The Effects of Part-Training on Cardiopulmonary Resuscitation Skill Acquisition and Retention

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THE EFFECTS OF PART-TRAINING ON CARDIOPULMONARY RESUSCITATION SKILL ACQUISITION AND RETENTION

by

David William Hagedorn

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Submitted to the
Faculty of The Graduate College
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requirements for the
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David William Hagedorn
THE EFFECTS OF PART-TRAINING ON CARDIOPULMONARY RESUSCITATION SKILL ACQUISITION AND RETENTION

David William Hagedorn, M.A.
Western Michigan University, 1994

Many thousands of lives could be saved annually in America with the prompt and correct execution of cardiopulmonary resuscitation (CPR). The bystander is a vital resource in the basic treatment of an out-of-hospital cardiac arrest. However, studies have demonstrated that not only is retention of these lifesaving CPR skills poor, but initial acquisition of the CPR skills during training may be inadequate. This paper reviews methods and tools for CPR training, discloses areas of retention loss, and proposes solutions to be explored with further empirical research. With critical skills like CPR, the urgency to better train lay people and medical personnel is great. The goal of CPR training is to teach a skill that can be utilized at a moment's notice in a real cardiac or respiratory arrest emergency. Currently this goal is not being adequately met.
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CHAPTER I

INTRODUCTION

Background of the Problem

The leading cause of death in America is cardiovascular disease which accounts for nearly 1 million deaths annually. It is estimated that over 5 million years of potential life are lost owing to cardiovascular disease in the United States alone each year (AHA, 1992). One strategy that holds promise for reducing the mortality associated with cardiovascular disease involves the application of basic cardiac life saving skills known as CPR (cardiopulmonary resuscitation). Thompson, Hallstrom, and Cobb (1979) suggested that as many as 200,000 lives could annually be saved in America with the proper and timely execution of cardiopulmonary resuscitation (CPR). The American Heart Association has embodied the need for more aggressive community action in an effort to increase the number of persons trained in CPR, thereby increasing the number of lives saved (AHA, 1992).

Timely provision of Advanced Cardiac Life Support (ACLS) within minutes of a heart attack is critical for the prevention of significant brain cell damage. Brain damage begins if a victim’s heart and breathing have been interrupted for a period of 4 to 6 minutes, and after 10 minutes brain death is certain (AHA, 1987c). The function of CPR is to maintain biological life long enough for definitive care to be administered (Riley, 1989). The initiation of CPR and the arrival of ACLS is critical for survival. "A stratified system of emergency cardiac care begins with CPR in the street by a layman and embraces every subsequent level of cardiac care..." (Carveth,
1974, p. 797). If CPR is initiated within 4 minutes and ACLS arrival is within 8 minutes, the victim has a 43% survival rate. The survival rate drops to 6% if CPR and ACLS is delayed past 8 minutes (Eisenberg, Bergner, & Hallstrom, 1979). The bystander is clearly a vital resource in basic treatment of an out-of-hospital cardiac arrest.

The effectiveness of CPR has been seen nationwide. For example, after implementing a large scale CPR instruction program, a city hospital recorded marked increases in survival rates of heart attack victims during that year (Robinson, 1980, p. 28). In 1985, Kaye, et al. concluded that, "Long term survival after cardiac arrest is increased two- to five-fold and brain cardiac function are preserved when bystanders initiate CPR before arrival of emergency care personnel (p. 916)." The American Heart Association has arrived at similar conclusions noting that (AHA, 1986):

Communities with large numbers of lay persons trained in BLS and a rapid response system of well-trained paramedical persons have demonstrated that more than 40% of patients with documented ventricular fibrillation out-of-hospital can be successfully resuscitated if CPR is provided promptly and followed closely by ACLS. (p. 2907)

In the absence of prompt bystander BLS, the likelihood of the paramedic response team saving the person's life is decreased (AHA, 1986; AHA, 1992).

Concern about the need for CPR training dates back as early as 1966 when the National Academy of Sciences-National Research Council (NAS-NRC) conference on CPR recommended that medical and allied professionals be trained to American Heart Association (AHA) standards of external chest compression and rescue breathing (AHA, 1987c). In 1973, the first national Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care conference, cosponsored by the AHA and NAS-NRC, recommended nationally standardized training to include the general public (AHA, 1987c). Currently, the 1992 conference
standards are being taught to medical and lay people all over the country and throughout the world (AHA, 1992).

Since 1973, over 50 million people have learned CPR (AHA, 1992). Despite this public interest, several problems still remain. People trained to perform CPR have been found to be reluctant to perform these lifesaving skills when the need arises (Riley, 1989; Genest, Levine, Ramsden, & Swanson, 1990; Sigsbee & Geden, 1990). This reluctance seems to be related to lack of motivation, fear of doing harm, inability to remember exact sequences, and poor retention of psychomotor skills (AHA, 1986). Recently, "fear of infection" and "fear of responsibility" have been identified as contributors to reluctance to perform CPR (Sigsbee & Geden, 1990). Thus, "a major training goal is for lay persons to learn and retain information concerning CPR and to be sufficiently motivated to be involved" (AHA, 1986, p. 2911).

Learning and retaining the information and skills of CPR has been a concern of researchers in medical fields, psychology, and education. There is agreement that the retention of CPR skills is so poor that it may even contribute to death or disability (Sternbach, Kiskaddon, Fossel, & Eliamstam, 1984), yet cost effective and empirically validated interventions to solve this dilemma are lacking (AHA, 1992). With the potential to save lives, CPR retention over time is critical. Both the acquisition of CPR skills to an acceptable performance criterion and the retention of those acceptable levels are yet needed.

The purpose of the research reported herein is to evaluate two approaches to training CPR skills and the retention of those skills. Some of the key literature on CPR skill acquisition and retention will be reviewed, and practical suggestions for future training and research offered. Retention and acquisition are often intertwined
by researchers, but it is important to try to separate the two as one may be the product of the other.
CHAPTER II

REVIEW OF THE RELATED LITERATURE

Acquisition

The development and dissemination of effective and reliable techniques for teaching CPR skills has been a surprisingly elusive goal. Seaman, Greene, & Watson-Perczel (1986) point out that performance problems are observed immediately after training, suggesting that "trainees may have never satisfactorily mastered CPR in the first place" (1986, p. 126). Thus, there is a need to identify effective CPR training techniques. The most recent National Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC) focused on improving the training protocol to include highlighting the multiple performance steps, providing timely feedback, and guiding practice with the mannequins (AHA, 1992).

There appears to be five important variables that may impact CPR skill acquisition: (1) modeling (2) feedback, (3) training tools (4) practice, and (5) teaching methods (Riley, 1989). Although these training strategies often overlap or are applied in combination, they will be discussed as separate elements of skill acquisition.

Modeling

An important aspect of CPR training, required by the AHA, is the demonstration of skills by the Instructor. Support for such observational learning or
modeling comes largely from motor skill and psychology research (Newell, 1991; Meier, Minirth, Wichern, & Ratcliff, 1991). When an Instructor talks through the steps of CPR while correctly performing them, the trainees are acquiring information for subsequent performance. Newell (1991) explains that it is very challenging to determine what is being conveyed in a demonstration, but a possible explanation is Bandura's (1969) proposal that much of behavior is learned by observation. In a study comparing self-training to traditional training where modeling of instructor demonstrated CPR skills took place, the authors confirmed that such traditional methods were needed to obtain and retain resuscitation skills (Breivik, Ulvik, Blikra, & Lind, 1980). The advantage of modeling through demonstration is that the nuances of CPR skills, tedious to explain verbally, can often be replicated by the observer.

Performance Feedback

Within the long history of motor skill research comes consistent support for the use of feedback in learning (Adams, 1987; Newell, 1991). Additionally, feedback is a critical component in the acquisition and maintenance of behavior skills. Skinner wrote (1953),

The reinforcement which develops must be immediate. Otherwise, the precision of the differential effect is lost. In many practical areas skilled behavior is encouraged by arranging a quick report of accomplishment. The report is needed to maintain the conditioned reinforcing power of the feedback. (p. 96)

Although they are not synonymous, feedback is thought to have behavioral functions analogous to reinforcement and punishment. Typically, instructional feedback is delivered on an intermittent schedule. Depending on the class size and the number of instructors, it may be impossible to give feedback on most or all CPR skill
components. As a result, many correct behaviors go without reinforcement and many incorrect responses will not be corrected. Never the less, skill acquisition and performance may still be observed under the intermittent schedule (Skinner, 1953).

**Training Tools**

Technological advances allowed for development of training mannequins and equipment that greatly enhance CPR skill acquisition and retention. This sanitary equipment provides immediate visual and auditory feedback on skill performance dimensions that would otherwise be unavailable. Furthermore, mannequins have been developed that provide a close simulation to a real person, thus enhancing the generalizability of skills to real people. Some of the commonly used mannequins are the Ambu Man, Torso Anne, Skillmeter Resusci Anne, Recording Resusci Anne, and ACTAR 911.

