THE RELATIONSHIPS AMONG SELECTED PRIOR PERSONAL EXPERIENCES, POOL SKILLS, AND INITIAL OPEN WATER PERFORMANCE IN SCUBA DIVING

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
May, 1985

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PREFACE

Scuba diving instructors have long held the premise that students who do well in scuba pool drills will also do well in open water during their initial open water dives. It was the purpose of this study to determine if this premise was true. To make this determination, correlations were computed among various pool and open water skill ratings.

The author wishes to express his appreciation to Dr. Lowell Caneday for his guidance and assistance throughout the course of this study. Appreciation is also expressed to the other committee members, Dr. Betty Abercrombie, Dr. Betty Edgley, and Dr. John Gardiner for their assistance in the preparation of the final manuscript.

A note of special thanks is given to Dr. Ken Rose for allowing the author to use his scuba students as subjects in the study. Thanks are also extended Dr. Steve Edwards for his help in constructing the research instrument. Lastly, I would like to express my love and appreciation to my parents, Mr. and Mrs. Le Roy Green. Without their love and support, attainment of the doctors degree would not have been possible.

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THE RESEARCH PROBLEM

INTRODUCTION

"High-Risk" or "High-Adventure" activities are becoming increasingly popular in the United States. Among the activities that are commonly identified as high risk are mountaineering, whitewater rafting, hang gliding, wilderness survival, and, one of the newest, ultra light aviation. A large majority of these activities have existed for quite some time and have been available for participation; however, the public's knowledge of their availability and their publicity were extremely limited. Such activities are prevalent on the television and movie screens, in magazines, and in the news. One of these high risk activities has become so popular that it now has its own periodical, a magazine called Skin Diver. This activity, of course, is scuba diving.

Since the development of the aqualung by Jacques-Yves Cousteau, scuba diving has evolved from strictly a military activity to a sport which today is enjoyed by men and women of all ages.[1] It is a sport which is not limited to the young. In addition, the sport is being taught in thousands

of secondary schools, colleges, and universities as a physical education activity.[2]

It is evident that the number of people participating in scuba diving is growing substantially, but so is the associated injury and fatality rate. A report published by the National Underwater Accident Data Center stated that the number of nonprofessional diving fatalities in the United States increased from 99 in 1970, to 137 in 1976.[3] Although these figures are not in direct proportion to the growth of the number of participants, they represent too great an increase in the number of fatalities. The causes for the increased fatality rate are numerous and varied. Among the more significant causes is the premise that scuba instructors are not adequately qualified or prepared to give courses of instruction.[4] Another contributory factor to the increased fatality rate is the fact that many existing instructional programs do not maintain professional standards of safety.[5] Lastly, a factor that must be considered is the diver himself, which is the emphasis of this study.

Barada stated: "The greatest danger to skin divers is the diver himself."[6] Possibly as a result of the two factors considered previously, many divers are certified who cannot cope with a diving emergency, and as a result, are injured or lose their lives. It would be inaccurate, however, to assume that all diving accidents are a result of incompetent instructors or poor instructional curriculums.

The diver himself must be examined. Some appropriate questions to consider would seem to include the following: What kind of experiences has the diver had in aquatics? Has the diver previously participated in an activity involving personal risk? And, why does the diver desire to participate in scuba diving? Other questions related to the diver's mental and physical condition and background would also be appropriate.

It was the general purpose of this study to try to determine if such individual factors as personal background, personal experience, and selected pool performance capabilities are related to a scuba diving trainees' performance on his first open water dive. Establishing a significant relationship among these factors and open water performance would provide scuba instructors with a means of identifying students who may experience problems on their first open water dive, thereby allowing for closer supervision and the possible prevention of an accident.

Various characteristics of successful scuba divers have already been identified in previous research. Rose found that first born children do better in pool performance skills than do later siblings.[7] This same study indicated that those who elect to participate in scuba have a lower average anxiety level than does the normal population.[8] Other indicators of divers who are likely to experience problems in the water have also been identified. A committee consisting of highly qualified specialists in the

field of scuba diving and aquatics joined with seasoned scuba instructors of the Young Men's Christian Association to design a course of instruction called Scuba Lifesaving and Accident Management (S.L.A.M.). During the development of this course of instruction, these professionals identified five pre-dive observations that can be made by instructors or dive team leaders to recognize divers that may be potential accident victims. These five tell-tale signs are:

1. Illness: Is the diver suffering from illnesses such as sea sickness, severe sinus blockage, or hangover?

2. Equipment Inadequacies: Is the diver wearing all necessary equipment and is this equipment in operable condition? Also, is the diver overequipped?

3. Ineptness: Is the diver having difficulty putting on or adjusting his equipment before the dive? Also, does the diver forget to put on a piece of essential equipment?

4. Vocalization: Does a usually quiet person become talkative or a talkative person become quiet just before a dive? Also, does the diver ask subtle, irrelevant questions such as 'Are there any sharks in the lake?'.

5. Hesitation: Does the diver hesitate to put on his gear or get in the water? Also, does the diver "hang back" during dive preparation and is he or she not ready when the dive is to begin?[9]

Other work dealing with prediction of performance of divers has also been done and will be presented in the

review of literature. It is evident from the brief discussion above that advancements have been made in trying to isolate predictors of scuba performance; however, this area of research is relatively new and the need exists for further exploration. Somers verified this need when he stated:[10]

> The next phase in the growth and development of the scuba diving industry must be cultivated in the academic community. The industry is badly in need of the direction, prestige, and research that can and should be provided by professional educators and scientists. The academic community must step forth to meet this challenge and the scuba diving community must accept and encourage this involvement.

STATEMENT OF THE PROBLEM

The primary purpose of this study was to identify relationships that may exist among personal background experiences, mask, fin, snorkel, and other pool skills, and initial open water performance. With regard to personal background experiences, factors that were examined included: (1) the number of in water traumatic experiences that the subject could recall, (2) previous participation in another high risk activity, (3) previous in water aquatic instruction (swimming class, lifesaving, etc.), and (4) the extent of involvement and participation in high school and or college varsity athletics. The pool skills that were considered included: (1) mask, fin, and snorkel bailout performance; and (2) the distance one can swim underwater in

one breath. Open water performance was measured in terms of mask clearing and buddy breathing capability.

To be more specific in stating the problem, the following null hypotheses were developed:

Ho_1: There is no relationship between the distance a scuba student can swim underwater with one breath and performance on his or her first open water dive.

Ho_2: There is no relationship between a scuba student's pool performance on a mask, fins, and snorkel bailout and performance on his or her first open water dive.

Ho_3: There is no relationship between the extent of a scuba student's previous varsity athletic experience and performance on his or her first open water dive.

Ho_4: There is no relationship between the amount of previous in water aquatic instruction a scuba student has had and performance on his or her first open water dive.

SUBPROBLEMS

In addition to testing the formal hypotheses, other possible relationships that are relevant to the study will be examined. These include the possible relationships among the following: both pool training skills; initial open water performance; the possible effect of previous participation in another high risk activity; and the possible effect of having previous traumatic experience in the water where the subject perceived his life to be in danger.

LIMITATIONS

One of the foremost limitations of this study dealt with the method of evaluating and rating the subjects' pool and open water performance. Due to the complexity and impracticality of trying to demonstrate inter-rater reliability, it was decided that the researcher would perform all ratings and evaluations.

The other limiting factor of this study concerned the evaluation instrument used in determining levels of skill in both the pool and open water. The instrument was constructed by the researcher specifically for this study. Specific levels of scuba skill performance were transformed onto a five point Likert scale. This scale is one of the most popular and widely used scales in rating performance or skill. The instrument was then examined and approved by a jury of experts composed of five individuals who are well respected in the field of scuba diving and hold positions of leadership in a nationally recognized scuba diving organization. In addition, a pilot study was conducted using the instrument. No problems were encountered and the data gathered was indicative of the corresponding performances; however, no reliability or validity coefficients were computed.

DELIMITATIONS

The subjects used in this study were students enrolled in basic scuba diving at Southwestern Oklahoma State University. Because of this sample selection, it will not be possible to generalize the results of this study to the entire population of scuba students.

OPERATIONAL DEFINITIONS

The following terms are frequently used in this study and will be defined as indicated.

1. High risk activity: an activity in which there exists inherent dangers and hazards that, if not negotiated, could result in injury or loss of life.[11]

2. Open water checkout dive: the first scuba dive a student makes in an ocean or lake, accompanied by a certified instructor.

3. Mask, fins, and snorkel bailout: a drill designed to teach scuba or skin diving students to manipulate essential gear while holding their breath. The drill consists of jumping from a pool deck into the water with mask, fins, and snorkel in hand; then donning the gear and clearing the mask and snorkel of water before surfacing.

