencies.
2. A program that can compare the effect on injury frequencies that CPR training might produce.
3. A controlled study of the effect that the three-year decay of skills (half-life) has on injury frequencies.
4. A program to find what type of first-aid skills decay fastest, and which should be stressed most. Test items and recall devices should be the result of these findings.
5. A design to study the behavior modifying effects of safety awareness programs without first-aid training.
6. An experiment to determine what other types of biasing statements might be effective in changing normal behavior to avoidance behavior. This should be studied in a controlled atmosphere.
(7) A controlled experiment to determine what is the minimum time required to renew half-life skills to a current status.

(8) Hypotheses to study to prove what program parts are needed to entirely eliminate on-the-job injuries. This would be a tremendous program that should be shared by many.

(9) Design and test a nation-wide clearing house for injury reduction from first-aid training statistics. If successful, it could easily become international in nature.

There are probably many more subjects of this kind that could be studied. Those mentioned above could use the data presented in this and other studies as the beginning point. The problems related to injuries at the work site need to be solved. Any progress in the areas mentioned in this paper would be a boon to all of mankind.
CHAPTER BIBLIOGRAPHY


BIBLIOGRAPHY

Books


Articles


Reports


Unpublished Materials


Other sources