Recently, computer-based interactive video (CBIV) have been developed that provide instruction by simply turning on the system, and following the instructions. Research with CBIV shows that a significantly greater proportion of students taught by the interactive videodisc method pass basic life support on the first testing compared to students taught by traditional instruction (Lyness, 1987). The CBIV advantages are attributed to immediate audio and visual feedback and the visual reality of emergency situations (Ebner, Manning, Brooks, Mahoney, Lippert, & Balson, 1984; Hannafin, & Colamaio, 1987). But at a cost of around $25,000.00 they are too expensive for wide spread community-based training.
Adams (1987) quoted F.C. Bartlett's comment, "The common belief that 'practice makes perfect' is not true. It is practice the results of which are known [original emphasis] that makes perfect" (1991, p. 48). This suggests that skill practice without corrective feedback does not help in the skill acquisition. Practice enhances the ability to learn a complex psychomotor skill, and CPR is such a skill (Kittleson, 1987). Wynne (1986) and Riley (1989) maintain that practice is the first step and most important aspect of CPR training.

In a comparison between a four-hour, single session course, and an eight-hour course taught over three sessions, significantly higher performance scores from the long course were seen compared to the shorter course (Gombeski, Effron, Ramirez, & Moore, 1982). With respect to initial CPR skill acquisition, the 4 and the 8-hour group scored high enough to meet American Heart Association standards. Unfortunately, none of the groups were able to perform the skills to certification level a year later, and slightly more skill decay was seen in the 4-hour group. This research indicates that increased practice contributes to skill acquisition, but that skill decay after a year is still extensive.

While more practice is generally better, there are some practical limitations. This raises the question of the practical value of overtraining, which extends practice, that suggests the importance of developing effective training techniques. After surveying 100 college and non-college educated lay people, it was found that a four-hour class is all that those individuals would tolerate (Hagedorn & Curran, 1992). Curiously, most every person reported that they would attend an annual two-hour refresher course. Other findings on trainees returning for follow-up instruction and
testing show that only about 20 percent actually return (Gombeski, Effron, Ramirez, & Moore, 1982).

**Teaching Methods**

A number of different approaches to teaching CPR have been tried and encouraged by the American Heart Association (AHA, 1992), but few actual methods of teaching have been evaluated. One training method evaluated is Self-Training. The Self-Training course consists of "audiotape-recorded instructions, flip-over charts, an instruction booklet, first aid materials and a 'Resusci Anne' training mannequin" (Breivik, Ulvik, Blikra, & Lind, 1980, p. 654). Some skill acquisition is demonstrated with this method of instruction (1980), but relative maintenance of skills has not been established. A potential problem with this method is the lack of professional feedback on the CPR performance. Benefits of Self-Training may include ready access to practice, and self-pacing which does seem to have some effect on acquisition and retention (Friesen, & Stotts, 1984).

Additionally, Elaboration has been implemented to enhance skill acquisition and maintenance and is described as follows (Rivera-Tovar, & Jones, 1990):

Briefly, elaborative rehearsal is a procedure whereby individuals are provided with (a) questions about skills to be acquired, (b) explanations as to why certain responses were correct, (c) summarization of how each correct response would assist in functioning, and (d) additional opportunity for individuals to ask questions concerning the information, followed by the trainer elaborating on the correct answer if necessary. (p. 125)

Slight gains were seen in acquisition and retention, but the authors point to combining elaborative rehearsal with prompts and feedback (1990; Sternbach, Kiskaddon, Fossel, & Eliastam, 1984). A similar method called Rehearsal-Plus seems to also have significant positive effects on acquisition and retention (Jones, Ollendick, & Shinske, 1989).
The American Red Cross CPR Training protocol endorses two general teaching methods. These are the Whole approach, and the Part approach (ARC, 1993). The Whole approach is the method currently taught to instructors, thus is the primary method used to train people in CPR. It allows the student to practice the entire sequence of CPR motor skills with corrective feedback provided at the end of the sequence. The Part approach focuses on the motor skill parts that make up the entire CPR performance sequence, providing feedback and corrections after each component rather than at the end of the CPR demonstration.

Evidence for this Part or "step" method training holds promise in the training of complex tasks (Croce, & Jacobson, 1986; Mane', Adams, & Donchin, 1989). Mane', Adams, and Donchin (1989) investigated the benefits of part training compared to adaptive training on the learning of a complex perceptual-motor skill (computer-controlled video game). Adaptive training is characterized by the learner advancing from easy to hard tasks over time. If these results have generality to CPR training, they would have two important implications. First, training to criterion in a shorter amount of time is an obvious goal. Second, when performing CPR it is important to apply those CPR skills that are relevant to each individual victim. For example, one person may only require rescue breathing while another may require both rescue breathing and chest compressions.

Several researchers have investigated whole and part training methods for CPR. Utilizing the whole-training method, Seaman, Greene, and Watson-Perczel (1986) developed a system for more objectively assessing and training CPR skill acquisition called STARS (System for Training and Assessing Resuscitation Skills). In this research, the specific steps or subtasks involved in one-rescuer CPR were written and illustrated on 19 index cards (16 steps, 2 time limits, and 1 card to
indicate repetition of a sequence of steps). While trainees practiced CPR, an observer compared the performance to the steps on the cards. If a performance error or omission of any particular step was made, the observer pulled that particular card from the stack. After the completed sequence, the observer showed the cards performed correctly and incorrectly with helpful feedback. If errors were observed, the subject was asked to practice the sequence three times independently before returning for another performance trial with the observer. This is a variation on the Part-Training method in that feedback was provided on specific skills components, but the CPR demonstration was not interrupted to provide the feedback.

The control group subjects followed standard Whole-Training with an instructor who gave corrective feedback after watching the trainees practice. The STARS method demonstrated significant skill mastery and subsequent maintenance compared to the standard teaching method outlined in the BLS Instructor's Manual (AHA, 1987c). The researchers state that "STARS provides the basis for reinforcing or correcting critical aspects in the trainees' performance of CPR" (Seaman, Greene, & Watson-Perczel, 1986, p. 134). The difference between Part- and Whole-Training in this research was at the level of feedback initiation.

This is an important finding because current CPR training guidelines train instructors to provide feedback and rehearsal within a Whole-Training approach (AHA, 1992; ARC, 1993). One limitation of the STARS approach is the lack of feedback that is close in time to the relevant skills. Research needs to be done to determine if a Part-Training approach that provides immediate feedback for component skills produces more rapid or efficient CPR skill acquisition.
Retention

If a recently trained CPR graduate is unable to competently perform CPR in an emergency situation, the life of the victim may be endangered. Unfortunately, loss of CPR skills is exactly what researchers have been finding since CPR courses began. Following successful completion of a CPR class, lay people may hold a successful completion card for one year and those in medically related fields may hold cards for two years. During these extended periods, it is unlikely that there is any practice of CPR skills - even among medical personnel, and certainly nor practice with corrective feedback. An earlier literature review found that "...previous medical experience and responsibility for patient care appear to have little influence on the duration of retention" (Stembach, Kiskaddon, Fossel, & Eliastam, 1984, p. 34)

Evidence suggests that even when adequate skill acquisition, trainees still demonstrate skill retention problems (Mandel, & Cobb, 1982). Four logical questions then are, (1) how soon after initial acquisition do skills cease to be performed correctly, (2) which components of CPR performance show worse decay, (3) what can be done to maintain skills, and (4) why haven't more progressive changes been implemented.

How Soon Are Skills Lost?

Unfortunately, "a large portion of knowledge and skills is probably lost within months or weeks" of CPR training (Stembach, Kiskaddon, Fossel, & Eliastam, 1984, p. 34). Most of the loss seems to occur within a few months of skill training, and by a year the amount of CPR skill retained is half of what was initially acquired (Stembach, Kiskaddon, Fossel, & Eliastam, 1984). Other studies examined CPR skill retention loss from one month to two years, and all found the same general
results (Weaver, Ramirez, Dorfman, & Raizner, 1979; Yakel, 1989; Plotnikoff & Moore, 1989; Mandel & Cobb, 1982; Kaye & Mancini, 1986). One of the complications in quantifying the degree of skill loss is the uncertainty about the level of performance trainees have mastered after their instruction. This uncertainty is due to instructor observation rather than objective performance measures. Fortunately, a more accurate assessment tools like the Skillmeter has become available. Second, review sessions were offered prior to follow-up measures in some cases. Certainly other variables like age of trainees, access to mannequins to practice on, and even the amount of practice time during training may all affect the skill retention variable. Regardless, skill decay is evident and certain elements of CPR performance seem to decay quicker.

**Which Components Decay?**

The correct sequence of behaviors are as critical for effective implementation of CPR as psychomotor proficiency with body position and ventilation volume. The initial steps of assessing the victim for responsiveness and breathing are important as the outcome of these steps determine the next. If rescue breathing is needed, the rate and volume of breaths must also be correct. Thus, all components of the complex sequence of behaviors and decisions are crucial to the effective delivery of CPR. For example, performing flawless chest compressions without effectively assessing for a pulse is dangerous, which unfortunately is a common error (Tweed, Wilson, & Isefeld, 1980). So, not only does CPR skill involve specific sequence, it also requires proper rhythm, depth of compressions, volume of ventilations, and body position.
Yakel (1989) found CPR sequence was measured to be almost 70% incorrect only four months after training. Cardiac compressions seem to be retained at higher levels of proficiency than adequate ventilations (Sternbach, Kiskaddon, Fossel, & Eliastam, 1984). Additional deficits commonly observed in CPR retention studies include absence of pulse check, hand placement on the sternum, ventilation volume, compression ratio, and opening the airway to assess for breathing (Mandel & Cobb, 1982; Yakel, 1989; Sternbach, Kiskaddon, Fossel, & Eliastam, 1984; Tweed, Wilson, & Isefeld, 1980).