4. Certified Scuba Diver (Bronze Star Certification of the Y.M.C.A. Scuba Program): an individual that has passed

the required examinations in the knowledge and performance areas in a scuba training program.

5. Certified Scuba Instructor: an individual who, as a result of intense cognitive and physical training, is sanctioned by the Y.M.C.A. or other organizations to teach scuba diving. This person must be at least 21 years of age and have made over 50 open water dives.

ENDNOTES

[1]Douglas G. Gorrie, "A Curriculum Guide for Scuba Diving Instruction," (Unpub. Ph.D. dissertation, Oklahoma State University, 1976), p. 1.

[2]Lee H. Somers, "Underwater Education," Journal of Physical Education and Recreation, May, 1979, Volume 50, p. 50.

[3]John McAniff, "U.S. Underwater Diving Fatality Statistics, 1970-1980," Report No. URI-SSR-80-13, September 1980, p. 4.

[4]Michael Greenwood, "Diving Behavior," Human Performance and Scuba Diving (Chicago, Ill., 1970), p. 146.

[5]John L. Cramer, Skin and Scuba Diving, (Garden City, New York, 1975), p. 151.

[6]Bill Barada, Let's Go Diving (Santa Ana, California, 1970), p. 52.

[7]K.G. Rose, "A Study of the Psychological and Physical Traits and Prediction of Performance of Participants in High Risk Activity--A Model for Program Development," (Unpub. Ph.D. dissertation, University of Oklahoma, 1980), p. 61.

[8]Ibid., p. 54.

[9]R.W. Smith and H.C. Allen, Scuba Lifesaving and Accident Management, (National Y.M.C.A. Underwater Activities Program, Key West, Florida, 1978), pp. 4-5.

[10]Somers, p. 2.

[11]Joel F. Meir, "Is the Risk Worth Taking?" Journal of Physical Education and Recreation, Vol. 49, No. 4, p. 32.

CHAPTER II

REVIEW OF LITERATURE

Overview

In order to adequately research factors that affect initial open water performance in scuba diving, it was necessary to examine literature dealing with existing scuba diving programs and instructional curricula. Also, research centered around prediction of performance of scuba divers was reviewed as was literature that discussed identifiable characteristics of those who engage in high risk activity. Lastly, material dealing with benefits of participation in risk activity was reviewed.

Existing Programs and Curricula

As stated earlier, reasons cited for the increasing accident rate in scuba diving were the inadequacies of scuba instructors and their associated programs and instructional curriculums; therefore, examination of this area was imperative.

A survey by John L. Cramer indicated a wide variation among scuba programs in United States colleges and universities in reference to how each was organized and taught. For example: course length varied from three weeks at Yale

University to 18 weeks at the University of Southern California, with a mean of 11.6 weeks; the number of lessons per week ranged from one at the University of Southern California to three at Stanford with a mean of two; the length of each lesson ranged from 50 to 120 minutes with a mean of 84.3 minutes.[1] From this it appears that there are no established criteria for conducting scuba classes with regard to time in class.

In an interview, John Reseck stated that not even nationally known certification agencies such as the Young Men's Christion Association, National Association of Underwater Instructors, or Professional Association of Diving Instructors have issued standardized, comprehensive, sequentially developed, and integrated curriculum guides.[2] Although this statement was made in 1973, the author knows of only one in existence today. It is evident by the information above that existing programs in the United States lack consistency with regard to program content and design.

The next step in examining existing programs and curriculums would be reviewing briefly the literature dealing with the requirements and qualifications of scuba instructors and dive team leaders.

Jean McCarthy found that, most of the time, courses taught outside colleges and universities had a person without a college degree as an instructor, who also had no formal training in teaching or learning theory.[3] Although

this obviously presents definite disadvantages to the instructor of such programs, McCarthy went on to say that if such instructors are graduates of an accredited instructor institute or college, then they are qualified to teach scuba diving.[4] Engstrom, however, maintains that scuba diving should be taught by professionally trained teachers and not simply by good divers.[5] Although it would seem to be a worthwhile goal of certification agencies, it would be impractical to suggest that all scuba instructors be required to obtain a college degree in education. In addition, one certification agency incorporates a brief unit of learning theory in their instructor preparational programs.[6]

Another quality of a good instructor is the possession and maintenance of various critical skills and expertise. Thompson supported this premise in his article in Skin Diver Magazine.[7] He went on to say the instructor can make diving education a pleasurable experience, or unfortunately, something much less.

It should be mentioned here that many certification programs exist that are not sanctioned by a reputable scuba certification agency.[8] These programs are located all over the United States, especially in aquatic resorts and tourist locations. These programs, called "quickie courses," are designed to enable an individual to scuba dive by undergoing only a few hours of training in a swimming pool. Essential cognitive concepts are often omitted.

Characteristics of Participants

This study is concerned with the examination of possible relationships among selected demographic information, pool skills, and initial open water performance in scuba divers; therefore, it seemed appropriate to examine material dealing with prediction of performance not only in scuba diving, but other risk activities as well.

In a study dealing with birth order and participation in dangerous sports, Nisbett found that firstborn children tend to elect not to participate in football, soccer, and rugby and that the probability of a child participating in one of these sports increases with family size. He stated: "The evidence is in complete accord with the expectation that firstborns would avoid dangerous activity."[9] This contradicts Rose's findings that firstborns tend to do better in scuba pool skills.

In a study that considered patterns of behavioral characteristics as indicates of recreation preferences, Granzin and Williams found that those desiring to participate in strenuous and dangerous sports viewed themselves as young, sporty, and robust.[10] Also, those who were inclined to participate in water sports perceived themselves as being comparatively bold along with exhibiting an easygoing lifestyle.[11] Due to absence of items in the research tool to measure the inclination to participate in risk recreation, this study yields little application to scuba divers.

Martin and Myrick found that scuba divers, sky divers, and snow skiers perceived themselves as being more socially "abrasive" than a control group and having a higher degree of self composure.[12]

Predictors of Performance

Exhaustive E.R.I.C. and library searches were made seeking literature dealing with factors that related to or predicted open water performance. These searches led to only three sources of information. These sources were Rose's study dealing with psychological characteristics of scuba divers, and two studies done by the United States Navy Medical Neuropsychiatric Research Unit in San Diego, California.

In addition to the findings previously mentioned, Rose's study yielded two more significant conclusions: (1). males performed better than females in all stages of training, including the checkout dive;[13] and (2). early performance in training was indicative of later success in scuba diving.[14]

In a study for the United States Navy, Gunderson, Rahe, and Arthur found that such factors as body weight, number of sit-ups and pull-ups, and age were significant predictors of later performance for those training in underwater demolition.[15] Also indicative of performance was a medical index questionnaire called the Cornell Medical Index.[16]

In another Navy survey, Biersner and Ryman found a positive correlation between success in a naval diving school and the following items: (1). education, (2). number of older brothers, and (3). amount of parental criticism.[17] To be more specific, performance rating increased directly with the amount of education. Also, older-born succeeded significantly more often than did the younger-born. It was also noted that:[18]

> . . . training performance of those scuba subjects who were criticized often as youngsters were more likely to be successful if the mother was employed. This suggests that criticism from the mother or the ways in which she mediated criticism were important in adjusting to hazardous situations many years later.

This study also incorporated the use of attitude scales. It was found that those who perceived themselves as being leaders passed the course more often. Additionally, scuba trainees who were least concerned about being physically injured performed better during training than those who were shown to be more concerned.

Benefits of Participation

In conjunction with examining the aforementioned relationships in scuba diving, it was the researcher's desire to know exactly why people elected to participate in diving and other high risk activities. Was it to experience risk or was it because the person enjoyed that specific activity? Given the fact that performance levels might be affected by

the reason for participation, it was necessary to examine literature dealing with the subject of benefits of participation in risk activity.

