THE DEVELOPMENT OF AN OBJECTIVE MEASURE OF ACHIEVEMENT IN SWIMMING AT THE ADVANCED LEVEL FOR COLLEGE WOMEN

by

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A Thesis Submitted to
the Faculty of
the University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Physical Education

Greensboro
1964

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LINTNER, MARIE ANNE. The Development of an Objective Measure of Achievement in Swimming at the Advanced Level for College Women. (1964) Directed by: Dr. Rosemary McGee. p. 58.

The study was conducted for the purpose of developing an objective measure of achievement in swimming at the advanced level for college women. A secondary purpose was to establish tentative norms.

The subjects were volunteers from the undergraduate classes at the University of North Carolina at Greensboro. All subjects participating in the study were enrolled in or had been members of one of the following groups at the University: (1) advanced swimming class; (2) water safety instructor's course; or (3) physical education major's course.

Ten students enrolled in an advanced swimming class served as subjects in a pilot study group. Thirty-seven students participated as subjects in a regular testing program.

An objective test was devised by the writer and used to measure achievement. A panel of three qualified judges rated the subjects on each of ten items of a subjective test. These ratings served as the criterion for establishing test validity. The initial test was followed by a re-test for thirty-one of the subjects within a period of three to seven days. The final version of the test consisted of the following items: (1) American crawl (distance); (2) inverted breast stroke (distance); (3) trudgen stroke (distance); (4) obstacle course (time); and (5) treading water supporting weight (time).

The objective test battery devised for this study has acceptable reliability and validity for use at the advanced swimming level for college women. The results of the present study have found the obstacle course to be the best single item measure of advanced swimming achievement. The objective test battery used in this study seems practical in terms of time, equipment, and ease of administration.

ACKNOWLEDGEMENT

The writer wishes to express her sincere gratitude and appreciation to Dr. Rosemary McGee, whose patient guidance and understanding have been an inspiration throughout the course of this study.

Sincere gratitude is expressed to Dr. Gail Hennis for her assistance during Dr. McGee's absence.

Appreciation is also expressed to Miss Nancy Angle and Miss Shirley Flynn for their assistance as judges.

For her assistance in the testing of subjects, the writer wishes to express thanks to Brenda Zeh.

Sincere appreciation is expressed to the many students who gave of their time and energy to make this study possible.

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CHAPTER I

INTRODUCTION

There has been increased emphasis on the need for objective evaluation in all areas of education. Objective measures have been used as a basis for evaluation of student achievement, classification, individual guidance and teacher direction. The field of physical education has endeavored to follow this pattern with varying degrees of success. Objective measurement has been almost nonexistent in many sports areas. This has been especially true in the area of swimming where most of the past measurements have used subjective ratings or skill check lists.

The number of participants in water activities has increased decidedly in the past few years. More and more of these swimmers have progressed to the advanced level. This indicates a need for additional measures of achievement for advanced swimmers. The Women's National Aquatic Forum listed the development of swimming tests for classification and diagnostic purposes as one of the areas needful of research in aquatics. (22) The lack of objective measures of achievement in advanced swimming initiated this study.

CHAPTER II

STATEMENT OF THE PURPOSE

The purpose of this study was to develop an objective measure of achievement in swimming at the advanced level. A secondary purpose was to develop tentative norms for the achievement measures represented in the objective test.

The test was administered to college women who were advanced swimmers. An advanced swimmer was defined as one who had had class instruction in the American crawl, inverted breast stroke, trudgen stroke and treading water.

LIMITATIONS

This study had the following limitations: (1) the selection of the subjects was confined to the subjects who met the qualifications of an advanced swimmer as defined in this study, (2) the subjects were volunteers, and (3) the time available for testing was limited by the closing of the pool for construction purposes.

CHAPTER III

REVIEW OF LITERATURE

A current study of literature can provide a basis for research concerning particular problems. Friermood made this statement:

> Thoughtful study directed toward some of these specific problems can help make progress. There is no special magic in study, search, and research, but the systematic application of methods that have been developed in other fields can well be utilized more effectively in aquatics. (18:44)

A survey of the completed studies in the area of aquatics established the foundation for further research in this field and showed the variety of studies undertaken. Alley (9), Counsilman (13), and Karpovich (20) report studies concerning the propulsive forces in swimming the crawl stroke. The problem of water resistance in swimming has been analyzed by Alley (9) and Karpovich (21). The relation of warm-ups and swimming performance has received considerable attention. DeVries (16) was concerned with the effects of warm-ups on competitive swimming. Carlile (12) studied passive warm-ups and their effect on performance in swimming. The effect of swimming on performance in other sports was studied by Nelson (23). The physiological effects of training and conditioning for swimming have been investigated by Davis (15). The controversial issue of swimming after meals has been the subject of concern for Ball (10) and Steinhaus (26). Bennett (11) considered the relationship of swimming and other activities to the motor ability of college women. A study of the learning rate of beginning swimmers as

related to motor ability, frequency of practice and swimming competence was conducted by Scott (24). The afore-mentioned studies are representative of the research which has been conducted in relation to aquatics.