The main influence on skill decay was the amount of time since the person's last training. Other variables that had an influence were, the level of skill achieved at the time of training (a higher initial score was likely to lead to a higher retest score), the age of trainees (older trainees showed more skill decay), and sex of trainees (female trainees showed more skill decay) (Glendon, McKenna, Hunt, & Blaylock, 1988).

What Can Be Done?

Some attempts to improve retention have been made. Home CPR refresher videos like the American Lung Association video "Emergency Action: Lifesaving First Aid for the Whole Family", (Acti Video, 1989), are available in libraries and video rental businesses. While these videos would seem to be helpful in maintaining previously acquired skills, no empirical research to validate the retention benefits of video modelling and instructions have been reported. Additional research to determine what interventions would delay the loss of CPR skill is badly needed.

Many researchers have suggested that more frequent refresher courses be offered (Mandel & Cobb, 1982; Yakel, 1989; Breivik, Ulvik, Blikra, & Lind, 1980;
Glendon, McKenna, Hunt, & Blaylock, 1988). Mandel and Cobb (1982) found that a one-hour review class with mannequin practice for those previously trained a year earlier showed significantly better skill competency compared to those without the refresher. A problem with refresher courses is that trainees are reluctant to attend such courses every six months (Hagedorn & Curran, 1992), especially since many course completion cards do not expire for up to two years.

In summary, cardiopulmonary resuscitation involves a complex psychomotor skills sequence that must be trained to high levels of proficiency and maintained at that level for long periods of time in spite of few or no opportunities to apply those skills and receive corrective feedback. Given a brief period of time to train in each CPR class session, each minute must be used to help teach the skills to mastery level. Several teaching methods were reviewed, of which Part-Training appears to be the most promising for further investigation (Croce, & Jacobson, 1986; Mane', Adams, & Donchin, 1989). Other work in the area of skill refresher methods also show promise and need further research (Mandel & Cobb, 1982; Yakel, 1989; Breivik, Ulvik, Blikra, & Lind, 1980; Glendon, McKenna, Hunt, & Blaylock, 1988).

The goal of the research herein was to evaluate the efficacy and efficiency of a variation on the Part-Training method and compare it to the standard, AHA-approved Whole-Training method. Additionally, the retention of CPR skills was investigated under a refresher training condition and compared to subjects who did not receive refresher training.
CHAPTER III

METHODS

Subjects

The study was conducted at the Western Michigan University health center in Southern Michigan. The researcher teaches cardiopulmonary resuscitation (CPR) throughout the year at this health center where students and faculty regularly sign up to take the many offered class. Those who called the health center to sign up for a class were told that they "may have the option of participating in a CPR research study in addition to being trained in CPR". Those interested were called prior to the class and asked to attend 20 minutes early on the evening of the class. When they arrived that evening, those interested in the study were handed both a study description and informed consent form (Appendix A) which was then fully explained. In the first class of 15 students, 13 were interested in participating as subjects. In the second class of 14, 11 were interested. The potential subjects were screened for prior CPR training two years prior to that evening. This screening left 10 eligible subjects from the first class, and 8 eligible from the second. Eight of the ten in the first class were randomly selected to be part of the experimental group. In the second class only eight were willing to participate, all of whom were included as subjects for the control group.

The eight selected subjects from both classes were individually, separate from the others who waited in the hall, asked to "perform CPR on the Skillmeter Resusci
Anne as best as they could". Each person was also told that the purpose of this initial test was to determine their CPR skills before training.

Special times and locations were offered in order to meet all the subjects for follow-up sessions. While the days and times varied across subjects, the setting for all follow-up trials remained the same. No subject terminated their voluntary involvement in the study and were given first aid kits, a CPR pocket protective mask, and $5.00 upon completion of the final follow-up session. Refresher courses were given to all subjects by the end of the study.

The experimental group consisted of 3 males and 5 females. The control group consisted of 2 males and 6 females. All of the subjects were undergraduate students at Western Michigan University. The approximate age of the subjects was 19 or 20 years old.

The course instructor was an American Heart Association certified Basic Cardiac Life Support Instructor, an Instructor-Trainer, and an American Red Cross certified Cardiopulmonary Resuscitation and First Aid Instructor who taught over 100 students the preceding year.

**Materials**

All classes included an outlined lecture, a CPR training video, and demonstration of the performance steps by the instructor in accordance with American Heart Association curriculum criteria for "Course A: Adult Heartsaver". Initial baseline performance measures were taken prior to these training components using the Skillmeter Resusci Anne and printer manufactured by Laerdal Medical Corporation. Four mannequins and one printer were used.
Lecture

Introductory comments stressed that the class would be informal. Students were encouraged to ask questions at any time, then told the outline for the four-hour course. The outline was as follows:

A. Heart disease and related problems statistics.
B. Basic physiology of cardiopulmonary function.
C. Sign and symptoms of a heart attack and what to do in case of a suspected heart attack.
D. Risk factors for heart disease.
E. "Prudent Heart Living" (healthy behaviors)
F. Video tape: "CPR for Rescuers" by Laerdal Medical Corporation
G. BREAK TIME
H. Airway obstruction management for conscious and unconscious victims.
I. Instructor demonstration of conscious and unconscious airway obstruction management. Instructor demonstration of CPR.
K. Written test.

Video Training

The video shown was called, "CPR for Rescuers" (Gordon, 1992). This video reviewed the steps of rescue breathing, CPR, and foreign body airway obstruction management, in the form of text displays on the screen and actors demonstrating the skills. The video concluded with a portrayal of a real heart attack.
and cardiac arrest emergency where the victim's wife performed CPR until police an ambulance arrived to perform advanced cardiac life support skills.

**Skill Performance Demonstration**

The instructor first demonstrated foreign body airway obstruction management skills, then re-explained that CPR was the technique used when no breathing and no pulse are present. It was explained that in some cases chest compressions are not needed (when a pulse is present) and only rescue breathing would be needed (when no breathing is present). From this, CPR was demonstrated twice. The first time, the instructor talked through the steps, telling the students what he was doing. The second time, he performed it from start to finish without interruption.

**Assessment of CPR Performance**

According to the American Heart Association criteria for "Adult One-Rescuer CPR", four categories of CPR performance must be evaluated in each course (AHA, 1987). These are sequencing, timing, ventilations, and compressions as seen in the "Critical Performance" section of Figures 1 and 2.

**Sequencing**

Sequencing must be exact except for "Call for Help" and "Activate the EMS system." Omission of any of the steps is a failure. The correct sequence is as follows:

1. Determine unresponsiveness.
2. Call for help.
<table>
<thead>
<tr>
<th>Step</th>
<th>Objective</th>
<th>Critical Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AIRWAY</td>
<td>Assessment: Determine unresponsiveness</td>
<td>Tap or gently shake shoulders.</td>
</tr>
<tr>
<td></td>
<td>Call for help.</td>
<td>Shout &quot;Are you OK?&quot;</td>
</tr>
<tr>
<td></td>
<td>Position the victim.</td>
<td>Turn on back as unit, if necessary, supporting head and neck (4-10 sec.)</td>
</tr>
<tr>
<td></td>
<td>Open the airway.</td>
<td>Use head-tilt/chin-lift maneuver.</td>
</tr>
<tr>
<td>BREATHING</td>
<td>Assessment: Determine breathlessness</td>
<td>Maintain open airway.</td>
</tr>
<tr>
<td></td>
<td>Ventilating twice.</td>
<td>Ear over mouth, observe chest: look, listen, feel for breathing (3-5 sec.)</td>
</tr>
<tr>
<td></td>
<td>Assessment: Determine pulselessness</td>
<td>Maintain open airway.</td>
</tr>
<tr>
<td></td>
<td>Activate EMS system.</td>
<td>Seal mouth and nose properly.</td>
</tr>
<tr>
<td></td>
<td>Begin chest compressions.</td>
<td>Ventilate 2 times at 1-1.5 sec/inspiration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise (adequate ventilation volume)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow deflation between breaths</td>
</tr>
<tr>
<td>2. CIRCULATION</td>
<td>Assessment: Determine pulselessness.</td>
<td>Feel for carotid pulse on near side of victim (5-10 sec)</td>
</tr>
<tr>
<td></td>
<td>Activate EMS system.</td>
<td>Maintain head-tilt with other hand.</td>
</tr>
<tr>
<td></td>
<td>Begin chest compressions.</td>
<td>If someone responded to call for help, send him/her to activate EMS system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rescuer kneels by victim's shoulders.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landmark check prior to hand placement.</td>
</tr>
<tr>
<td>3. Compressions</td>
<td></td>
<td>Proper hand position throughout.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rescuer's shoulders over victim's sternum.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equal compression-relaxation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compress 1 1/2 to 2 inches.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keep hands on sternum during upstroke.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complete chest relaxation on upstroke.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Say any helpful mnemonic (&quot;One-and-two-and...&quot;).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compression rate: 80-100/min (15 per 9-11 sec).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise: 1-1.5 sec/inspiration; 4 cycles/52-73 sec.</td>
</tr>
<tr>
<td>Repeat steps 1-4 at least twice.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Reassessment*</td>
<td>Determine pulselessness.</td>
<td>Feel for carotid pulse (5 sec). If no pulse Continue CPR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise: 1-1.5 sec/inspiration.</td>
</tr>
<tr>
<td></td>
<td>Resume compression/ventilation cycles.</td>
<td>Feel for carotid pulse every few minutes.</td>
</tr>
</tbody>
</table>