Meir suggests that an analysis of the danger and benefit factors of the activity be examined before participation. In other words, is taking the risk worth the benefit? Meir discussed such concepts as the development of self concept, self reliance, and self confidence as possible outcomes of participation in high risk activity. Also mentioned were environmental awareness, ability to deal with stress, and physical fitness.[19]

It is Miles' opinion that "Specific rewards of high adventure risk recreation vary with the activity."[20] Specifically, mountaineers enjoy the scenery that can only be obtained on the heights, while the diver enjoys freedom from gravity in a mysterious environment.[21] Miles also mentions the social values of risk participation; in particular, the bonds and relationships that are formed through cooperation and trust involved in activities where the life of one directly or indirectly depends on another.[22] Another value of participation identified by Miles was the distraction from the preoccupations of everyday life facilitated by the necessity of total concentration on the risk activity being pursued. In other words, when one must concentrate fully on performing skills necessary to stay alive, he has a tendency to forget prior problems.[23]

Schreyer, White, and McCool noted that there appears to be marked differences between responses of those who are just beginning to participate in a risk activity and veterans of that activity. More specifically, the initial experiences of the beginner may be directed toward emotional release through risk while the experienced veteran seeks skill and sensory arousal while being oblivious to the danger.[24]

Instrumentation

In order to obtain demographic and background information, a questionnaire was constructed. The guidelines for this instrument were taken from the second edition of Leedy's "Practical Research--Planning and Design." To be more specific, the outline for item construction was employed to analyze the relevance of each question. Initial readings on the development of the research design were also taken from this source.[25]

The two pool skills incorporated in this study were underwater swimming and mask, fins, and snorkel bailout. These skills are taught in almost all courses of scuba instruction and were classified as "basic" by Ascher and Shadburne.[26] Also the doff and don skills required in a mask, fins, and snorkel bailout were thought to be "necessary" and "essential" by Roberts.[27] In addition to the above sources, five professional diving instructors from

the Young Men's Christian Association scuba diving program were consulted in connection with the development of the pool skills test. The open water evaluation criteria of buddy breathing and mask clearing are also used by the majority of instructional agencies to determine the competency of the student diver in open water and are thought to be essential by Ascher and Shadburne.[28]

In order to evaluate pool and open water skills a rating scale was constructed by the researcher. This five category scale is similar to a Likert scale and was developed according to guidelines set forth by Verducci in his book Measurement Concepts in Physical Education.[29]

Summary

From the literature examined, it was evident that existing programs in scuba instruction lack conformity and qualified teaching personnel. It was also found that various characteristics of individuals who participate in high risk activity have previously been identified. Additionally, items that are indicative of scuba performance have been discovered through research. Finally, articles concerning outdoor education and high risk activity yielded numerous benefits of participation in high risk pursuits.

ENDNOTES

[1]J. L. Cramer, "Status of Scuba Diving as a Physical Education Activity," Journal of Physical Education and Recreation, Volume 42, No. 3, p. 77.

[2]Reseck, John, Interview, May 11, 1973.

[3]J. J. McCarthy, "School Scuba." The Physical Educator, Vol. 25, No. 1 (March 1968) pp. 59-61.

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[7]T. Thompson, "The Quality of Instruction," Skin Diver, Vol. 17, No. 3 (March 19688) pp. 6-9.

[8]Joyce Hartman, "Scuba Training in the United States Colleges," Journal of Physical Education and Recreation, (March 1971), Vol. 42, No. 3, p. 81.

[9]Richard E. Nisbett, "Birth Order and Participation in Dangerous Sports," Journal of Personality and Social Psychology, Vol. 8, No. 4, pp. 351-353.

[10]K. L. Granzin and R. H. Williams, "Patterns of Behavioral Characteristics as Indicants of Recreational Preferences--A Canonical Analysis," Research Quarterly, Vol. 49, No. 2, pp. 140.

[11]Ibid., p. 142.

[12]W. S. Martin and F. L. Myrick, "Personality and Leisure Time Activities," Research Quarterly, Vol. 47, No. 2, pp. 250-251.

[13]K. G. Rose, "A Study of Psychological and Physical Traits and Prediction of Performance of Participants in High Risk Activities--A Model for Program Development," (Unpub. Ph.D. dissertation, University of Oklahoma, 1980), p. 105.

[14]Ibid., p. 108.

[15]E. K. Gunderson, R. H. Raye, and R. J. Arthur, "Prediction of Performance in Stressful Underwater Demolition Training," Journal of Applied Psychology, 1972, Vol. 56, No. 5, pp. 430-432.

[16]Ibid.

[17]R. J. Briesner and D. H. Ryman, "Prediction of Scuba Training Performance, " Journal of Applied Psychology, 1972, Vol. 59, No. 4, pp. 519-521.

[18]Ibid.

[19]Joel F. Meir, "Is the Risk Worth Taking?" Journal of Physical Education and Recreation, 1978, Vol. 49, pp. 31-33.

[20]J. C. Miles, "The Value of High Adventure Activities," Journal of Physical Education and Recreation, 1978, Vol. 49, pp. 27-28.

[21]Ibid.

[22]Ibid.

[23]Ibid.

[24]R. M. Schreyer, B. White, and S. F. McCool, "Common Attributes Uncommonly Exercised," Journal of Physical Education and Recreation, 1978, Vol. 49, pp. 36-38.

[25]Paul D. Leedy, Practical Research--Planning and Design (New York: MacMillan Publishing Co., Inc., 1980), pp. 99-104, 253.

[26]S. M. Ascher and William L. Shadburne, Scuba Handbook for Humans (Dubuque, Iowa: Kendall/Hunt Publishing Company, 1975), pp. 25-40.

[27]Millie Roberts, Beginning Skin and Scuba Diving, Physical Education Activity, A proposal for use in the Dade County Public Schools, Miami, Florida, 1971.

[28]Ascher and Shadburne, pp. 25-40.

[29]Frank M. Verducci, Measurement Concepts in Physical Education, C. V. Mosby Company, 1980, pp. 184.

[30]Ibid., p. 62.

CHAPTER III

METHODOLOGY

Research Design

The purpose of this research was to analyze data obtained by questionnaires and skill ratings in order to identify the possible existence of relationships among demographic data, skill ratings, and performance ratings. According to Leedy, this design falls under the analytical survey method of research.[1]

Sample Description

The subjects of this study were students enrolled in basic scuba diving at Southwestern Oklahoma State University (N = 34), during the spring and summer semesters of 1984. Sixteen students were randomly selected from the spring class and 18 from the summer class. According to Leedy, this representation is a form of cluster sampling, due to the fact that the subjects were selected from a predetermined group.[2] Although this sample represents one of convenience, the impracticality of testing a sample of scuba students taken from a large geographic area made this type of sampling procedure necessary.

The age of the subjects ranged from 19 to 49 with a mean of 25.1 years. The sample contained 22 males and 12

females. All subjects had received the basic course of scuba instruction as taught by the National Young Men's Christian Association Underwater Activities program under the direction of Dr. Ken Rose, the aquatics director at Southwestern Oklahoma State University. This course of instruction was worth two hours of undergraduate credit and resulted in a basic scuba diving bronze star certification as issued by the Y.M.C.A. scuba program.

Instrumentation

The tools of research used in this study included a demographic questionnaire and a skill test both developed by the author. The statistical evaluations were made using the Spearman rank-difference correlation.

The questionnaire used in the study was a demographic tool designed to ascertain answers to the following questions:

1. What activities had the subject participated in that he or she would consider to be high risk?

2. How much formal aquatic instruction had the subject received in the last five years?

3. How much varsity athletic competition had the subject participated in?

4. Had the subject ever been involved in a traumatic experience in the water in which he or she thought they might drown?

To answer the first question, the subjects were simply asked to list all activities that he or she had participated in that they considered to be high risk. Question number two asked the subject to place an "X" beside any course of aquatic instruction he or she had taken within the past five years. Each of these courses were weighted according to the level of expertise taught in the course. The weights ranged from one to five with five indicating the most difficult course content. The weights of all courses marked were added together to obtain a score representing the level of formal aquatic instruction received by the subject. In order to answer question three, a five point scale indicating degree of athletic participation was constructed. The subject was asked to place an "X" beside the statement that described his or her participation level with regard to years of participation and degree of achievement within a team. More specifically the subject was asked how many years, if any, he or she was a member of a starting varsity team in at least one sport. Here again, each of the five choices were weighted with one assigned to the level of no participation and five assigned to the level representing the highest degree of participation. To answer question four, the subject was asked to briefly describe all situations in which he or she thought they might loose their life due to drowning. A copy of the questionnaire appears in the appendices.

Although questions one and four did not relate directly to the hypotheses and were not a formal part of this study, the ratings of students who listed responses to these questions were compared to those who did not list responses using a Mann-Whitney U test. The results were included in chapter four of this study.

In order to evaluate and rate pool and open water performance in scuba diving, a skills test instrument had to be constructed. Although no formal skills test was found in the literature search, information dealing with the description of essential and necessary scuba skills was abundant. From this information along with the aid of experienced scuba instructors and a statistician, a skill test was constructed which was designed to rate both pool and open water scuba diving performance. Also, guidelines from the thirteenth chapter of Verducci's Measurement Concepts Book entitled Constructing Motor Performance Measurements were used. The skill test was constructed using a Likert scale format with the value of one assigned to the poorest or incomplete performance and the value of five assigned to the best possible performance. The criteria used to define each of the five categories for each skill dealt with the quantity of equipment successfully manipulated and the physical signs of stress exhibited during the manipulation. Also, breath hold swimming skills were incorporated in the pool portion of the test instrument.