EVALUATION OF SWIMMING

Swimming teachers have relied principally on rating scales or check lists of skills to measure achievement. There are few objective tests of swimming ability. Cureton was concerned with the lack of standardization in testing and said,

> with the goal in view of producing a sound educational experience, graduated in nature, and comprehensive enough to insure the development of well rounded aquatic ability, some modification of a fundamental nature is needed in the testing program. (14:54)

He conducted a study with beginning swimmers for the purpose of making a standard test at that level. A list of beginning swimming skills was classified into the following groups according to the emphasis received during instructional periods:

I. Introductory confidence and adjustment skills
II. Breathing and buoyancy skills
III. Gliding and body control skills
IV. Initial diving skills
V. Leg movements
VI. Arm movements
VII. Coordination and combination swimming items (14:56)

A test battery of twenty-five items was prepared and administered to regular swimming classes. Analysis of the results indicated that the final item was the most valid and could be used as a "Standard Single

Item Achievement Test" for beginners. The standard test for beginners consisted of a foot first jump into deep water followed by a twenty-five foot swim, turn and swim back to the starting point (4).

Hewitt (19) constructed achievement scale scores in swimming for high school students. His scores were based on the following test items:

		Reliability	Validity
1.	25 yard flutter kick holding water polo ball - timed	.89	.60
2.	50 yard crawl - timed	.92	.65
3.	25 yard elementary back stroke - number of strokes	.96	.88
4.	25 yard side stroke - number of strokes	.90	.94
5.	25 yard breast stroke - number of strokes	.93	.77
6.	10 minute endurance swim - distance		

A push-off from the side of the pool was used in items 1, 3, 4 and 5. The crawl for time was started with a racing dive. The raw scores made on the six tests were totaled and the total test battery score was used as the criterion. The last item necessitated too much administrative time, correlated lowest with the criterion, and was dropped from the final test battery. With a correlation coefficient of .94, the best single measure of the criterion was shown to be the side stroke.

Scott (24) used a "15-Minute Keep-Up Test" as the criterion of achievement in a study with beginning swimmers. The test consisted of an "headfirst entry in deep water, level off and tread two minutes; swim five lengths (length = 60 feet) - any stroke, but only one length on back; keep up for remainder of fifteen minutes." (24:92) In addition,

form and safety in the water were judged on a five-point scale and the combined ratings of five judges were used as a measure of competence in the water.

Fox (17) developed an objective test of swimming power for the side stroke and front crawl. The test was based on an unpublished study by the same author showing little correlation between speed and form ratings. She concluded that "in rating a stroke, power is one of the important factors, while speed is not." (17:233) The ankles of the swimmer were supported by a weighted rope; when the rope dropped, the swimmer began stroking from a dead start thereby eliminating any help from a push-off. The distance covered (to the nearest foot) during five complete strokes served as the measurement of power. The measurement was taken from the ankles in the starting position to the position of the ankles at the beginning of the leg recovery on the sixth stroke of the side stroke; for the front crawl, the ankle position was noted as the fingers entered the water at the beginning of the sixth arm cycle. Any part of a stroking movement at the beginning of the test was counted as a stroke regardless of whether or not it was a completed stroke. Fox reported coefficients of reliability and validity for the side stroke as .97 and .83 respectively. The coefficients of reliability and validity for the front crawl were found to be .95 and .69 respectively. The test was used for all levels of swimming from beginning through advanced. Fox thought that the test design had definite possibilities for the measurement of the back crawl, breast stroke, and elementary back stroke. The Fox test was used in this study with a modification of the starting position.

In a study initiated to determine the relationship between general motor ability and achievement in intermediate swimming, Wilson (27) developed an objective swimming test as a measure of achievement at the intermediate level. A six-item battery was administered to regular women's swimming classes. The battery consisted of the following skills:

1. Time: 25 yard flutter kick with kickboard
2. Time: 25 yard sculling, no leg kick
3. Number of strokes: 25 yard side stroke
4. Number of breaths: drownproofing
5. Distance in feet: plunge dive and glide
6. Number of turns: Underwater swim (27:20)

The last item involved an underwater course in which numbered bricks had to be turned in numerical order. The following coefficients of reliability and validity were reported for the test items:

	Reliability	Validity
1. Flutter kick	.85	.46
2. Sculling	.74	.60
3. Side stroke	.72	.60
4. Drownproofing	.61	.25
5. Plunge dive	.80	.65
6. Underwater swim	.76	.60

The Drownproofing item was deleted from the battery because of its poor statistical showing. A subjective test of nine items representing intermediate swimming skills and utilizing judges ratings was employed as the criterion.

Silvia (25) developed requirements for a proficiency examination in swimming for men and women physical education majors at Springfield College. The examination included five items:

1. Continuous swim for twenty-eight minutes, demonstrating correct techniques of seven basic strokes.
2. Continuous bobbing in deep water for fifteen minutes with legs tied together with a rubber band and hands clasped behind back.
3. Underwater swim of fifty yards for men and forty yards for women.
4. Forty yard crawl for time of twenty-four seconds or better for men and twenty-eight seconds or better for women.
5. Forty yard backstroke for time of twenty-eight seconds or better for men and thirty-five seconds or better for women. (25:32)

This is probably the most strenuous of the batteries available at the present time.