Figure 1. Adult One-Rescuer CPR Performance Sheet: Part-Training Method.
**Adult One-Rescuer CPR**

<table>
<thead>
<tr>
<th>Step</th>
<th>Objective</th>
<th>Critical Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRWAY</td>
<td>Assessment:</td>
<td>Tap or gently shake shoulders.</td>
</tr>
<tr>
<td></td>
<td>Determine unresponsiveness</td>
<td>Shout &quot;Are you OK?&quot;</td>
</tr>
<tr>
<td></td>
<td>Call for help.</td>
<td>Call out &quot;Help!&quot;</td>
</tr>
<tr>
<td></td>
<td>Position the victim.</td>
<td>Turn on back as unit, if necessary,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>supporting head and neck (4-10 sec.)</td>
</tr>
<tr>
<td>BREATHING</td>
<td>Assessment:</td>
<td>Maintain open airway.</td>
</tr>
<tr>
<td></td>
<td>Determine breathlessness</td>
<td>Ear over mouth, observe chest: look, listen, feel for breathing (3-5 sec.)</td>
</tr>
<tr>
<td></td>
<td>Ventilate twice.</td>
<td>Maintain open airway.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seal mouth and nose properly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ventilate 2 times at 1-1.5 sec/inspiration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise (adequate ventilation volume)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow deflation between breaths</td>
</tr>
<tr>
<td>CIRCULATION</td>
<td>Assessment:</td>
<td>Feel for carotid pulse on near side of victim (5-10 sec)</td>
</tr>
<tr>
<td></td>
<td>Determine pulselessness.</td>
<td>Maintain head-tilt with other hand.</td>
</tr>
<tr>
<td></td>
<td>Activate EMS system.</td>
<td>If someone responded to call for help, send him/her to activate EMS system.</td>
</tr>
<tr>
<td></td>
<td>Begin chest compressions.</td>
<td>Rescuer kneels by victim's shoulders.</td>
</tr>
<tr>
<td></td>
<td>Compressions</td>
<td>Landmark check prior to hand placement.</td>
</tr>
<tr>
<td></td>
<td>Proper hand position throughout.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rescuer's shoulders over victim's sternum.</td>
<td></td>
</tr>
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<td></td>
<td>Equal compression-relaxation.</td>
<td></td>
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<tr>
<td></td>
<td>Compress 1 1/2 to 2 inches.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Keep hands on sternum during upstroke.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete chest relaxation on upstroke.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Say any helpful mnemonic (&quot;One-and-two-and...&quot;.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compression rate: 80-100/min (15 per 9-11 sec).</td>
<td></td>
</tr>
<tr>
<td>Compression and</td>
<td>Do 4 cycles of 15 compressions and 2 ventilations.</td>
<td>Proper compression/ventilation ratio:</td>
</tr>
<tr>
<td>Ventilation Cycles</td>
<td></td>
<td>15 compressions to 2 ventilations per cycle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise: 1-1.5 sec/inspiration;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 cycles/52-73 sec.</td>
</tr>
<tr>
<td>Reassessment*</td>
<td>Determine pulselessness.</td>
<td>Feel for carotid pulse (5 sec). If no pulse Continue CPR</td>
</tr>
<tr>
<td>Continue CPR</td>
<td>Ventilate twice.</td>
<td>Ventilate 2 times.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observe chest rise: 1-1.5 sec/inspiration.</td>
</tr>
<tr>
<td></td>
<td>Resume compression/ventilation cycles.</td>
<td>Feel for carotid pulse every few minutes.</td>
</tr>
</tbody>
</table>

Figure 2. Adult One-Rescuer CPR Performance Sheet: Whole-Training Method.
3. Position the victim.
4. Open the airway.
5. Determine breathlessness.
6. Ventilate twice.
7. Determine pulslessness.
8. Activate the EMS system.
10. Recheck the pulse.
11. Ventilate twice.
12. Resume compressions/ventilations cycles.

Timing

From step 1 (determine unresponsiveness) to step 8 (activate the EMS system) 15 to 35 seconds is the time range allowed for correct performance. For the four cycles of compressions/ventilations, with 10% error range, the 50 to 76 second range is acceptable. For the initial pulse check, the check must last at least 5 seconds with an allowed range of 5 to 10 seconds.

Ventilations

During the one-rescuer sequence, a total of 12 ventilations are given; 2 ventilation errors are acceptable. Ventilation errors include the following: (a) incorrect number of ventilations, (b) omissions of ventilation, (c) incorrect volume, (d) not allowing total exhalation between breaths, and (e) too fast (less than 1.0 second) or too slow (more than 1.5 seconds). The ideal ventilation volume has
shown to be .8 to 1.2 liters, but learners are not failed for registered volume measure outside these acceptable parameters.

Compressions

During the one-rescuer sequence, a total of 60 compressions are given; 6 compression errors will be allowed. Compression errors include the following: (a) incorrect hand placement, (b) depth of compression too shallow or too deep, (c) pressure maintained on chest during relaxation (upstroke), (d) hand lifted off chest during relaxation, (e) incorrect number of compressions per cycle, (f) approximately equal compressions: ventilation ratio (50% each), and (g) improper ratio.

The intention of the American Heart Associations certain allowance for performance error is to have as many lay people trained to perform the basic skills to save a life as possible. While the above AHA performance criteria for the four categories allow a student to make certain errors and still pass the course, a need within this research was to measure all errors made in these categories.

Apparatus Used

The measurement device used in this study was the "Skillmeter Resusci Anne" developed by Laerdal Medical Corporation. It's jaw could be opened, and it's head and neck could be extended and rotated. The chest cavity contained an inflatable synthetic lung and a large spring which returned the chest wall to its normal contour following chest compressions. The Skillmeter is a sensorized full body length mannequin (35 1/2" x 13" x 19 1/2") with a computerized LCD monitor. Sensors in the mannequin are activated when CPR is performed. The Skillmeter device receives indication from the mannequin sensors that CPR measures including check of
responsiveness, breathing and pulse have been performed. Feedback is visible on the
LCD screen both during performance and after. During performance the screen will
display depth of each compression, volume of each ventilation, incorrect or correct
hand positioning, total number of compression and ventilation given, rate of
compressions, and compression/ventilation ratio. Along the bottom of the screen is a
time line to identify the sequence and timing of steps. After CPR performance is
complete for one cycle lasting approximately two minutes, a touch of a button
provides a visual performance analysis of the overall CPR performance trial in terms
of total percent correct of compressions and ventilations, total number and type of
ersors, and a timing and sequence record.

Experimental Procedures

At the first class meeting, the instructor introduced himself and provided an
outline for the course and experiment. All the students were provided and asked to
read the "Basic Life Support Heartsaver Guide" course book up to a week prior to the
first class. Before any formal instruction began each subject was taken aside, out of
sight of the others, and asked to perform CPR on the Skillmeter mannequin as best as
they could. Following this individual baseline measure, the course material was
presented in the form of lecture, video taped instruction ("CPR For Rescuers" by
Laerdal), demonstration, and subject involvement through practice.

Because only two Skillmeter mannequins and one printer were available,
identical Resusci Annes without the recording features of the Skillmeter were also
used. For the final post-test measure, all subjects performed on the Skillmeters while
some of the students finished taking the written test or observed the CPR
performances. Two subjects at a time performed CPR on the Skillmeter with the
LCD performance feedback screen visible only to the instructor. Unlike the post-test conducted in a group, the pre-test and follow-up tests were conducted individually.

Independent Variables

Both the experimental and control groups were exposed to these above stated training methods. They differed in the actual method of mannequin practice. One method of practice used was the standard training method indicated by the American Heart Association and American Red Cross (AHA, pg 89, 1987c). This can be referred to as Whole-Training (Figure 2). The second was the experimental method to be referred to as Part-Training (Figure 1). Figures 1 and 2 show that the two groups experienced the same sequence of training and evaluation with the only exception being the two differing practice training methods.

Whole-Training vs. Part-Training

Whole-Training

Each subject is asked to kneel in front of their Skillmeter Anne. The instructor asks a participant to volunteer to begin practice. Subjects then practice with the instructor observing and making corrective comments and praising correct performance as seen. After practice is over the subjects perform for the instructor and a printout of that performance cycle is made. This outcome measure represents what skills were initially acquired following the instruction and practice. This approach is referred to as "Whole-Training" because the entire sequence of CPR performance is viewed as a "whole". With this method, feedback is provided after the "whole" performance. Prompts during the performance may be intermittently given, but generally the bulk of corrective or praise feedback is offered at the end of the
performance; followed by another attempt by the student to perform CPR correctly.

Practice generally takes the form of numerous trials with feedback at the end of each trial.

**Part-Training**

Unlike with Whole-Training, the strategy in Part-Training is to isolate the CPR steps that make up the complete sequence. Errors in performance observed by the instructor are immediately identified and the group will together practice that particular step. For example, if the step being practiced incorrectly is "location of the pulse", the instructor will again demonstrate to the group exactly where and when the pulse is to be obtained; then the group will go back and practice that step before moving on. Likewise, when a step is performed well, the instructor provides specific and immediate praise. This training method is called "Part-Training" because it trains all the parts of the CPR performance sequence individually.

Specifically, each subject is asked to kneel in front of their Skillmeter Anne. The instructor informs the subjects that they will be performing CPR on the Skillmeter Annies together as a group and that they will take directions from the instructor. Table 1 shows the sequence of the presented situation, coaching or helpful prompts from the instructor, and expected responses from the subjects.