The pool skill portion of the instrument consisted of two fundamental skills that were identified by Roberts as "necessary" and "essential." These skills were underwater breath-hold swimming and the mask, fins, and snorkel bailout task.[3] The evaluation and rating of the underwater swim was accomplished in the following manner. The subject was asked to jump in the water from the deck of the pool and begin his underwater swim without a push-off from the side of the pool. The subject was instructed to swim as far as possible underwater without surfacing for air. The subject was allowed a push-off from the far wall if he or she could swim more than one length of the 75 foot pool. The distance of the swim was measured from the point of submersion to the point where the subject's head broke the surface of the water to breathe. The measurement was accomplished by using the one foot graduations on the side of the pool deck and was rounded to the nearest foot.

The second part of the pool skill test was the performance of a mask, fins, and snorkel bailout. This task required the subject to jump from the pool deck into the water carrying his mask, fins, and snorkel. While submerged, the subject was to don fins, mask, and snorkel in that order and clear the water from the mask and snorkel. If the subject could not don and clear all of his equipment, he was to don as much gear as possible before surfacing for air. The evaluation and rating was done by the researcher

who was in the pool in scuba gear observing and rating each performance. Ratings were recorded on an underwater slate. This slate also contained a detailed description of the criteria set forth for each rating category as to be a reference for the evaluator. The criteria for the pool rating scale and associated categorical division was con structed in consultation with five certified Young Men's Christian Association scuba instructors and a statistician. The five scuba instructors were: Dr. Ken Rose, regional commissioner for the Young Men's Christian Association underwater activities program and aquatics director at Southwestern Oklahoma State University; Dr. Rick Love, otolaryngeologist and Young Men's Christian Association underwater activities program board member; Mike McGovern, commercial diving and underwater construction specialist; Chris Pollman, Young Men's Christian Association underwater activities program board member; and Stan Johnson, sales representative for Fathom Wetsuit Company. These men have logged over 100 pool and open water instructional dives each and are well qualified for consultation on the construction of the evaluation instrument. The statistician consulted was Dr. Steve Edwards, research design and statistics consultant for the School of Health, Physical Education and Recreation at Oklahoma State University. These six men along with Dr. Lowell Caneday, dissertation advisor, served in an advisory capacity not only for the construction of the

pool skill portion of the instrument, but for the open water portion as well.

The basis for the rating scale categories for the mask, fins, and snorkel bailout was the amount of gear donned while submerged and the amount of stress exhibited by the subject during the donning and clearing. Since "stress exhibition" is an ambiguous concept, it was necessary to define the different observable behavior. The exact rating scale and associated criteria for the mask, fins, and snorkel bailout were as follows:

Excellent (five points)

1. Both fins donned and completely clear, snorkel completely clear upon surfacing.

2. Absolutely no signs of stress are observed (task is performed in a smooth, fluid manner).

Good (four points)

1. Both fins donned, mask donned and cleared to the point where only a minimal, negligible amount of water remains, snorkel is cleared to the point where breathing is not inhibited by the amount of water remaining.

2. Slight signs of stress are observed (task is performed in a slightly urgent manner).

Average (three points)

1. Both fins donned, mask is donned and cleared to a point just below eye level, snorkel requires one extra exhalation upon surfacing to become breathably clear.

2. Minimal but obvious signs of stress are observed (task is performed in a noticeably urgent manner with some of the movements being ungainly).

Fair (two points)

1. Both fins are donned, mask is donned but is not clear.

2. Moderate signs of stress are observed (task is performed in an awkward manner with the majority of the movements being executed with extreme urgency and jerkiness).

Poor (one point)

1. One or both fins are donned, mask donning may be attempted but unsuccessfully, snorkel donning is not attempted (surfacing without attempting to complete the task places the subject in this category).

2. Extreme signs of stress are observed (task is performed in an extremely awkward manner with all of the movements appearing desperate).

The open water portion of the test instrument involved two basic skills used by the majority of instructors and instructional organizations to determine competency in open water scuba diving. These two skills are mask removal and buddy breathing.[4]

The mask removal skill required the subject to remove his mask from his face and hand it to the researcher. After a period of ten seconds, it was returned to the subject for

donning and clearing. This skill was performed at a depth of approximately 15 feet. The buddy breathing skill required the subject to share his air with the researcher. Upon command, the subject was to remove his air source from his mouth and offer it to the researcher. The subject and researcher then engaged in eight cycles of air source exchange after which the subject returned the air source to his mouth and continued the dive. As in the pool portion of the instrument, the evaluation and rating of the subjects' performance was done by the researcher. The researcher accompanied each subject on his or her first open water dive and rated their performance on the two skills. The researcher was listed as the certifying instructor on record for each subject of the study due to the fact that the two skills being evaluated were the same as those required for certification. In other words, the dive in which the ratings took place went on record as one of the three dives required by the Young Men's Christian Association underwater activities program for certification.

The criteria for the rating scale categorizations of both mask removal and buddy breathing were similar to that of the mask, fins, and snorkel bailout. The difference was the fact that the criteria for the five catagories was based exclusively on various degrees of stress exhibited by the subject. As in the criteria for the mask, fins, and snorkel bailout, the signs and degrees of stress were defined as

much as possible in terms of observable behavior. The exact rating scale and associated criteria for the mask removal and buddy breathing skills were as follows:

Mask Removal

Excellent (five points)

Absolutely no signs of stress are observed. (Task is performed in a smooth fluid manner with no hesitation in task initiation. The mask is completely clear of water upon completion. The subject appears completely comfortable during the 10 second time lapse when he is not in possession of the mask.)

Good (four points)

Very slight signs of stress are observed. (Task is performed in a smooth manner, but with a noticeable sense of urgency. The subject may appear slightly uncomfortable with the fact that he does not have his mask on or in his possession.)

Average (three points)

Minimal but obvious signs of stress are observed. (Task is performed relatively smoothly but slight hesitation in task initiation may be observed. The subject may appear obviously uncomfortable without his mask during the 10 second time lapse.)

Fair (two points)

Moderate signs of stress are observed. (Task is performed in a somewhat awkward manner with the subject fumbling the mask strap or mask skirt. The subject may show moderate hesitation in task initiation and may be unable to clear the mask completely of all water. The subject may appear moderately uncomfortable without his mask during the 10 second time lapse.)

Poor (one point)

Extreme signs of stress are observed. (Task is performed in an awkward and desperate manner. Extreme hesitation in task initiation may be observed along with the subject on the verge of panic during the entire task. Failure to complete the task places this subject in the category.)

Buddy Breathing

Excellent (five points)

Absolutely no signs of stress are observed. (Task is performed in a smooth fluid manner and there is no hesitation in task initiation. The subject remains calm during the task with his attention focused on the rhythm of regulator exchange.)

Good (four points)

Very slight signs of stress are observed. (Task is performed in a smooth manner but with a noticeable sense of

urgency on the part of the subject. The subject may also appear slightly uncomfortable with the fact that his air source is not in his mouth and may have his eyes focused directly on his own regulator.)

Average (three points)

Minimal but obvious signs of stress are observed. (Task is performed relatively smoothly but slight hesitation in task initiation is observed. Subject's attention is focused on his own breathing patterns rather than the regulator exchange rhythm.)

Fair (two points)

Moderate signs of stress are observed. (Task is performed in a somewhat awkward manner. The subject may offer the regulator with the wrong hand or offer it with the second stage upside down. The subject may also show a time lapse of three or more breaths in initiating the regulator exchange. Here again, the subject's attention is focused on his own breathing patterns rather than the rhythm of regulator exchange, but to a greater degree than in the previous category.)

Poor (one point)

Extreme signs of stress are indicated. (Task is performed in a desperate frenzied manner. The subject may pull at the regulator during the researchers cycle of breathing. The "wide-eye" syndrome may be observed through the mask. The subject may also show a time lapse of five or more

seconds before initiating regulator exchange. Failure to complete the task would also place the subject in this category.)

Procedure

After securing permission from Dr. Ken Rose to use a cross section of his scuba classes for the sample, the project was initiated. The procedure described here was employed in both the spring and summer class. The only difference was that 16 subjects were selected from the spring class as opposed to 18 in the summer class. There were two reasons for the data being taken from two different classes. The first reason was the fact that the researcher could not take more than 15 to 20 subjects on their first open water dive in one day due to time limitations. The other reason was that the researcher felt that selecting the sample from two different classes would lend more credibility and reliability to the results of the study.