ADVANCED SWIMMING SKILLS

The literature reveals variations of opinion concerning the classification of advanced skills. The main difference appears to be in the placement of the various strokes in the swimming progression. Torney (8) compiled a list of twenty swimming fundamentals which should be possessed by a competent swimmer. Among the items listed were the fundamental strokes (breast, side, back and overhand strokes); surface diving; underwater swimming for a limited distance; treading; and advanced skills and stroke variations (racing back, trudgen, and inverted breast stroke). He expressed the opinion that an advanced swimmer should be capable of treading water using the legs only; submerging rapidly from the surface; and swimming underwater with relative ease.

The American Red Cross (1) classified the following as advanced swimming skills: inverted breast stroke, trudgen, crawl, trudgen-crawl, surface dive and underwater swim, and timed treading, sculling or swimming in place and diving. The basic front crawl is presented prior to the advanced level, but "the crawl may be said to be the acme of all styles of swimming" and, therefore, merits a place in the advanced skills list. (1:139)

Goss (5) lists the crawl, back crawl, starts and turns, and diving as advanced swimming skills. The inverted breast stroke, said Brown, ". . . is a rather difficult stroke to coordinate properly and, as a result, will present a challenge to the better swimmers." (3:121) Armbruster listed the following as skilled strokes of the higher level:

1. The side stroke on both left and right side
2. The crawl strokes on both back and front sides
3. The breast stroke and the dolphin butterfly stroke. (2:42)

The literature shows that most of the achievement tests in swimming have been done for the beginning and intermediate levels. The number of test batteries including a variety of swimming skills are few in number. Most of the measurement devices include subjective ratings or skill check lists. Comprehensive objective tests, especially for the advanced level, are almost nonexistent. The observable lack of objective measures of achievement in the field of swimming indicates a need in this area.

CHAPTER IV

PROCEDURE

The procedures for this study were developed to establish an objective measure of achievement in swimming at the advanced level for college women. An objective test was devised by the writer and was used to measure achievement. A subjective measure was utilized as a criterion for validating the objective test. This chapter will present the details related to the selection of subjects, the objective test, the subjective test, and the statistical treatment.

SELECTION OF SUBJECTS

The subjects were volunteers from the undergraduate classes at the University of North Carolina at Greensboro. Each subject was enrolled in or had been a member of one of the three following groups at the University: (1) advanced swimming class; (2) water safety instructor's course; or (3) physical education major's course. Students from these three groups were contacted and introduced to the basic plan of the study. Each student was asked if she could perform the inverted breast stroke and trudgen stroke as prerequisites for participating in the study. A preliminary test in the water was not given.

Forty-six undergraduate women students agreed to act as subjects. Due to absences and medical reasons, thirty-seven volunteer subjects actually participated.

The subjects were asked to attend two separate one hour sessions scheduled in the evenings. The objective test was administered and subjective evaluations were made by the judges during the first session. The second session consisted of re-testing the subjects on the objective test. The subjects were scheduled for the second session within three to seven days of the first testing period.

OBJECTIVE TEST

The selection of test items was partially based upon the statements of swimming authorities. The results of a pilot study with an advanced swimming class were also utilized in the item selection. The advanced swimming class was taught by the writer during the second semester of the 1963-64 school year.

Twelve to fourteen items were considered for the objective test battery. These items represented a variety of skills appropriate to the advanced swimming level. The items were administered to the pilot study group. Several skills were combined as part of an obstacle course. The skills included were the standing front dive, surface dive, swimming turns, underwater swimming and swimming on the side carrying a weight. The overarm side stroke was eliminated as inappropriate to the skill level being tested. The breast stroke was dropped since the inverted breast stroke included the same basic movements and included the skill of swimming on the back. Swimming with the legs only was eliminated in preference to treading as an endurance and safety skill. The pilot study group was also used to detect alterations needed in the items selected for the final battery.

The six items selected for the final objective test battery were chosen to represent advanced swimming skills at the college level. Each

item of the battery yielded an objective score measured in time or distance. Every item was scored for one individual at a time. The following items comprised the final test battery:

1. Distance in feet: American crawl, 5 strokes
2. Time: American crawl, 25 yards
3. Distance in feet: inverted breast stroke, 5 strokes
4. Distance in feet: trudgen stroke, 5 strokes
5. Time: obstacle course
6. Time: treading water supporting weight

Every effort was made to facilitate the administration of the objective test. One assistant helped administer the test battery. The assistant was used to hold the legs of the swimmer at the starting position for the first four items, to replace the ten-pound weight as it was retrieved in the obstacle course, and to record the times for the final item as announced by the writer. A class instructor could administer the battery without an assistant with the swimmers working in partners.

The test battery was administered and recorded for a group of six to ten subjects in one hour. The initial testing period required more time because of the simultaneous subjective evaluation by the panel of three judges. The objective test could be administered to a group of ten to sixteen students during one class period. Each item in the test battery was scored by the writer.