The instructor begins by presenting the situation saying, "Ok, you come upon a victim and don't know what is wrong. What do you do? You want to 'shake and shout for help'. Do it." While the subjects assess for responsiveness by shaking and shouting, the instructor says, "Do you know if the person is breathing? Go ahead and open the airway with the Head-Tilt-Chin-Lift method and look, listen, and feel for breathing." The instructor then tells them to take their time and be sure their is no
Table 1
Part-Training: Stimulus-Response-Prompt Sequence

<table>
<thead>
<tr>
<th>STIMULUS</th>
<th>RESPONSE</th>
<th>PROMPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment: A CPR manikin for each subject is lying on its back on the floor.</td>
<td>Kneel on a side of the manikin.</td>
<td>Kneel next to the manikin.</td>
</tr>
<tr>
<td>Ok, you come upon a victim and don't know what is wrong? What do you do?</td>
<td>Shake the victim on the shoulder, and shout for help.</td>
<td>Shake and shout.</td>
</tr>
<tr>
<td>Do you know if the person is breathing?</td>
<td>Open the airway with head-tilt/chin-lift method and look, listen, and feel for breathing.</td>
<td>Open the airway with head-tilt/chin-lift. Look, listen, and feel for breathing.</td>
</tr>
<tr>
<td>No breathing is observed.</td>
<td>&quot;Two breaths&quot; Give two full breaths so the chest rises and falls.</td>
<td>What does the person need?</td>
</tr>
<tr>
<td>&quot;Stop.&quot; Nice job. Let's start from the beginning.</td>
<td>Subjects stop and look up.</td>
<td>Give two breaths.</td>
</tr>
<tr>
<td>Ok, you come upon a victim and don't know what is wrong? What do you do?</td>
<td>Shake the victim on the shoulder. Head-tilt-chin-lift method</td>
<td>Open the airway with head-tilt/chin-lift.</td>
</tr>
<tr>
<td>No breathing is observed.</td>
<td>Give two full breaths using mouth-to-mouth resuscitation.</td>
<td>What does the person need?</td>
</tr>
<tr>
<td>Does the person have a pulse?</td>
<td>Tips of the fingers placed on the carotid artery on the side of the neck that the subject is kneeling.</td>
<td>An artery is located next to the Adam apple. Press in lightly.</td>
</tr>
<tr>
<td>Locate the carotid artery on the side that you are on to find out.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take your time. This is an important step.</td>
<td>Subjects keep checking for around 5-10 sec.</td>
<td>Keep checking.</td>
</tr>
<tr>
<td>No pulse is present.</td>
<td>&quot;Help&quot; or &quot;Call EMS&quot;</td>
<td></td>
</tr>
<tr>
<td>Ok, locate the &quot;landmark&quot; and hold it until I can come and check each persons location.</td>
<td>Subjects hold their hands in position to do CPR.</td>
<td></td>
</tr>
<tr>
<td>Get in position to begin compressions.</td>
<td>Knees are about shoulder width apart; fingers are interlace with the heel of the hand two fingers width above the tip of the xyphoid process; elbows locked, arms straight; arms pressing straight down over the sternum.</td>
<td>Place your knees about shoulder width apart, interlace your fingers with the heel of your hand two fingers width above the tip of the xyphoid process, lock your elbows to keep your arms straight, your arms should be pressing straight down over the sternum.</td>
</tr>
<tr>
<td>On my count, begin compressions at a rate I will set for you. When I say, &quot;one&quot;, begin compressing, and when I say, &quot;and&quot; you should be releasing the compression or coming up. Ready, &quot;one...and..two...and three...and...four...and&quot;.</td>
<td>The chest of the manikin is compressed 1 1/2 - 2&quot; as soon as the instructor says, &quot;one...&quot;, and released when the instructor says, &quot;and&quot;. Subjects count out loud with the instructor.</td>
<td>Stay with me. Specific prompts are now directed to individual subjects who perform in error. Feedback on correct performance is given individually and as a group.</td>
</tr>
<tr>
<td>&quot;Stop.&quot; Nice job. Let's start from the beginning.</td>
<td>Subjects stop and look up.</td>
<td></td>
</tr>
<tr>
<td>Ok, you come upon a victim and don't know what is wrong? What do you do?</td>
<td>Subjects begin by shaking and shouting</td>
<td></td>
</tr>
<tr>
<td>Start on your own.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Now give two breaths. Continue compressions.</td>
<td>Without moving the knee placement, the subjects give two breaths.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The 15 compressions to 2 breaths continue until this is done 4 times.</td>
<td></td>
</tr>
<tr>
<td>&quot;Stop.&quot; Nice job. Let's start from the beginning.</td>
<td>Subjects stop and look up.</td>
<td></td>
</tr>
<tr>
<td>Ok, you come upon a victim and don't know what is wrong? What do you do?</td>
<td>Subjects begin by shaking and shouting</td>
<td></td>
</tr>
<tr>
<td>Start on your own.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ok, 4 sets of compressions and ventilations are given. Now check the pulse. (pause) No pulse and no breathing.</td>
<td>Give two full breaths.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Another four sets of 15:2 are done.</td>
<td>First get air into the lungs, then pump the oxygenated blood using compressions. Feedback is given individually.</td>
</tr>
<tr>
<td>Ok, the EMT’s came to take over.</td>
<td>Subjects stop.</td>
<td>Stop. The EMT’s will jump and takeover.</td>
</tr>
</tbody>
</table>
breathing. He then says, "Ok, no breathing. What does the person need?" Waiting for at least one person to respond with "Two breaths", the instructor then says, "Go ahead and give the person the two needed breaths." After the subjects inflate the lungs, the instructor tells them to "stop". They look up and he tells them "nice job, now take it from the top." "Shake and shout." They are told to continue by themselves. During this and following independent practice phases, the instructor makes specific corrective and praise comments to each individual. This requires the instructor to watch all the students very carefully. This can be done when the number of mannequins being practiced on at any one time is about five. With large classes, the instructor breaks the class into two or three groups of four or five (depending on how many mannequins are available). Some students take the written test, others take a break, and the rest practice on the manikins.

Once the subjects inflate the lungs the instructor asks, "Does the person have a pulse? Go ahead and find out by placing your fingers on the carotid artery on the side that you are kneeling to feel for a pulse." Waiting a few seconds and observing that the subjects locate the correct point to place their finger tips, he advises, "Be sure to take your time and check the pulse very carefully." Waiting a few more seconds he says, "Ok, there is no pulse. What does the person need?" Waiting for someone to say "a pulse" or "compressions", the instructor tells them to "Locate the landmark and hold it so I can check to make sure you are in the correct place." The instructor goes to each subject and individually helps the subject find the correct place. After all have found the correct location for compressions, the instructor tells them, "Place your knees about shoulder width apart, interlace your fingers with the heel of your hand two fingers width above the tip of the xyphoid process, lock your elbow to keep your arms straight, your arms should be pressing straight down over the sternum. Now,
on my count, begin compressions at the rate I will set for you. Count with me. One..and..two..and..three..and..four..and..five..and..six..and..seven; ok, that enough. Lets start over from the very beginning." The instructor then tells them to go ahead while watching and stopping the group if a problem comes up. When they have performed the sequence of skills up to the point of hand placement on the sternum, the instructor begins to count as before but continues to count up to fifteen then says, "now give two breaths and continue compressions." The instructor counts with the subjects to keep their rate even and consistent, but as they go along he occasionally stops counting outloud listening only to the counting of the subjects. By the last set of fifteen compressions and two breaths the instructor is mostly silent other than occasional praise for correct performance such as "Great form on compressions" or "Nice transition from compressions to breaths." At the end of the four cycles of 15:2, the instructor gives the subjects a brief break to stand up. At the end of the next trial that ends after 4 sets of 15 compressions and 2 breaths (about 1 minute), the instructor tells the subjects to "check the pulse to see if a pulse has returned." Waiting a few seconds, he says, "No pulse. What should you do?" Then he says, "Because of the pause between your last 2 breaths, give 2 more and then give compressions." After the instructor sees that the students are still performing correctly he tells them to "stop and take a break".

Then he says, "Ok, you come upon a victim who looks to be in some trouble. Do what you have been trained to do." The subjects get down and perform the skills with only minor amounts of coaching to keep them performing correctly. Once they have finished performing the skills completely on their own, the instructor asks them to do it again without any coaching. This last trial yields a printout from the Skillmeter. This is considered to be the initial acquisition measure.
Refresher vs. No Refresher Training

As displayed in Figure 3, following the initial post-test to determine initial skill acquisition, a four week post-test session was scheduled for both groups on different days. Both the experimental group and control group were randomly assigned to a refresher course or a no-refresher course follow-up at the 4-week probe. Half of the experimental group and control group returned after four weeks for a performance trial on the Skillmeter followed by feedback and a five minute refresher course to strengthen their skills. The other half came to perform the performance trial on the Skillmeter and then left. It should be noted that all subjects performed on the Skillmeter with only the instructor present. No coaching was offered prior to or during the performance trial; nor could the "no-refresher" subjects see their performance display on the monitor while performing or after. The purpose here was to determine to what extent skill retention decreased from the initial training to the four week mark, and then from initial training to the eight week mark with and without refresher instruction. At the eight-week post-test session, the no refresher subjects from both groups were given skill refresher instruction as a courtesy to help them perform CPR more effectively.