One week prior to the date set for the first open water dive, the author met with the class at the Southwestern Oklahoma State University pool and explained in detail the procedure for the study. Each student was assigned a number written on paper and the number placed in a jar and randomly drawn out. Sixteen students were selected from the first class and 18 from the second class by this method. After the subjects were selected they were asked to complete the

questionnaire. The subjects were arranged in a line in alphabetical order then instructed one at a time to enter the water feet first and swim as far as possible underwater without surfacing for air. They were not allowed a push-off from the side upon entry, but were allowed one on the far wall should they be able to swim more than one length of the 75 foot pool. The distance of their swim was recorded from the point of entry into the water to the point where they surfaced for air using the one foot graduation markings on the inside of the pool wall. The distances were rounded to the nearest foot and recorded.

After all subjects completed the underwater swim, the details of the mask, fins, and snorkel bailout were explained. The subjects were asked to enter the water, one at a time, with their mask, fins, and snorkel in hand. After entry they were to don the fins, mask, and snorkel in that order and clear the mask and snorkel of water. This was to be done without surfacing for air if possible. Should they not be able to complete the entire task without surfacing they were to don and clear as much gear as they possibly could. During the performance of each subject, the researcher was on the bottom of the pool in scuba gear with an underwater slate containing the written criteria for each category of the rating scale and a place on which to record the rating score of each subject. As each subject performed the skill, their score was recorded on the slate. The

subject would then exit the pool and the next one would enter the water. The completion of this skill by all subjects ended the pool portion of the data collection. It should be noted here that the rating the subject received corresponded to the lowest category in which a behavior of that category was observed. For example, if a subject exhibited no signs of stress but was unable to clear his mask completely of water he received the rating of "Good" corresponding with the inability to clear all of the water from the mask.

One week later, all of the subjects met at Lake Tenkiller on the diving dock of Gene's Aqua Pro Shop. The subjects were given a briefing by the researcher on dive procedures and the two skills they were to perform during the dive. The researcher then took each subject on their first open water dive. At a depth of 15 feet, each subject was asked to remove his mask and hand it to the researcher. After a period of 10 seconds, the mask was returned to the subject for donning and clearing. The researcher then recorded the rating score of the performance on an underwater slate containing the written criteria for each category of the rating scale for both mask clearing and buddy breathing. Both the subject and the researcher then proceeded to a depth of 35 feet where the researcher gave the signal to begin buddy breathing. The subject took the regulator from his mouth and offered it to the researcher. The subject and

the researcher then engaged in eight cycles of regulator exchange. After the completion of the skill the rating score for the performance was recorded on the underwater slate. The subject and the researcher then surfaced. This dive procedure was repeated until all subjects were evaluated.

As mentioned earlier, the procedure described above was carried out with the sample subjects from both the spring and the summer class. Diving conditions for both open water dives were fair with visibility ranging from 6 to 10 feet and water temperature about 82 degrees at 40 feet. No serious problems were encountered with any subject.

Methods of Data Analysis

After the data was collected, it was summarized in table form with each subject's skill test scores, aquatic experience score, and athletic experience score appearing in a row corresponding to the subject's number. Also appearing in this row are responses indicating whether or not the subject had previously participated in a high risk activity or had a traumatic experience in the water. To be specific, a "yes" or a "no" appears under the headings of high risk activity and traumatic experience; the "yes" indicating a positive response to the question and "no" indicating nonparticipation or no traumatic experience. This table appears in the appendix. Also a basic statistical summary (means, standard deviations, etc.) appears in chapter four of this study.

All of the statistical analysis of the data was accomplished by using the SPSSx statistics program on the central computer at Oklahoma State University. All of the formal hypotheses were tested using the Spearman rank-difference correlation statistic. This statistic was used because the data analyzed fell under the heading of rank or ordinal data. Acceptance or rejection of the null hypotheses was based strictly on the significance level of the correlation which was $\alpha = .05$. This precludes the fact that the relationship is by chance but says nothing about the nature or strength of the relationship. The nature of the relationship, whether it be positive or negative, and the relative strength of the relationship will be the criteria by which the relevance and applicability of the relationship will be finally judged. For example a relationship significant at the .05 level might be obtained between the underwater swim and open water performance, but having a correlation coefficient of only .2. Even though it could be said with a degree of confidence that this relationship exists, and not just by chance, the strength of the relationship is not sufficient to conclude that scuba instructors should pay extra attention on the open water dive to those students who cannot swim very far underwater. Lastly, all correlations are displayed in matrix form in chapter four.

In order to determine if there was a significant difference between the scores of those who recorded previous

participation in a high risk activity and those who did not a Mann-Whitney U test was employed. A Mann-Whitney U test was used to determine if a significant difference exists between the scores of those who listed a response to the question and those that did not. The results of these two tests will be discussed in chapter four.

Individual Hypothesis Testing

In order to test Ho_1, a Spearman rank-difference correlation coefficient was computed between the distance a subject can swim underwater and his or her performance on their first open water dive. Rejection level for the null hypothesis was .05. The significance, nature, and strength of this correlation will be discussed in chapter four.

The testing of Ho_2 was also accomplished by the computation of a Spearman rank-difference correlation using the rating score of the mask, fins, and snorkel bailout and the combined score of both open water skills. The level of significance was, again, .05. The result of this statistical test will be discussed in chapter four.

In testing Ho_3, the Spearman rank-difference correlation was again used to determine the significance and strength of the possible realtionship between the extent of the subject's varsity athletic experience and the performance level of his or her first open water dive. Here again the rejection level for the null hypothesis was .05. The

significance, nature, and strength of this correlation will be discussed in chapter four.

Finally, the Spearman rank-difference correlation was again used to test Ho_4. The aquatic experience score was correlated with the combined open water score to determine if a significant relationship existed between a subject's level of formal aquatic instruction and his or her performance on their first open water dive. As in the testing of the other three hypotheses, the level of significance was .05. The results of this test appears in chapter four.

Validity and Reliability Concerns

The first validity and reliability concern that warrants discussion deals with the fact that the researcher was the only evaluator and performed all ratings on both parts of the evaluation instrument. There were two reasons that this was done. First, obtaining qualified and certified scuba instructors to rate both pool and open water performance would be extremely impractical if not impossible. In addition inter-rater reliability would have to be demonstrated. This too would be extremely difficult due to scheduling problems and conflicts of potential raters. Second, since the researcher had constructed the evaluative instrument, it was decided that he would be by far the most qualified to use it. This reasoning is supported by Baumgartner and Jackson who stated "One well qualified rater is preferable to several poorly qualified raters."[7]

According to Verducci there are four common errors related to rating skill performance. They are: (1) error of central tendency; (2) error of standards; (3) error of halo; and (4) logical error.[8] Error of central tendency involves the observer being hesitant to award extremely low or extremely high ratings while error of standards deals with inaccurate ratings due to the rater having predetermined standards. In considering the possibility of these two errors occurring, it should be remembered that the rating scale criteria was defined, as much as possible, in terms of observable behavior. The purpose of this was to eliminate as much subjectivity as possible and prevent these types of errors. It should also be noted that the researcher was keenly aware of these types of errors and every effort was made to avoid them. The next type of possible error that warrants discussion is the error of halo. This error refers to the rater's personal impression of the subject influencing his rating of that person's performance. There was little chance of this error occuring in this study due to the fact that the researcher had no contact whatsoever with the subjects except during the pool and open water observations. Another error that must be considered is logical error. This type of error appears when two or more traits are being rated and the rater tends to give similar ratings to traits that do not necessarily belong together. It should be noted that the researcher was aware of this

possibility and made every effort to insure that it did not occur. To be more specific, the researcher was aware that on the open water evaluation, mask clearing was a skill independent of buddy breathing and vica versa. Care was taken to rate each skill independently of the other.

The last type of validity concern related to the author being the evaluator deals with the possibility of author bias. This is perhaps the weakest area of the study and the most difficult with which to demonstrate nonexistence. According to Leedy: "Bias for the researcher, like the presence of germs for the surgeon, is next to impossible to avoid."[9] This statement would certainly hold true for this study due to the fact that the author not only performed the evaluation but also constructed the evaluative instrument and the questionnaire. Leedy goes on to say, however, that given the inevitability of bias, we should not be upset by its presence.[10]

The next area of validity and reliability to be discussed has to do with the research instruments. The scaling techniques used in evaluating pool performance, open water performance, athletic experience, and aquatic experience were all formed using guidelines set forth in the section of Verducci's Measurement Concepts Book entitled Suggestions for Construction of Rating Instruments.[11] These guidelines included the following:

1. Define selected traits in terms of observable behavior.

2. Determine the value of each trait and weight them accordingly.

3. Try out and revise the rating scale.

The first guideline was followed very closely during construction of the rating criteria and associated categories for the pool and open water evaluation instrument. As much as possible, the catagorical divisions were defined in terms of behavior that could be clearly recognized by any competent scuba instructor or experienced scuba diver. For example, in the "fair" catagory in mask removal, one of the behaviors placing a subject in this catagory is the inability to clear his or her mask of all water. This behavior is easily observed. It was impossible, however, to define each catagory in this manner. Some subjective criteria had to be included. For example, a differentiating criteria in mask removal was slight hesitation in initiating task performance in the average catagory and "moderate hesitation" in the fair catagory. Obviously, the difference between slight and moderate hesitation is subject to individual interpretation. This type of description of catagories was avoided when possible. Also, there was always more than one descriptor per catagory, allowing the evaluator more than one behavior on which to make a decision.