1. American Crawl (distance in feet)

The American crawl is considered by many swimming authorities as the epitome of swimming strokes. The crawl was selected as illustrative of the combined action of the flutter kick, arm-over-arm movement and

rhythmic breathing. Fox (17) found a fair validity correlation between the criterion of judges' ratings of the crawl and her power test.

The power test devised by Fox (17) was utilized in measuring this item. The test prevents the swimmer from pushing-off to gain momentum. The starting position was modified to eliminate the need for a rope in supporting the legs. An assistant stood in the water to support the swimmer's ankles as she assumed a prone float position with arms and legs extended. The assistant held the feet several inches under the surface with the toes just off the end of the pool. The swimmer was instructed to begin swimming the crawl stroke as soon as her legs were brought up into position by the assistant. The distance covered by the swimmer in five strokes was recorded to the nearest foot. The distance was measured from the ankles in the starting position to the ankle position at the completion of the fifth stroke. Any part of a stroke was counted as a complete stroke. The swimmers were instructed to swim the length of the pool (25 yards) to prevent their being concerned with counting strokes. Measuring the distance covered was further refined by counting the number of arm strokes and noting the ankle position as the fingers entered the water for the beginning of the eleventh arm cycle. The length of the pool deck was marked off at one foot intervals to facilitate measuring. Each swimmer was scored individually.

2. American Crawl (time)

The timed 25-yard crawl was included in the final test battery as an item requiring speed over a specified distance. Two methods of scoring the crawl, by distance and by time, were used in an effort to determine which method might better indicate advanced swimming skill.

The starting position was in the prone float with arms and legs extended and head up. The assistant again supported the swimmer's ankles underwater to prevent any momentum from a push-off. The swimmer was instructed to swim a length of the crawl starting on the signal "Ready, Go", given by the test administrator. A stopwatch was started at the same time the verbal starting signal was given. The crawl was measured from the starting signal to the moment the swimmer touched the end of the pool. The time was recorded to the nearest tenth of a second.

3. Inverted Breast Stroke (distance)

This skill was selected as representative of the advanced strokes performed on the back. It called for use of either the wedge or the whip kick. Brown (2) stressed the challenge presented to advanced swimmers in coordinating the inverted breast stroke.

The swimmer was instructed to assume a back float position with arms and legs extended. The ankles were supported by the assistant and the swimmer began stroking as soon as the legs were brought into position. Measurement was taken from the ankles at the starting position to the position of the ankles at the completion of five strokes. The same procedure was used for the inverted breast stroke as was used for the crawl in regard to swimming the length of the pool, counting partial strokes and measuring to the nearest foot.

4. Trudgen Stroke (distance)

The trudgen stroke, selected as a skill requiring precise coordination, presented a stroke with a scissors kick. The power of this type of stroke was measured by the distance covered in five strokes.

Instructions for the body position and swimming start were identical to those given for the crawl for distance. The method of measuring the distance covered in five strokes was also the same as that used for the distance crawl.

An objective score was recorded for each swimmer regardless of the questionable coordination of the stroke by several of the subjects. The subjects had indicated a knowledge of the trudgen stroke prior to the testing session.

5. Obstacle Course (time)

The obstacle course included the combination of a number of skills considered important at the advanced level. Detailed directions were given for the sequential performance of the skills included in the course. Specific directions as to the manner in which the skills were to be performed were not included. This omission was made in an effort to measure the swimmer's ability to handle herself in a variety of aquatic situations. The course design elicited the need for decisions by the swimmer concerning the most effective method of swimming through the course. It was hoped that the obstacle course would serve as a type of aquatic motor ability measure.

Entry into the water was effected by a standing front dive. The skills of submerging rapidly on a surface dive and swimming underwater were emphasized by Torney (8) as important skills for advanced swimmers. Goss (5) indicated that starts and turns should be within the ability of the advanced swimmer. Retrieving a weighted object and swimming with it introduced a safety skill.

The obstacle course required detailed instructions due to the number of skills involved and the nature of the course. An illustrated

diagram of the course was used in instructing the swimmers. A detailed copy of the diagram appears in the Appendix. The swimmers were given the following directions: stand on the starting mark, hands at sides; dive through the plastic hoop; swim on the surface to the brick marker positioned in the trough, surface dive and turn the brick on the bottom of the pool a half turn; swim underwater to the next brick and turn it a half turn; swim on the surface toward the float, make a left turn around the float; swim on the surface to the side of the pool, turn, swim back and make a right turn around the float; swim on the surface to the brick marker positioned in the trough, surface dive and recover the weighted brick from the bottom of the pool; swim on the side to the finish mark carrying the brick on the upper hip; and place the brick on the deck at the finish mark.

The entire course was easily seen by the test administrator stationed on the side of the pool nearest the starting position. This item was timed from the moment the swimmer's heels left the deck on the dive until the weighted brick was placed on the deck at the finish mark. No time was recorded for a swimmer failing to complete the obstacle course. A swimmer was stopped by a whistle signal if she failed to follow the specified course pattern. The swimmer was allowed to start over again following a rest period. Each subject was given two trials on the obstacle course with a rest between trials.