Refresher

Upon the subjects arriving at the Health Center, each was individually given the same initial situation as printed on Table 1. The subject walked up to the Skillmeter mannequin and the instructor said, "Ok, you come upon a victim and don't know what is wrong? What do you do?" After the subject's attempt is complete, the instructor shows the person the performance results on the LCD screen and explains
Volunteers From CPR Course

PRE-TEST

Part-Training Method

POST-TEST

4-WEEK POST-TEST

Refresher

8-WEEK POST-TEST

Refresher

No Refresher

Whole-Training Method

POST-TEST

4-WEEK POST-TEST

Refresher

8-WEEK POST-TEST

Refresher

No Refresher

Figure 3. CPR Training and Skill Evaluation Flowchart.
what was done correctly and incorrectly. The subject then is allowed to perform CPR on the manikin again with feedback from the instructor during this practice attempt. Then, the instructor dismisses the subject and repeats the same steps with the next subject.

No refresher

Half from each group were assigned to the no refresher element. They were not given feedback or additional instruction. To avoid irritating them with this loss, the instructor first told them when they entered the room that they would have to perform CPR as best as they could and that after the eight week session they would be given refresher instruction to help them perform CPR better. At this point, the instructor gave the same situation as was given to the other subjects. When the subjects finished the single trial of four repetitions of fifteen compressions to two breaths, and looked up indicating completion, the instructor thanked them and walked them to the door.

Experimental Design

Because between-group comparisons are especially useful when the experimenter is interested in comparing treatments, this is the design of choice for this experiment (Kazdin, 1982). The design allowed both between group and repeated measure comparisons of CPR skill performance. Eight subjects served as controls by remaining in the standard training program throughout the experiment, while comparative data was obtained from the eight subjects who remained in the part-training group. Within both groups the effects of refresher courses on follow-up skill performance were evaluated.
The total number of subjects were assigned to the control and experimental groups randomly. Pre- and post-measures of CPR performance were obtained. A four-week post-test was then given with the additional variable of a refresher and a no refresher session for both groups randomly split within each group. Finally, an eight-week post-test was conducted and the no refresher subjects were at this time given the skill refresher instruction after their post-test.
CHAPTER IV

RESULTS

Compression Performance

Pre-Test

Figure 4 depicts the mean scores for compression performance of both Part-Trained and Whole-Trained groups. Prior to any CPR training, both groups were given a pre-test on the mannequin. Raw score percentages for the Part-Trained group ranged from 0 to 44% (Table 2). The mean was 16.63%. The Whole-Trained group scores ranges from 0 to 70% with a mean of 16.5%. Scores were generally low in spite of instructions to read the CPR text prior to the first class during which pre-test measures were taken.

Post-Test

Following the CPR training for both groups, significant performance increases were noted. The post-test scores for the Part-Trained group ranged from 68 to 98% correct, with a mean of 85.88. Among the Whole-Trained group the range was 70 to 99% with a mean of 86.63. In Figure 5 the score change from pre- to post-test were so similar that they nearly overlapped. At this point no significant skill acquisition differences could be seen between the two training methods.
4-Week Follow-Up

At the 4-week performance measure, both groups showed similar decrements in performance relative to their post-test scores. The Part-Trained group had a range of scores from 0 to 95%, and a mean of 48.25. Three of the eight subjects performed compressions so poorly that they would not have passed a CPR course. Whether or not they would be able to save a victim of cardiac or respiratory arrest is unknown. The range of the Whole-Trained group was 0 to 100% with a mean of 48.13. Four of the eight subjects performed compressions so poorly that they would not have passed a CPR course.

Figure 4. Compression Performance Means Across Groups.
8-Week Follow-Up

Half of the subjects in each group were given refresher instructions to correct their performance errors and obtain a bit more practice with feedback from the instructor. Shown in Figure 4, both the Part- and Whole-Trained groups were split after the 4-week measure with half of each group participating in a brief refresher course. All the subjects, those with and without the refresher, were given a CPR performance test at the 8-week follow-up session. The compression score means at this 8-week measure point are based on only four subjects per data point. Subjects in both Part- and Whole-Training groups who were exposed to the 4-week refresher

![Graph showing ventilation performance means across groups.](image)

Figure 5. Ventilation Performance Means Across Groups.
Table 2

Individual Compression and Ventilation Performance Percentages:
Part-Trained Group A

<table>
<thead>
<tr>
<th>PART-TRAINING GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>COMPRESSION PERFORMANCE DATA</td>
</tr>
<tr>
<td>Subjects</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>A1</td>
</tr>
<tr>
<td>A2</td>
</tr>
<tr>
<td>A3</td>
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<td>A6</td>
</tr>
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<td>A7</td>
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<tr>
<td>A8</td>
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<p>| VENTILATION PERFORMANCE DATA |</p>
<table>
<thead>
<tr>
<th>Subjects</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>4-wk FU</th>
<th>8-wk FU</th>
<th>(Refresher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
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<td>70</td>
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<td>100</td>
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<tr>
<td>A2</td>
<td>10</td>
<td>80</td>
<td>88</td>
<td>75 R</td>
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</tr>
<tr>
<td>A3</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>67</td>
<td>90</td>
<td>70</td>
<td>80 R</td>
<td></td>
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<td>90</td>
<td>98</td>
<td>89 R</td>
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</tr>
<tr>
<td>A7</td>
<td>0</td>
<td>80</td>
<td>76</td>
<td>60</td>
<td></td>
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<tr>
<td>A8</td>
<td>25</td>
<td>88</td>
<td>76</td>
<td>84</td>
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Table 3

Individual Compression and Ventilation Performance Percentages:
Whole-Trained Group B

WHOLE-TRAINING GROUP

**COMPRESSION PERFORMANCE DATA**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Pre-test</th>
<th>Post-test</th>
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<th>8-wk FU (Refresher)</th>
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<tbody>
<tr>
<td>B1</td>
<td>0</td>
<td>90</td>
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<td>B2</td>
<td>33</td>
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<td>70</td>
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<td>B3</td>
<td>7</td>
<td>80</td>
<td>22</td>
<td>95 R</td>
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<td>70 R</td>
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**VENTILATION PERFORMANCE DATA**

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<th>Subjects</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>4-wk FU</th>
<th>8-wk FU (Refresher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>20</td>
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<tr>
<td>B2</td>
<td>100</td>
<td>90</td>
<td>57</td>
<td>75</td>
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<td>B3</td>
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<td>100</td>
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<td>100</td>
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<tr>
<td>B8</td>
<td>0</td>
<td>75</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
training improved their performance above the level at the 4-week measure. On the 8-week compression performance trial, the Part-Trained subjects who had the refresher training average 65%, with a range of 46 to 95%. From the 4-week measure the range decreased and the mean performance percent increased by 35% or 16.75 percentage points. Those from that group who did not have the refresher instruction scored between 10 and 48% with a mean of 32.75. This performance mean was a decrease from the 4-week measure by 15.5 percentage points (32%).

The Whole-Trained group subjects who were given the refresher training also scored better than they did at the 4-week measure. Unlike the Part-Trained group, the four subjects who did not get the refresher performed almost as well as did the refresher half. The range of the Whole-Trained refresher subjects was 33 to 95%; the mean was 61.25%. This was an improved difference of 13 percentage points (27%). The range of those who did not get the refresher from that group was 48 to 72%, and mean was 60%. This was also an improved difference of 11.75 percentage points (24%).

**Ventilation Performance**

**Pre-Test**

Similar to the compression pre-test performance, ventilations were performed poorly prior to training. Figure 5 shows the mean percentage scores for the Part-Trained group to be 29.38 at pre-test. The range of scores for the part-trained group was 0 to 67%. On average the Whole-Trained group range was 0 to 100%, and the mean was 45.75%. The Whole-Trained group did perform better than the Part-Trained group prior to any training.
Post-Test

After CPR training, both the Part-Trained and Whole-Trained groups performed better. The Part-Trained group mean increased to 78.5% with a range of 30 to 100%, and the Whole-Trained group mean increased to 86.88% with a range of 74 to 100%. While the mean of the Whole-Trained group was higher than that of the Part-Trained group, a poor performance score of one of the Part-Trained subjects (30%) brought down the average. The bottom of Tables 2 and 3 show that the individual subject scores were above 70% at post-test with the exception of one subject. Without the 30% score of one subject in the Part-Trained group the average for the Part-Trained group would have been 85.43%, which is about the same as the Whole-Trained group mean.

4-Week Follow-Up

Declines in performance were seen in both groups upon the 4-week follow-up measures. The mean score of the Part-Trained group was 61% (range 0 to 98%), a decline of 17.5 percentage points (22%) from the post-test mean. The mean score of the Whole-Trained group was 57.13% (range 0 to 100%), a decline of 29.75 percentage points (34%) from the post-test mean. As with compressions, performance declines across groups were about the same.

8-Week Follow-Up

The Part-Trained subjects that received the refresher training after the 4-week measure was taken did much better at the 8-week measure, an increase from 61% at the 4-week to 77.25% at the 8-week measure. This 16.25 percentage point difference is somewhat misleading because half of the subjects in this group received refresher
training at the 4-week session. The mean of the refresher subjects was 81% (range 75 to 89%), a 20 percentage point increase from the 4-week mean. Those who did not receive the refresher had an 8-week mean of 73.5%, a 12.5 percentage point increase from the 4-week mean. In contrast, the Whole-Trained group recorded a slight decline in performance at the 8-week measures regardless of whether the subjects received refresher training. The Whole-Trained refresher subjects still performed slightly better than the no-refresher subjects on average. The mean of the refresher subject's performance at 8-weeks was 56.25% (range 10 to 80%), a decline of .88 of a percentage point from the 4-week mean of 57.13%. The no-refresher subjects at 8-weeks had a mean of 51.25% (range 0 to 100%), a decline of 5.88 percentage points from the 4-week mean.