The second guideline was useful during the construction of the scales for aquatic and athletic experience. In determining the scale for formal aquatic educational experience, a wide selection of courses taught by the Red Cross, major universities, and other aquatic agencies were weighted on a scale from five to one with five representing the courses involving the most difficult skills and one representing no courses having been taken. In determining the scale for athletic experience a similar scale was constructed with five representing the longest extent of athletic participation and one representing no previous varsity athletic experience.

The third guideline adhered to also. A pilot study was performed on 15 subjects using the pool and open water instruments discussed in this chapter. Results were clearly indicative of performance levels as observed by the author and other certified scuba instructors, however, no validity and reliability coefficients were computed.

Finally the research instrument was examined and approved by a jury of experts in both the scuba diving and academic fields. The last limiting factor of the study that will be discussed deals with the area of reliability. According to Verducci, perfect reliability rarely occurs in the field of physical educatiion.[12] The main reliability concern of this study involved what Huck, Cormier and Bounds calls replicative validity.[13] In other words, could this

study be done by another researcher using the same instrumentation? The authors answer to this question is a conditional yes. Another researcher using the instrumentation of this study could conduct a valid research effort provided he or she possesses a moderate degree of experience in both scuba diving and teaching scuba diving. In other words, in order for a researcher to use this instrumentation effectively he or she would have to know, understand, and have experienced the ways in which people learn how to manipulate scuba equipment and the mental, emotional, and physical stress that is present while doing so. This would be necessary in order for the researcher to accurately evaluate the subjective areas of the rating instrument. Also, Huck, Cormier, and Bounds identify two types of replication of studies. The first type is direct or exact replication. The second type is systematic replication in which the techniques or instrumentation of the initial study are changed.[14] Using this premise, a researcher would be able to modify the procedure or instrumentation as to increase validity and reliability. It should be remembered that the instrument used to evaluate pool and open water skills is, to the author's best knowledge, the first of its kind.

ENDNOTES

[1]Paul D. Leedy, Practical Research--Planning and Design (New York: MacMillan Publishing Co., Inc., 1980), pp. 133-165.

[2]Ibid., p. 120.

[3]Millie Roberts, Beginning Skin and Scuba Diving, Physical Education Activity, A proposal for use in the Dade County Public Schools, Miami, Florida, 1971.

[4]S. M. Ascher and William L. Shadburne, Scuba Handbook for Humans (Dubuque, Iowa: Kendall/Hunt Publishing Company, 1975), pp. 25-40.

[5]SPSSx Users Guide (McGraw Hill Book Company, 1983).

[6]Frank M. Verducci, Measurement Concepts in Physical Education (C.V. Mosby Company, 1980), p. 26.

[7]Baumgartner and Jackson, Measurement for Evaluation in Physical Education (Houghton Mifflin Company, 1975), p. 239.

[8]Verducci, p. 194.

[9]Leedy, p. 126.

[10]Ibid.

[11]Verducci, pp. 192-194.

[12]Ibid., p. 154.

[13]Huck, Cormier, and Bounds, Reading Statistics and Research (Harper-Row Publishers, 1974), p. 369.

[14]Ibid.

CHAPTER IV

ANALYSIS OF DATA

It was the purpose of this study to determine if relationships existed between the initial open water performance of a scuba student and the variables of pool performance, extent of athletic participation, and level of formal aquatic instruction. From this problem statement the following hypotheses were formed:

Ho_1 - There is no significant relationship between the distance a scuba student can swim underwater with one breath and his or her performance on his or her first open water dive.

Ho_2 - There is no significant relationship between a scuba student's pool performance on a mask, fin, and snorkel bailout and his or her performance on his or her first open water dive.

Ho_3 - There is no significant relationship between the extent of a scuba students previous varsity athletic experience and performance on his or her first open water dive.

Ho_4 - There is no significant relationship between the amount of previous in water aquatic instruction a scuba student has had and his or her performance on his or her first open water dive.

In addition to the above hypotheses, possible differences in the combined open water scores of those who participated in high risk activity or those who had a traumatic aquatic experience were investigated.

The sample used in the study consisted of 34 students randomly selected from two basic scuba courses at Southwestern Oklahoma State University. These students first completed a questionnaire designed to determine their levels of previous athletic experience, previous traumatic aquatic experience, and formal aquatic instruction. The students were then evaluated on pool and open water scuba skills using an evaluation instrument designed by the researcher and approved by a jury of experts. The questionnaire and the evaluation instrument were constructed so that a numerical representation of the pool skill variables, open water skill variables, athletic experience variable and the aquatic instruction variable were obtained. The variables of traumatic experience and experience in high risk activity were true dichotomous variables and required only yes and no answers.

The data collected from the questionnaires, pool performances, and open water performances, were documented and then placed on the Oklahoma State University central computer using the SPSSx program format. In addition to computing the correlations for hypothesis testing and selected tests for significant score differences, the

computer was instructed to calculate a general statistical analysis of each variable. The statistics computed for each variable included the mean, median, mode, standard deviation, and a frequencies table. The results are summarized below.

As can be seen in Table I, the distance subjects swam underwater while holding their breath ranged from 42 feet to 117 feet with a mean of 76.2 feet. Also appearing in Table I are the frequencies and percents for each distance swam along with the measures of central tendency for this variable. It is interesting to note that the mean, median, and mode of the distances were in close proximity.

Table II lists the frequency of each rating assigned in the mask, fins, and snorkel bailout task along with corresponding frequencies and percents. When examining these tables, it should be remembered that one represents the lowest level of performance and five the highest level of performance. As was the case in the majority of pool and open water ratings, all measures of central tendency were relatively close.

The frequencies and corresponding percents of each of the ratings assigned in the open water skill of mask clearing are presented in Table III. All subjects completed this skill with a rating of at least two, therefore; no scores of one were obtained.

TABLE I

POOL SKILL 1 - UNDERWATER BREATH-HOLD SWIM
DISTANCES MEASURED TO THE NEAREST FOOT

Distance in Feet	Frequency	Percent	
42	1	2.9	Mean = 76.2
48	1	2.9	Median = 75.0
53	2	5.9	Mode = 75.0
57	2	5.9	Standard
58	2	5.9	Deviation = 18.4
62	2	5.9	
65	1	2.9	
70	2	5.9	
71	1	2.9	
73	1	2.9	
74	1	2.9	
75	4	11.8	
77	1	2.9	
85	1	2.9	
86	1	2.9	
87	1	2.9	
90	1	2.9	
92	3	8.8	
93	1	2.9	
95	1	2.9	
98	1	2.9	
100	1	2.9	
115	1	2.9	
117	1	2.9	
Total	34	100.0	

TABLE II

FREQUENCIES, PERCENTS, AND MEASURES OF CENTRAL TENDENCY FOR MASK, FINS, AND SNORKEL BAILOUT RATINGS

Rating	Frequency	Percent	
1	3	8.8	Mean = 3.2
2	7	20.6	Median = 3.0
3	9	26.5	Mode = 4.0
4	10	29.4	Standard Deviation = 1.2
5	5	14.7	
	34	100.0	

TABLE III

FREQUENCIES, PERCENTS, AND MEASURES OF CENTRAL TENDENCY FOR MASK CLEARING RATINGS

Rating	Frequency	Percent	
1	0	0.0	Mean = 3.4
2	4	11.8	Median = 3
3	16	47.1	Mode = 3
4	9	26.5	Standard Deviation = .894
5	5	14.7	
	34	100.0	

Table IV contains the frequencies, percents, and measures of central tendency for the open water skill of buddy breathing. All subjects did well on this skill resulting in no ratings in the one or two category. Also, the mean, median, and mode were all computed to be 4.0.

TABLE IV

FREQUENCIES, PERCENTS, AND MEASURES OF CENTRAL TENDENCY FOR BUDDY BREATHING RATINGS

Rating	Frequency	Percent	
1	0	0.0	Mean = 4.0
2	0	0.0	Median = 4.0
3	4	11.8	Mode = 4.0
4	25	73.5	Standard Deviation = .521
5	5	14.7	
	34	100.0	

To obtain a numerical representation of both the open water skills of mask clearing and buddy breathing, each subjects scores on these two skills were summed. The rating values ranged from five to ten with a mean of 7.5. Both the

median and the mode for this rating was 7.0. These results are listed in Table V.