The course was designed to standardize the requirements for all subjects rather than to give detailed instructions on the style of performance. The dive was performed through a plastic hoop to standardize the point of entry for all swimmers. Brick markers indicated the location

of underwater bricks. Turning underwater bricks indicated attainment of appropriate depths in the water. Swimming turns performed around a weighted float assured the distance from other parts of the course. A ten-pound rubber brick was used for testing ability to retrieve a weighted object and to swim with it.

6. Treading Water (time)

Treading water while supporting a ten-pound weight was selected as a measure of endurance. It was also considered as a safety skill. Torney (8) expressed the opinion that an advanced swimmer should be able to tread water using the legs only. Treading with the legs only was assured by requiring that both hands be used to hold the weight.

The object of this item was to tread water as long as possible using only the legs. The swimmer was instructed to maintain an upright position in the water while supporting a ten-pound brick against the body. Both hands had to be used in holding the brick and the upper arms were kept close to the body. Treading was started on the signal, "Ready, Go", with the swimmer facing the side of the pool and approximately five feet from it. Separate stopwatches were used to time two swimmers on treading from the starting signal until treading stopped or the mouth and nose went underwater. The time to the nearest second was recorded for each subject. Testing was facilitated by starting another subject as one swimmer finished treading. Swimmers were asked to maintain the upright position and approximate distance from the side of the pool. This was done to prevent swimmers from swimming on the back instead of treading.

SUBJECTIVE TEST

Previously validated tests are not always available nor appropriate for use as a criterion in establishing new tests. Judges' ratings are acceptable as the criterion if obtained according to certain standards. With this basic assumption in mind, the subjective measure of achievement was devised.

The subjective test was composed of skills thought to be representative of the advanced swimming level. The following strokes and swimming skills were selected on the basis of face validity to form the subjective battery:

1. American Crawl (distance)
2. American Crawl (speed)
3. Inverted Breast Stroke
4. Trudgen Stroke
5. Standing Front Dive
6. Underwater Swim
7. Surface Dive
8. Swimming with Weight
9. Overall Obstacle Course Ability
10. Treading Water

It was hoped that the composite ratings of these items would provide an acceptable measure of advanced swimming ability for each subject. The quality of the definitions and the differentiation on the rating scales were factors affecting the subjective measures. Another factor was the consistency of the judges in using the scales.

Rating Scales

Seven rating scales were constructed to cover the items in the subjective battery. The four strokes were represented on one rating scale and a separate scale was made for each of the other items. Values from one to five were used in the scales; five represented the highest value. A zero represented no attempt on the part of the swimmer to perform the test item. It was also used to indicate the performance of a skill other than the one the swimmer was asked to do. The rating scales appear in the Appendix.

Each swimmer was rated on each of the ten items by three qualified judges. The judges were all qualified water safety instructors, experienced teachers and members of the physical education department at the University of North Carolina at Greensboro. One judge was experienced in Women's National Officials Rating Committee work in swimming. Another of the judges had experience in the Amateur Athletic Union swimming program. A decision was made following the practice session with the judges to include the use of a "plus" or "minus" sign with a numerical score. This made allowance for further differentiation in ability levels when rating the swimmers.

Administration of the Subjective Test

A number was placed on the cap of each swimmer with adhesive tape and a marking pen. These numbers were written on the judges' score sheets. The test administrator kept a master list of the numbers and the names of the swimmers. Groups of six to ten subjects were rated during a session.

The numerical order of the swimmers was maintained during the performance of all test items. The subjects were observed individually

as they swam a length of the pool for each of the four strokes. The obstacle item started from the deep end and was judged by having one subject at a time swim through the course. Ratings on treading water were made by having two swimmers tread at one time.

The swimmers who were unable to complete the entire obstacle course were rated only on the items completed. The ratings were erased for those swimmers called back due to a fault in performance on the obstacle course. New ratings were given for those swimmers when they repeated the test item.

This subjective test was administered to the eight girls in the pilot study group as a practice session for the judges. The results of this session provided the basis for some needed changes in the rating scales and procedures. The final subjective test battery was administered to the subjects toward the end of the spring semester.

STATISTICAL TECHNIQUES

Several procedures were used in completing the statistical analyses needed to establish an objective test of swimming ability at the advanced level.

Spearman Rank-Difference Correlation Method

Intercorrelations between the three judges' ratings on each of the ten items were obtained by using the Spearman Rho method. This method was employed to determine the agreement of the three judges in their use of the rating scales. This particular method of correlation was used only with the subjective ratings obtained during the practice session.

T-Scales

T-scales were constructed for each item in the final Objective Test battery. These scales were based on the scores recorded during the initial testing session. The T-scores were used to indicate tentative norms for the objective test items and to establish a composite battery score on the objective test.

Pearson Product-Moment Method of Correlation

This method of correlation was employed in several of the statistical procedures:

1. The scores obtained on the two administrations of the objective test battery were correlated to determine the reliability of the test items.
2. The agreement of the judges was determined by computing intercorrelations between the three judges' ratings on each of the ten items in the subjective test battery.
3. The validity of each test item was obtained by correlating the scores of each subject with the total of the three judges' ratings for that item.
4. The degree to which the items measured the same thing was determined by correlating each test item with every other test item.
5. The validity of the objective test was established by correlating the composite T-scores of the objective test with the total of the judges' ratings from the subjective test.