Sequence Performance

Pre-Test

Prior to any CPR training, both the Whole-Trained and the Part-Trained groups showed poor CPR sequence performance (Figure 6). The sequence of skills in the CPR performance skills was done correctly in half of the trials from both groups (mean=50).

Post-Test

Following the CPR training both Part- and Whole-Trained groups performed the sequence perfectly at the post-test measure. Errors of "failure to call for help", "failure to check pulse", and "incorrect compression/ventilation ratio" were not seen. This is the criterion level of performance for students to obtain a successful completion card at the end of the class.
4-Week Follow-Up

The Part-Trained group mean scores fell below the post-test level at the 4-week measure. Half performed the actual sequence correct giving a mean score of 50%. The Whole-Trained group performed slightly better than the Part-Trained (two of the eight Whole-Trained subjects performed the sequence without any errors) but still worse than the post-test measure. Performance was at an acceptable level by American Heart Association standards for both groups.

Figure 6. Sequence Performance Means Across Groups.
8-Week Follow-Up

After the 4-week follow-up measures were obtained, half of the Part-Trained and Whole-Trained subjects were given refresher instructions and feedback on their performance. At the conclusion of the refresher instruction, those eight subjects demonstrated perfect sequence performance.

At the 8-week follow-up, just four weeks after the refresher instructions, general improvements were observed with respect to sequence performance. The Part-Trained subjects who had the refresher instruction, performed with a mean of 100%. Those from the Part-Trained group who did not have the refresher performed with a mean of 75% (only one subject performed incorrectly). The Whole-Trained subjects who had the refresher had a mean of 75%, and those who did not had a mean score of 25% with only one subject performing the sequence correctly. Overall the Part-Trained group performed better than the Whole-Trained group at the 8-week measures.

CPR Performance Errors

Compression Errors

Table 4 summarizes the nature of performance errors. These are recorded herein to the nature document the nature of errors pre- and post- training and to provide some rational for skill areas in need of further training. The "rate of compressions" were for the most part performed within an acceptable range (80 to 100 per minute). Both groups performed about the same. As shown in Table 4, pre-test compression rates were performed below the 80 compression per minute rate specified as the low end of the acceptable range. No subject performed compressions
at a rate higher than 99. After training, compression rate errors declined to an acceptable level. Other errors related to compressions that were measured included "incomplete releasing", where the subject did not release enough pressure off the chest after each compression. Table 4 shows that this type of error improved slightly after training, but still occurred among a few subjects throughout the follow-up measures. The Skillmeter device is very accurate and has no allowance for error. As

Table 4

CPR Performance Errors

<table>
<thead>
<tr>
<th>Performance Error Types</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>4-week</th>
<th>8-week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compression rate (too high)</td>
<td>0 (0/16)</td>
<td>0 (0/16)</td>
<td>0 (0/16)</td>
<td>.06 (1/16)</td>
</tr>
<tr>
<td>Compression rate (too low)</td>
<td>.56 (9/16)</td>
<td>0 (0/16)</td>
<td>.19 (3/16)</td>
<td>.19 (3/16)</td>
</tr>
<tr>
<td>Incomplete release</td>
<td>.44 (7/16)</td>
<td>.19 (3/16)</td>
<td>.31 (5/16)</td>
<td>.25 (4/16)</td>
</tr>
<tr>
<td>Compression depth (too deep)</td>
<td>.5 (8/16)</td>
<td>.13 (2/16)</td>
<td>.25 (4/16)</td>
<td>.19 (3/16)</td>
</tr>
<tr>
<td>Compression depth (too shallow)</td>
<td>1 (16/16)</td>
<td>.63 (10/16)</td>
<td>.69 (11/16)</td>
<td>.81 (13/16)</td>
</tr>
<tr>
<td>Hand position</td>
<td>.81 (13/16)</td>
<td>0 (0/16)</td>
<td>.25 (4/16)</td>
<td>.13 (2/16)</td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation volume (too much)</td>
<td>.25 (4/16)</td>
<td>.38 (6/16)</td>
<td>.5 (8/16)</td>
<td>.44 (7/16)</td>
</tr>
<tr>
<td>Ventilation volume (too little)</td>
<td>.44 (7/16)</td>
<td>.25 (4/16)</td>
<td>.44 (7/16)</td>
<td>.38 (6/16)</td>
</tr>
<tr>
<td><strong>Sequence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Failure to call for help</td>
<td>.88 (14/16)</td>
<td>0 (0/16)</td>
<td>.38 (6/16)</td>
<td>.44 (7/16)</td>
</tr>
<tr>
<td>Failure to check pulse</td>
<td>.81 (13/16)</td>
<td>0 (0/16)</td>
<td>.13 (2/16)</td>
<td>.19 (3/16)</td>
</tr>
<tr>
<td>Incorrect comp./vent. ratio</td>
<td>.63 (10/16)</td>
<td>0 (0/16)</td>
<td>.06 (1/16)</td>
<td>.13 (2/16)</td>
</tr>
</tbody>
</table>

with the incomplete release errors, subjects had trouble with "compression depth" accuracy as well. Table 4 shows that all 16 subjects compressed the chest less than 1 1/2 inches during most compressions. After training, this improved slightly but
remained a consistent error throughout the study. Compressions that were deeper than 2 inches also occurred to some degree, but not as frequently as the shallow compressions. A final area of compression errors measured was "hand position". This error type occurred in 13 of the 16 subject pre-test performances. During the post-test performances no errors of this type were seen, but a few occurred in the 4- and 8-week performance measures. None of the compression errors made after initial training were significant enough to cause a subject to fail their performance trial by American Heart Association standards.

**Ventilation Errors**

The volume of ventilations should be between .8 and 1.2 liters per breath. Breaths that are in excess or are less than those amounts registered as errors. In Table 4, initial pre-test measures across both groups showed only 4 occasions of "too much breath volume". Errors of "too little volume" at this first measure were more common with a total of 7 occurrences. After training, more errors of too much ventilation volume was seen. None of the ventilation volume errors made after initial training were significant enough to cause a subject to fail their performance trial by American Heart Association standards.

**Sequence Errors**

The errors in sequence were relatively infrequent, but when they occurred they were enough to cause a subject to fail that performance trial according to American Heart Association standards. More specific skills performed out of sequence or not performed at all included, "calling for help", "checking the pulse", and maintaining the correct compression to ventilation ratio (15:2). Their occurrences
or non-occurrences appeared to be random after the post-test measures which were all flawless. Table 4 shows that pre-test performance errors were quite high. Most all subjects performed sequence errors that would cause them to fail that performance trial. "Failure to call for help" was very common, as 14 of the 16 subjects failed to shout for help. The "failure to check the pulse" was also a common error at the pre-test measure. Both of these error types were better at the follow-up measures where slightly less than half of the subjects failed to call for help. On three occasions after the post-test measures did subjects perform an incorrect compression to ventilation ratio. One subject performed a ratio of 15:1 and another performed a ratio of 17:2. This error type was prevalent with 10 of the 16 subjects making this error at the pre-test measure.

After attaining the 8-week measures, those subjects who did not receive the 4-week refresher and any of those who wished to receive another were provided refresher practice and feedback. In all cases, the subjects performed well enough to pass American Heart Association standards with just brief exposure to this refresher instruction. In summary, the measurement of compression, ventilation, and sequence performance showed that the Part-Trained and Whole-Trained did not perform remarkably different. The only significant differences noted occurred between those subjects who received refresher training and those who did not. The data would indicate that refresher training improved performance or slowed performance decay.
Figure 7. Eight Week Part-Training Measures Across Subjects With and Without Refresher Training.
Figure 8. Eight Week Whole-Training Measures Across Subjects With and Without Refresher Training.
CHAPTER V

DISCUSSION AND RECOMMENDATIONS

Part-Training vs. Whole-Training

Overall Conclusions

All subjects among both groups performed notably better after initial training. Whether trained using Part-Training or Whole-Training CPR skill acquisition measures increased substantially. One line of conclusions that can be made from this research is that (a) CPR performance was adequately acquired regardless of the training method used, (b) CPR skill performance declined similarly across both groups, and (c) refresher training slowed the performance decay or improved performance.

With respect to the post-training level of CPR performances, all subjects, regardless of training method were trained until they met a mastery performance level. Unfortunately, this study did not systematically monitor training time in each training method and thus cannot report empirical data on training efficiency. Nevertheless, it is my opinion that the Part-Training method was more efficient than the Whole-Training method in that subjects were instructed as one group instead of as individual trainees practicing at different speeds and levels of accuracy. The instructor was able to maintain good organization and move the group through at a quicker pace than those who practiced more independently among the Whole-Trained group. Further research on the relative efficiency of alternative training methods would contribute to the literature in this area.
The weeks following the post-test measures appeared to take a toll on the CPR skill retention of both groups. The declines were not significant enough to return to pre-test levels, but the poor performance after just four weeks is alarming given that current American Heart Association standards allow people to retain "current" completion cards for up to two years. After eight weeks, skill retention again dropped but not to the degree it did after the first four weeks. This may indicate that the skill retention decay slows or levels off at some performance plateau. Possibly a more longitudinal study with more subjects could yield conclusive information on this point. Overall, the effects of one training method or the other to limit the well documented skill loss over time was unremarkable. CPR performance declines seemed to occur readily among both groups.