TABLE V

FREQUENCIES, PERCENTS, AND MEASURES OF CENTRAL TENDENCY FOR THE SUM OF MASK CLEARING AND BUDDY BREATHING RATINGS

Summed Rating Values	Frequency	Percent	
5	3	8.8	Mean = 7.5
6	2	5.9	Median = 7.0
7	15	44.1	Mode = 7.0
8	7	20.6	Standard Deviation = 1.3
9	4	11.8	
10	3	8.8	
	34	100.0	

A questionnaire was used to obtain a numerical representation of each subjects athletic experience. Scores ranged from one to five with five representing the greatest extent of athletic participation and one the lowest. The frequencies, percents, and measures of central tendency for these numeric scores are listed in Table VI.

TABLE VI

FREQUENCIES, PERCENTS, AND MEASURES OF CENTRAL TENDENCY FOR ATHLETIC EXPERIENCE SCORES

Score	Frequency	Percent	
1	12	35.3	Mean = 3.2
2	1	2.9	Median = 4.0
3	2	5.9	Mode = 1.0
4	7	20.6	Standard Deviation = 1.8
5	12	35.3	
	34	100.0	

Table VII contains the frequencies, percents, and measures of central tendency for the scores representing each subject's formal aquatic education. Various aquatic courses were weighted according to level of difficulty. The subjects were asked to check each of these courses they had completed. The weights of the courses checked were summed yielding an aquatic experience score.

It was interesting to note that all subjects scored above one on the first open water skill and above two on the second. This was expected however, because of the fact that all students involved in the study completed both of their required open water skill tests and went on to complete all

requirements necessary for certification. Another descriptive statistic that was noteworthy was the fact that almost 74% of the subjects had no formal aquatic instruction within the last five years prior to enrollment in scuba. Also, as seen in Table VIII, 67.6% of the subjects had previously participated in an activity that they considered to be high risk while only 17.6% had been involved in a traumatic experience in the water. Lastly, all but three of the males in the class (86.4%) had an athletic experience score of three or greater indicating that the majority of the males were or had been at one time good athletes. Only 3 of the 12 female subjects had an athletic score of three or greater with 75% having no varsity athletic experience at all.

TABLE VII

FREQUENCIES, PERCENT, AND MEASURES OF CENTRAL TENDENCY FOR AQUATIC EXPERIENCE SCORES

Score	Frequency	Percent	
1	25	73.5	Mean = 1.9
2	2	5.9	Median = 1.0
3	3	8.8	Mode = 1.0
4	1	2.9	Standard Deviation = 1.8
7	3	8.8	
	34	100.0	

TABLE VIII

QUESTIONNAIRE RESPONSES TO HIGH RISK ACTIVITY EXPERIENCE AND AQUATIC TRAUMATIC EXPERIENCE

Responses to the question: "Have you ever participated in an activity that you consider high risk?"			
Yes = 23	No = 11	% responding affirmative:	67.6
Responses to the question: "Have you ever been in a situation in which you thought you might drown?"			
Yes = 6	No = 28	% responding affirmative:	17.6

Hypothesis Testing

Ho_1 stated that there is no relationship between the distance a scuba student can swim underwater with one breath and his or her performance on his or her first open water dive. In order to test this null hypothesis a Spearman rank order correlation was computed between the underwater swim distances and the combined open water skill scores. A significant correlation at the .05 level constituted grounds for rejection of the null hypothesis. The results showed the probability level for this correlation to be .052, therefore the null hypothesis could not be rejected.

Ho_2 stated that no relationship existed between a scuba student's performance on a mask, fins, and snorkel bailout

task and his or her performance on his or her first open water dive. The testing of this null hypothesis was accomplished by correlating the rating scores of the mask, fins, and snorkel bailout task with the combined open water skill scores using a Spearman rank order correlation statistic. A probability level of .05 was required to reject the null hypothesis. The results showed the probability level for this correlation to be .001. Based on this probability level, the null hypothesis was rejected. The correlation coefficient for this relationship was .4955.

Ho_3 stated that no relationship existed between the extent of a scuba student's varsity athletic experience and his or her performance on his or her first open water dive. The testing of this null hypothesis was done by correlating the athletic experience scores with the combined open water skill scores using a Spearman rank-order correlation statistic. Grounds for rejection of the null hypothesis once again consisted of a correlation significant at the .05 level. The probability level for this correlation was .133, indicating the null hypothesis could not be rejected.

Ho_4 stated that there is no relationship between the amount of formal aquatic instruction a scuba student has received and his or her performance on his or her first open water dive. The testing of this hypothesis was accomplished

by correlating the aquatic experience scores with the combined open water skill scores using a Spearman rank-order correlation statistic. As with the other hypothesis, the grounds for rejection was a correlation significant at the .05 level. The probability level for this correlation was .330, indicating the null hypothesis could not be rejected. The probability level for each correlation along with the corresponding coefficients are listed in Table IX.

From the testing of the hypotheses it can be seen that the only relationship that was significant was the one between the mask, fins, and snorkel bailout and open water performance. The probability level was .001 which indicates that the correlation did not occur by chance. The strength of the correlation was moderate as indicated by the correlation coefficient of .4955. The rest of the correlations relating to the hypotheses were not significant at the .05 level.

Examination of the correlation matrix in Table IX yielded some facts worth noting. First, the correlation between the two open water skills of mask clearing and buddy breathing was significant ($p < .001$) and had a coefficient of .6776. This indicates a fairly strong relationship between these two skills. Also, a relationship significant at the .002 probability level was found between the underwater swim distance and the mask, fins, and snorkel bailout task. The strength of this relationship was moderate with a correlation coefficient of .4719. From this discussion we

can conclude that a significant relationship exists between the two pool skills and also between the two open water skills.

In order to determine if previous participation in high risk activity by the subject affected his or her initial open water performance, a Mann Whitney U test was performed. This nonparametric statistic compared the combined open water skill scores of those who indicated participation on the questionnaire with the scores of those who did not. The results of this test showed that no significant difference existed between the scores of the two groups. The Z value was .99 which did not equal or exceed the .05 significance level value of 1.96. The Mann Whitney U test was also used to compare the combined open water skill scores of those who recorded a traumatic aquatic experience with those who did not. Here again, the results indicated that no significant difference existed between the scores of the two groups with the value of z equaling .26. Lastly, this same statistic was used to compare the combined open water skill scores of males and females. The Z value for this test was -.34 indicating no significant difference. The results of all of the Mann Whitney U computations are displayed in Table X.

TABLE IX

SPEARMAN CORRELATION COEFFICIENT MATRIX

Pool Skill 2	(Mask, Fins, and Snorkel Bailout)	.4719 p = .002			
Open Water Skill 1	(Mask Clear-ing)	.2107 p = .116	.4732 p = .002		
Open Water Skill 2	(Buddy Breath-ing)	.4430 p = .004	.4582 p = .003	.6776 p < .001	
Combined Open Water Skill	(The sum of mask clear-ing and buddy breath-ing scores)	.2834 p = .052	.4955 p = .001	.9758 p < .001	.7984 p < .001

TABLE IX (Continued)

Aquatic Experience Score	.1173 p = .254	-.0604 p = .367	-.0596 p = .369	-.0145 p = .468	-.0784 p = .330	
Athletic Experience Score	.1962 p = .113	.1942 p = .135	.2172 p = .109	.0153 p = .277	.1961 p = .133	.0539 p = .381
	Pool Skill 1 (Underwater swim distance)	Pool Skill 2 (Mask, Fins, and Snorkel Bailout)	Open Water Skill 1 (Mask Clearing)	Open Water Skill 2 (Buddy Breathing)	Combined Open Water Skill (The sum of mask clearing and buddy breathing)	Aquatic Experience Score Score

TABLE X

MANN WHITNEY U TEST RESULTS

Male vs Female	$U_1 = 122.5$	$U_2 = 141.5$	$Z = -.34$
High Risk Activity	$U_1 = 153.5$	$U_2 = 99.5$	$Z = .99$
Traumatic Experience	$U_1 = 78.0$	$U_2 = 90.0$	$Z = .26$

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine if relationships existed among personal background experiences, mask, fins, snorkel and other pool skills, and initial open water performance in scuba diving. The problem was more explicitly defined in terms of null hypotheses based on the following questions:

1. Does a relationship exist between one's performance level on selected pool training skills and initial open water performance?

2. Does a relationship exist between participation in athletics and scuba diving performance levels?

3. Does a relationship exist between the extent of one's previous in-water aquatic instruction and scuba diving performance levels?