Doolittle Multiple Correlation Method

This technique was used to determine which combination of objective test items would give the highest validity.

CHAPTER V

ANALYSIS AND INTERPRETATION OF DATA

The purpose of this study was to develop an objective test of swimming achievement at the advanced level for college women. A secondary purpose was to establish tentative norms for this test. The objective test battery designed for this study was administered to undergraduate students at the University of North Carolina at Greensboro. A subjective measure of the students' ability was obtained from the ratings of three qualified judges. The subjective measure served as a criterion in validating the test. The data obtained from the objective and subjective tests were analyzed using several statistical techniques. The results and interpretations of these analyses are discussed in this chapter.

AGREEMENT AMONG THE JUDGES

The subjective test consisted of rating each subject on ten items representative of advanced swimming skill. Rating scales were constructed for each item. Numerical ratings were given by the panel of judges with five representing the highest rating value. A zero was used for failure to perform the skill or for performance of a skill other than the one requested.

Pilot Study Group

Eight of the swimmers in the pilot study group participated in a session designed to acquaint the panel of judges with the use of the

rating scales. These swimmers were rated individually on each of the ten items of skill included in the subjective test. Intercorrelations between the three judges' ratings were obtained for each of the ten items. The use of the Spearman rank-difference correlation method described in Guilford (6) was warranted by the small number of subjects rated. The resulting rho coefficients may be found in Table I. Correlations on the surface dive (.6072, .7560, and .6967) and underwater swimming (.5000, .5239, and .7798) were generally lower than those on other sections of the obstacle course. A change in the order of rating the sections of the obstacle course was suggested by the judges. The scoring chart was changed accordingly so that the second surface dive of the course was rated. This change allowed more time for rating the underwater swim and the surface dive.

The trudgen stroke showed a wide range of judgment with coefficients from .1875 to .9286. Explicit definition of the coordination pattern of the stroke occurred following the session with the pilot study group in an attempt to unify the judges' ratings. Observation of the subjects during the practice session brought out the fact that their feet were being held too high in the water at the starting position. The off-balance position seemed to result in poor starts and stroke patterns. This was true for the trudgen and the other three swimming strokes. The test assistant was asked to hold the subjects feet several inches underwater for the remainder of the testing periods.

A new set of directions was written for the final item, treading water. The subjects location in the water and body position were further designated. The swimmers were instructed to maintain a distance of approximately five feet from the side of the pool. The directions also

TABLE I

RHO COEFFICIENTS OF INTERCORRELATIONS BETWEEN THE JUDGES' RATINGS ON EACH OF THE TEN ITEMS FOR THE PILOT GROUP
N = 8

Item	Judges 1-2	1-3	2-3
American Crawl (distance)	.7084	.7798	.7560
American Crawl (time)	.9286	.9822	.8929
Inverted Breast Stroke	.6875	.8304	.8215
Trudgen Stroke	.9286	.1875	.4554
Standing Front Dive	.8989	.7739	.6548
Underwater Swimming	.5000	.5239	.7798
Surface Dive	.6072	.7560	.6967
Swimming with Weight	.8750	.9180	.7768
Overall Course Ability	.7590	.8125	.8840
Treading Water	.4733	.4018	.9286

specified that the subjects maintain an upright position in the water to avoid swimming on the back. This was done to aid in both the objective and the subjective testing.

Several adjustments were made in the testing program on the basis of the work with the pilot study group. A modification was made in the rating scales to permit the use of a "plus" or "minus" sign with a numerical score. This made possible a greater degree of differentiation among subjects. The order of test items was also changed to increase the efficiency of test administration. The new directions listed the four swimming strokes first. These were followed by the trials on the obstacle course and treading water. A change in the order of rating items within the obstacle course made allowance for additional time in rating the underwater swim and the surface dive. The starting position was modified for the four items involving a specific swimming stroke. The treading item was further delimited by additional specifications in the directions. It was hoped that these adjustments would increase the efficiency of the subjective measurement device and aid in test administration.

Initial Testing Program

The subjective test battery was administered to thirty-seven subjects. The agreement of the judges was determined by computing intercorrelations between the three judges' ratings on each of the subjective test items for the initial test. The Pearson Product Moment method was used in computing these intercorrelations. The results may be found in Table II. Sections of the obstacle course show the most variation and the lowest correlations in the judges'

TABLE II

INTERCORRELATIONS BETWEEN THE JUDGES' RATINGS ON EACH OF THE TEN ITEMS OF THE SUBJECTIVE TEST
N = 37

Item	Judges 1-2	1-3	2-3
American Crawl (distance)	.7192	.8073	.7629
American Crawl (time)	.7014	.8435	.6959
Inverted Breast Stroke	.6471	.7579	.7907
Trudgen Stroke	.9629	.8987	.9055
Standing Front Dive	.7758	.7737	.7075
Underwater Swimming	.3426	.4154	.6780
Surface Dive	.7825	.7989	.7806
Swimming with Weight	.6242	.6300	.4926
Overall Course Ability	.7115	.6423	.8302
Treading Water	.7128	.7029	.7588
Total Scores	.8360	.8976	.8009

ratings. Underwater swimming resulted in two of the lowest correlations, .3426 and .4154. The following factors may account for this situation: (1) poor visibility for accurate judging; (2) swimming distance too short for effective rating; and (3) lack of definite stroke designation for performance of the item on the rating scale. The latter would appear to be the major cause for discrepancies in the results.