An alternative line of analysis yields a much different explanation for the high post-test measures and subsequent declines at the four and eight week follow-up sessions. Each subject performed individually in front of the instructor during the initial pre-test measure and during both the four and eight week measures. The post-test assessment occurred in a group setting unlike the other assessments that occurred as individual assessments. Because subjects could observe the performance of other participant, they may have performed better than would be expected had they performed alone. Furthermore, the assessment environment was identical to the training environment thus further facilitating performance during the post-test. This poses the hypothesis that the subjects performed artificially better when taking group cues from performing subjects in the group environment and from the environment identical to that of the one initially trained in. If this is the case, the performance results from the post-test performances can not be directly compared to those of the follow-up sessions. Perhaps the post-test performance, viewed as an accurate skill
acquisition measure for comparative analysis against the follow-up measures, was not a true acquisition measure at all but an artifact of differing environmental cues. Further, the actual skill acquisition may lie somewhere between the obtained post-test measure and the four-week measure, leaving the degree of skill retention loss not as significant as the data would indicated. This post-test artifact hypothesis requires serious consideration given the implications on this and other like research where skill acquisition measures may be confounded by subtle yet powerful environmental cues. Initial training and follow-up session environments are rarely described in the available literature, but among others where such variables are mentioned CPR training is often conducted in a group setting followed by post-measures taken under differing conditions (Glendon, McKenna, Hunt, & Blaylock, 1988; Tweed, Wilson, & Isfeld, 1980; Kaye & Mancini, 1986). Attention to the possible performance differences from one training environment to another post-measure environment is lacking. Further research in this area is needed in light of the potential effects differing cues may have on CPR performance.

**Refresher Training**

As in other research, this study demonstrated the positive impact of a brief refresher session where subjects were given the opportunity to practice with corrective feedback and praise for correct performance. This seems to indicate that regular practice is the only variable that maintains CPR skills. Still, performance benefits of refresher training lacks a thorough explanation. When presented with the mannequin at the 4-week follow-up session, one subject knelt in front of the Skillmeter and stated "A... open airway", then performed this initial skill. Perhaps the skill competency level of an individual is composed of both the maintained
psychomotor skill, as required to compress the chest a certain amount, and the retention of covert verbal behaviors like the prompting acronym "A-B-C" for airway, breathing, circulation. There seems to be a relationship between the verbal behavior and the physical behaviors in the demonstration of CPR.

A difference can be seen among CPR instructors and others who could be referred to as being fluent or as experts in CPR performance. Johnson and Layng (1992) identify "fluency" as the rate of performance that allows skills to be useful and remembered even after significant periods of time without practice. Their research indicates that performance needs to be not only accurate, but also quick, easy, and automatic in order to be of any application and to be remembered. Thus, a promising area for research is to determine the contribution of fluency training to the long term retention of CPR skills. This would require training two groups to an accuracy criterion, but for one group adding a fluency criterion to the training intervention as well.

Recommendations for Future Research

In addition to the application of generative instruction to build fluency as a possible answer for refresher effects, the rapid skill execution and other tenants of this line of applied technology may have direct implication for initial CPR training from instructors (Johnson & Layng, 1992). A restructuring of the current CPR training format to provide varied skills practice in the beginning and at the end may improve skill fluency and retention.

Under current training protocols, CPR skill retention will decline without practice and corrective feedback. Interactive video and home computer CD-ROM technology is becoming a growing reality for the general public. Exploring such
technology in light of the need to practice CPR and other like skills may yield favorable results. Additionally, the availability of inexpensive mannequins like the ACTAR 911 and a practice video could be offered and tied to an entire home safety package for routine home safety training. With respect to the issue of transfer of training, more lifelike mannequins and more realistic training environments need to be established. Perhaps the addition of sirens or even limited hand placements and pulse checks on live people in class would help. Comparing the performance in the classroom to that on the street during a real emergency is difficult, but this skill transfer is precisely the purpose for training. If skill decay is observed after just four or eight weeks in similar environments, how significant would the decay be if performed in a stressful emergency environment on an actual victim. The degree of skill transfer from the classroom to the real emergencies is an area where future research should focus. Any changes that can be done in and out of the classroom to this end should be investigated and empirically validated for widespread application. Possibly, the AHA could provide funding to local AHA Training Centers to set up demonstration and practice booths in shopping malls in order to attract and inspire more people to learn CPR. Even, trauma training centers could be developed to mimic real emergency situations.

In 1997 the National Conference on Standards and Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care will again meet and review CPR standards. Further investigation into new teaching and testing measures that better teach CPR skills is needed. An emphasis on home based refreshers or practice sessions look promising. Interactive-video training with large corporations or hospitals also seems plausible. A push for more generalizable skill performance is
needed and should be encouraged as the next improvement area for basic and advanced life support training.

In summary, CPR is a learned skill that impacts lives when performed or not performed. The importance of efficient lifesaving skill acquisition, regular practice to maintain skill accuracy, and ultimately retention for immediate application across settings is great. The ability of a lay person to deliver lifesaving skills when needed is critical, and current training programs and methods fail to demonstrate sufficient skill maintenance over extended periods of time. Research that addresses current problems and attempts to empirically answer the many implicit complex issues regarding skill retention must continue.
Appendix A

Informed Consent Form
INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROTOCOL:
"THE EFFECTS OF PART-TRAINING ON CARDIOPULMONARY RESUSCITATION SKILL ACQUISITION AND RETENTION"

As a student or faculty of Western Michigan University, the Health and Wellness Program offers CPR courses at a substantial savings. American Heart Association Instructor-Trainer, David Hagedorn, will be instructing the courses and conducting Masters thesis research on CPR skill acquisition and retention. Other American Heart Association BCLS and ACLS Instructors, Instructor-Trainers, and Affiliate Faculty will be assisting. The research study will attempt to determine if a part-training method of instruction as applied to Cardiopulmonary Resuscitation skills will effectively help the learner to both initially acquire CPR skills and then maintain the skills better than the currently used whole-training method of instruction. Participants in the study will be randomly assigned to either the part-training or whole-training method of Adult-CPR instruction.

CPR performance will be measured using the Skillmeter recording mannequin. Prior to learning the CPR skills, a pre-test of performance will be taken. Following the training offered in the course, skill performance will again be measured in the same way. At four and eight week follow-up sessions, CPR skill performance will again be measured.

Eligibility will be based on the first 30 people who sign up and pay for the course and book. These people merely have to read the text before the class, and
come for the four-hour course on either Tuesday, January 19 or 26 from 5:00-9:00 PM. Following this initial class completion, the subjects will need to return in four and then eight weeks. After the eighth week, the subjects will receive $5.00, a First Aid Kit, and a free CPR Refresher course.

One benefit of this research is that all of the participants will learn CPR skills. Even if participants decide to withdraw from the study, they will still be trained in CPR. Another benefit of being involved in this research is to help identify and develop a potentially more effective training method for CPR courses across the country.

Risks of participation in this study are minimal. Possible risks may include not being sufficiently trained to save a life under one training method compared to the other. To avoid this problem, at follow-up training the alternate training method will be used to refresh your skills. Also, the potential for your name to be seen as among those who are participating in this study is a risk. Even though there is no reason why this would be a problem, your name will be assigned a code and that code will be destroyed after the study is complete. All risks, even though not sensitive or harmful in any way, have been corrected so as to benefit the participant.

All participants are at liberty to withdraw his or her consent to the experiment or discontinue participation in the experiment at any time without prejudice. Likewise, the experimenter may terminate a participant from the experiment if the person fails to return for the four and eight week follow-up sessions.

By agreeing to participate in this study, you give us permission to present the results at a professional conference, and to publish the results under the condition that the results be presented in such a manner that the identification of individual performance is impossible.
Should problems or questions arise in connection with CPR or this experiment, the participant may contact David Hagedorn at 342-4758.

You will receive a copy of this consent form.

YOUR SIGNATURE BELOW INDICATES THAT (1) YOU HAVE BEEN GIVEN THE OPPORTUNITY TO ASK QUESTIONS AND THESE QUESTIONS HAVE BEEN ANSWERED TO YOUR SATISFACTION; AND (2) YOU UNDERSTAND THE ABOVE STATED INFORMATION AND HAVE GIVEN YOUR PERMISSION TO BE ASSESSED FOR ELIGIBILITY AND POSSIBLE PARTICIPATION IN THIS STUDY.

Signed ___________________________ Date ________________________
Appendix B

Protocol Clearance From the Human Subjects
Institutional Review Board
Date: December 18, 1992

To: David Hagedorn

From: M. Michele Burnette, Chair

Re: HSIRB Project Number 92-12-23

This letter will serve as confirmation that your research protocol, "A comparison of part-training vs whole-training on CPR skill acquisition and retention" has been approved after full review by the HSIRB. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the approval application.

You must seek reapproval for any change in this design. You must also seek reapproval if the project extends beyond the termination date.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: December 18, 1993

xc: Fuqua, PSY
BIBLIOGRAPHY


Armstrong Medical Industries. (1988). 1988 catalog. (Available from [575 Knightsbridge Parkway, P.O. Box 700, Lincolnshire, IL 60069-0700])