4. Does previous participation in other high risk activity affect initial open water performance in scuba diving?

5. Does previous traumatic experience in the water affect initial open water performance in scuba diving?

If affirmative answers were found to these questions, scuba diving instructors would have a means by which they could identify potential problem students. Negative answers would also benefit the diving community. For years, scuba diving instructors have assumed that if a person performs well during pool training, he will also perform well in the open water. If this assumption is false, these instructors could possibly be giving insufficient attention to students who may have severe problems in dealing with the open water environment even though their pool skills are above average. This creates both a hazardous and liable situation. From this discussion it can easily be seen that a need for this study exists.

In order to determine if relationships existed between pool skills and initial open water performance correlations were computed between the following: (1) breath-hold underwater swim distances and a combined rating score representing open water skill levels, and (2) a rating score taken from a mask, fins, and snorkel bailout task and the combined rating score representing open water skill levels. The possible relationship between athletic experience and scuba performance was investigated by computing a correlation between a numerical representation of athletic experience obtained through a questionnaire and the combined open water skill score mentioned above. A similar correlation was computed in testing the possible relationship between scuba

diving performance and amount of formal aquatic instruction received by the student. In order to determine if the variables of previous participation in a high risk activity and previous aquatic trauma had a significant affect on open water performance a nonparametric statistic was computed testing for significant differences between the combined open water scores of those students who indicated positive responses to these variables and those who did not.

Findings

The results of the statistical analyses yielded the following findings related to the problem statements:

1. No significant relationship exists between the distance a scuba student can swim underwater and his or her performance on his or her first open water dive.

2. A significant relationship does exist between a scuba student's performance on a mask, fins, and snorkel bailout task and his or her performance on his or her first open water dive.

3. No significant relationship exists between the extent of a scuba student's varsity athletic experience and his or her performance on his or her first open water dive.

4. No significant relationship exists between the amount of formal aquatic instruction a scuba student has received and his or her performance on his or her first open water dive.

5. There is no significant relationship between previous participation in high risk activity and the performance of a scuba student on his or her first open water dive.

6. There is no significant relationship between prior traumatic aquatic experience and the performance of a scuba student on his or her first open water dive.

7. There is no significant difference between the performance levels of males and females on their first open water dive.

Other findings of interest are as follows:

1. A moderate to high relationship exists between the open water skills of mask clearing and buddy breathing.

2. A moderate relationship exists between the two pool skills of underwater swimming and the mask, fins, and snorkel bailout task.

Conclusions

Taking into consideration the findings, parameters, limitations, and delimitations of the study, the following conclusions were made:

1. A relationship does exist between a scuba student's ability to perform pool skills and his or her ability to perform open water skills. The mask, fins, and snorkel bailout task combines the skills of breath holding and equipment manipulation and is representative of a large

majority of pool skills. The moderate correlation obtained between this skill and open water performance substantiates this conclusion even though the underwater swim correlation was not significant. The implication of this conclusion is that scuba instructors should observe their students while they are performing pool skills in order to identify students who might experience difficulty in open water.

2. The amount of athletic experience a scuba student has undergone is not related to his or her initial open water performance. In other words, a scuba instructor cannot assume that people who are athletically inclined will do well in scuba diving.

3. The amount of formal aquatic instruction previously received by a scuba student is not related to his or her initial open water performance. Given this fact, scuba instructors cannot assume that those students who are advanced swimmers and/or lifeguards will do well in scuba diving.

4. A scuba student's prior experience in high risk activity does not affect initial open water performance. Scuba instructors cannot assume that those students who have considerable experience in stressful or risk oriented sports will do well in scuba diving.

5. Having experienced trauma in the water does not affect a scuba student's initial open water performance. Scuba instructors cannot assume that previous aquatic trauma will decrease performance levels in scuba diving.

6. The se of a scuba student does not affect initial open water perf mance of scuba divers. Assuming scuba diving performa e levels based on sex is erroneous.

In summati , it would behoove scuba instructors to pay close attention n open water to those students who experienced probl s during pool training exercises. However, trying to ident y potential problem students by means of demographic inf mation is not worthwhile. Also, scuba instructors sho d not assume a student will do well in open water divi just because he is a strong swimmer, lifeguard, athl e, or has experience in risk oriented activity.

Recommendations

Based on t findings, parameters, limitations, and delimitations o the study, the folllowing recommendations are made:

1. This s dy should be identically replicated by other individua scuba diving instructors in order to validate the resear instrument and the corresponding correlation results.

2. The st y should be replicated using subjects selected from a on-academic setting in order to attain a wider age and s range along with a greater variation of background expe ences.

3. The study should be replicated with initial open water dive and associated ratings taking place in the ocean where visibility is increased and the water composition and associated buoyancy is different.

4. The study should be replicated using multiple evaluators and raters instead of one. Interrater reliability should then be computed.

5. Other types of evaluative instrumentation should be developed for both pool and open water skills.

6. Scuba diving instructors should closely monitor a students pool skills in order to attain a general evaluation of the skills. This evaluation should be reviewed prior to the student's first open water dive with the instructor taking great care with those students who demonstrated poor skills in the pool.

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APPENDIXES

APPENDIX A

RESEARCH QUESTIONNAIRE

Name_____ Age_____ Sex_____

1) With regard to varsity athletic experience, place an x before the category that applies to you.

_____ I have been a member of a starting varsity athletic team in at least one sport for 3 or more years.

_____ I have been a member of a starting varsity athletic team in at least one sport for 2 years.

_____ I have been a member of a starting varsity athletic team in at least one sport for 1 year.

_____ I have been a member of a varsity athletic team but never made the starting team.

_____ I have never been a member of a varsity athletic team.

2) Identify with an x each of the following aquatics courses you have completed within the past 5 years.

_____ Water Safety Instruction

_____ Skin Diving

_____ Advanced Swimming and Lifesaving (or equivalent)

_____ Competitive Swimming

_____ Intermediate Swimming (or equivalent)

_____ Senior Lifesaving (or equivalent)

_____ Beginning Swimming (or equivalent)

_____ Synchronized Swimming or Water Exercise

3) Have you ever participated in another activity that you consider to be high risk? yes_____ no_____

4) Have you ever been in a situation where you thought you might drown? yes_____ no_____

APPENDIX B

RAW SCORES AND QUESTIONNAIRE RESPONSES

Subject Number	Underwater Swim Distances	Mask, Fins, and Snorkel Bailout Ratings	Mask Clear-ing Ratings	Buddy Breath-ing Ratings	Combined Open Water Skill Ratings	Aquatic Exper-ience Scores	Athletic Exper-ience Scores	Previous High Risk Actiiity Exper-ience?	Previous Traumatic Aquatic Exper-ience?
1)	75	2	2	3	5	3	4	No	No
2)	62	5	3	4	7	1	1	No	No
3)	73	4	5	4	9	1	4	Yes	No
4)	75	3	4	4	8	1	5	Yes	No
5)	58	3	3	4	7	1	5	Yes	No
6)	98	5	4	4	8	1	4	Yes	Yes
7)	92	3	4	4	8	1	5	Yes	No
8)	74	2	3	4	7	3	5	Yes	No
9)	86	3	3	4	7	1	4	Yes	Yes
10)	70	4	4	4	8	1	5	Yes	No
11)	92	4	3	4	7	1	4	Yes	No
12)	100	5	5	5	10	1	4	No	No
13)	57	4	5	5	10	1	4	Yes	No
14)	93	3	3	4	7	1	3	Yes	No
15)	77	4	3	4	7	2	5	No	No
16)	62	1	3	4	7	1	5	No	No
17)	115	5	4	5	9	1	5	No	No
18)	85	2	3	4	7	3	3	No	No
19)	87	4	3	4	7	1	5	Yes	No
20)	75	2	3	4	7	1	1	Yes	No
21)	71	2	2	4	6	1	1	No	No
22)	65	1	4	4	8	1	1	Yes	Yes
23)	53	2	4	4	8	1	1	Yes	Yes
24)	75	4	5	4	9	1	5	No	No
25)	42	2	2	3	5	1	2	Yes	No
26)	70	3	3	4	7	1	1	No	No

Subject Number	Underwater Swim Distances	Mask, Fins, and Snorkel Bailout Ratings	Mask Clear-ing Ratings	Buddy Breath-ing Ratings	Combined Open Water Skill Ratings	Aquatic Exper-ience Scores	Athletic Exper-ience Scores	Previous High Risk Actiiity Exper-ience?	Previous Traumatic Aquatic Exper-ience?
27)	58	3	3	3	6	7	5	Yes	No
28)	92	4	5	5	10	7	1	Yes	No
29)	48	3	2	3	5	1	1	No	No
30)	53	4	4	4	8	2	1	Yes	No
31)	95	3	3	4	7	7	1	Yes	No
32)	57	1	3	4	7	1	1	Yes	Yes
33)	117	5	3	4	7	1	1	Yes	Yes
34)	90	4	4	5	9	4	5	Yes	No

VITA 2

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Doctor of Education

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