Swimming with a weight showed the other low correlation, .4926, and the lowest overall coefficients other than the underwater swimming item. The definition of swimming with a weight stated on the rating scale that any type of side stroke in which the brick was carried on the upper hip was acceptable. The definition may have been too vague to serve as a guide for the judges.

The coefficients for the trudgen stroke showed a very high correlation. A partial explanation for the situation would seem to stem from the judges' discussion following the practice period. It was agreed that no value above "2" would be given if a swimmer failed to coordinate the trudgen stroke as it was defined. Several of the subjects failed to properly coordinate the stroke and, therefore, the three judges consistently awarded ratings very close in value.

The cumulative percentages of the coefficients obtained from the judges' ratings may be found in Table III. Ninety per cent or 30 of the 33 coefficients were .60 or better. Those correlating at .70 or above included seventy-five per cent or 25 of the 33 correlations. Only ten per cent or 3 of the coefficients fell below .60. This amount of agreement among the judges justified the use of their ratings as the criterion for establishing validity of the test battery.

TABLE III

CUMULATIVE PERCENTAGES SHOWING THE GROUPINGS OF THE COEFFICIENTS IN TABLE II

N	r	Cumulative Percentage
4	.90 - 1.00	12.0
6	.80 - .89	30.0
15	.70 - .79	75.0
5	.60 - .69	90.0
0	.50 - .59	----
2	.40 - .49	96.0
1	.30 - .39	100.0

RELIABILITY OF THE OBJECTIVE TEST ITEMS

The objective test battery was administered to thirty-seven subjects. Thirty-one of the subjects completed a re-testing session within three to seven days following the initial testing period. The scores obtained on the two administrations of the objective test were correlated to determine the reliability of the test items. The coefficients indicating the reliability of the test items may be found in Table IV. The reliability of all items was significant at the five per cent level or better. The arbitrary standards for interpreting reliability coefficients which appear in most measurement books would classify four of these six coefficients as very good. Guilford's (6) table on judging the significance of correlation was used to evaluate the coefficients.

Two trials on the obstacle course were administered as a part of the objective test battery. Computations were necessary to determine which trial or combination of trials would be used for statistical analysis. The score obtained on the first trial of the obstacle course was found to be better than any of the following conditions: (1) score on the second trial; (2) average of the two trials; (3) total of the two trials; or (4) better score of the two trials. The correlation coefficient .9370, shown for the obstacle course item, was obtained by correlating the scores recorded for the first trial of the initial test and the first trial of the re-test. The score for the first trial of the obstacle course was used in all further computations.

The raw score made by one subject on the treading item was deleted from the correlation of the reliability coefficient. The writer was informed that this particular student had been challenged

TABLE IV

RELIABILITY COEFFICIENTS BETWEEN THE INITIAL TEST AND RE-TEST ON EACH ITEM OF THE OBJECTIVE TEST
N = 31

Item	r
American Crawl (distance)	.6478*
American Crawl (time)	.9227*
Inverted Breast Stroke (distance)	.8807*
Trudgen Stroke (distance)	.5904*
Obstacle Course (time)	.9370*
Treading Water (time)	.9622*

* Indicates statistical significance at the five per cent level of confidence.

by another student to obtain the highest possible score on the treading item. Retaining the questionable score would have resulted in a coefficient of .6662. It was thought that deletion of the score presented a more accurate picture of the performance on the treading item.

The reliability coefficients for the objective test items were all significant at the five per cent level or better. Three of the 6 coefficients were above .90. The American crawl (distance) and the trudgen stroke were the lowest with respective coefficients of .6478 and .5904. The lower coefficients indicated a need for adjustments in the conduct of those particular test items. The overall relationship between the two administrations of the objective test seemed to indicate a consistency of measurement.

VALIDITY OF THE OBJECTIVE TEST ITEMS

The subject of validity covered four distinct aspects. The four areas discussed in relation to validity were the following: (1) individual item validity; (2) relationships between items; (3) multiple correlations of various item combinations; and (4) validity of the composite objective battery.

Individual Item Validity

The validity of each objective test item was obtained by correlating the scores of the thirty-seven subjects with the total score of the three judges' ratings for each of the items. According to Scott and French (7), it was preferable to use the total of the judges' ratings as the criterion. The sum of the ratings provided a wider range than the average.

The obstacle course presented a separate problem prior to final computation concerning validity. This involved determing which rating(s) would be used to correlate with the objective score. The following items were correlated with the single time score recorded for the obstacle course on the objective test: (1) sum of the standing front dive, underwater swimming, surface dive, swimming with weight and overall ability; (2) sum of the standing front dive, underwater swimming, surface dive and swimming with weight; and (3) rating on overall course ability only. The latter correlation yielded the most satisfactory result with a coefficient of .8295. Coefficients for the first two combinations in order were .7388 and .6883. The single rating on the overall obstacle course ability item was used in all further computations concerning that portion of the subjective test.

The coefficients computed for item validity may be found in Table V. All correlation coefficients shown for individual item validity except one were significant at the five per cent level or better. The validity coefficients for the obstacle course and for the American crawl (time) were considered very good by arbitrary standards (7). The remaining items in the objective test were retained to investigate their worth to a test battery.

The one validity coefficient which did not meet the standard was for the trudgen stroke. The reason for this low correlation, .2547, was readily seen by comparison of the subjective rating and the objective method of scoring on the item. Several of the subjects received a high score on the objective test which was recorded in the number of feet covered in five strokes. Several of these same subjects received a low rating from the judges due to improper coordination of

TABLE V

VALIDITY COEFFICIENTS FOR EACH ITEM IN THE OBJECTIVE TEST
N = 37

Item	r
American Crawl (distance)	.5119*
American Crawl (time)	.8056*
Inverted Breast Stroke (distance)	.5351*
Trudgen Stroke (distance)	.2547
Obstacle Course (time)	.8295*
Treading Water (time)	.4444*

* Indicates statistical significance at the five per cent level of confidence.

the stroke. Computing the correlation between these two extremes then showed little relationship. The item was retained in the objective battery because it did represent a swimming skill involving a more advanced level of stroke coordination. The trudgen stroke contributed to the total battery even though it did not have an acceptable individual validity. Improvement in the details of the test administration might be helpful in further testing.

Relationship of Objective Test Items

Computation of the intercorrelations between items on the objective test was necessary to ascertain whether any of the items were measuring the same ability. A high correlation coefficient would indicate just such a condition. The results of these intercorrelations may be found in Table VI. Correlation of the American crawl (time) and the obstacle course yielded a coefficient of .7466. This relationship was sufficiently high to indicate that one of the items should be discarded from the test battery. The item to be discarded was determined by computing correlations for various combinations of items employing the Doolittle Multiple Correlation method presented in Scott and French (7). This procedure will be described in a later section.

Other intercorrelations which seemed to indicate some degree of relationship were too low to be significant. Correlations of the treading item with the American crawl (distance) and with the trudgen stroke showed negative coefficients which were also too small to be significant (6).

Multiple Correlation of Test Items

The Doolittle Multiple Correlation method was employed to determine which combination of items would give the highest validity. Previous

TABLE VI

INTERCORRELATIONS BETWEEN EACH OF THE ITEMS IN THE OBJECTIVE TEST BATTERY

	American Crawl (time)	Inverted Breast Stroke	Trudgen Stroke	Obstacle Course	Treading Water
American Crawl (distance)	.5692	.4064	.3471	.3739	-.0773
American Crawl (time)		.4792	.3827	.7466	.1247
Inverted Breast Stroke			.3077	.3699	.0123
Trudgen Stroke				.3713	-.1192
Obstacle Course					.1284

intercorrelations between items on the objective test had shown that two of the items had a significant relationship and were measuring the same ability. These items were the American crawl (time) and the obstacle course. Only one of these items should be retained in the final test battery. Multiple correlation coefficients were computed for all possible item combinations on two separate five-item batteries. One of these batteries deleted the American crawl (time) and the other battery deleted the obstacle course. The results of the various objective test item combinations may be found in Table VII.

One of the combinations showed a decidedly higher validity than all others. The following five-item battery showed a multiple correlation coefficient of .9542: (1) American crawl (distance); (2) inverted breast stroke; (3) trudgen stroke; (4) obstacle course; and (5) treading water. This statistical evidence provided the basis for dropping the American crawl (time) from any further computations involving the data from the objective test.

The original objective test battery including the American crawl (time) and two trials on the obstacle course was administered to ten students in one hour. The number of students who could be tested in a one hour period would probably increase to fifteen or twenty by deletion of the crawl item and cutting the obstacle course to one trial.

One other combination of items would seem to have an acceptable validity if an even shorter battery were desired. The following group of items had a multiple correlation coefficient of .8789: (1) American crawl (distance); (2) inverted breast stroke; (3) trudgen stroke; and (4) obstacle course. This grouping would eliminate the time consumed in administering the treading item.

TABLE VII

MULTIPLE CORRELATION COEFFICIENTS FOR VARIOUS COMBINATIONS OF THE OBJECTIVE TEST ITEMS

	American Crawl (time) Deleted	Obstacle Course Deleted
(1) American Crawl (distance)	$R_{0.13} = .6247$	$R_{0.12} = .7316$
(2) American Crawl (time)	$R_{0.134} = .6248$	$R_{0.123} = .7647$
(3) Inverted Breast Stroke	$R_{0.1345} = .8789$	$R_{0.1234} = .7669$
(4) Trudgen Stroke	$R_{0.13456} = .9542$	$R_{0.12346} = .8614$
(5) Obstacle Course		
(6) Treading Water		

Validity of the Composite Objective Battery

A final product-moment correlation was necessary to determine the validity for the composite objective test battery. No attempt was made to weight the items in the battery. It was assumed that each item was equally important to the assessment of advanced swimming ability. A composite T-score was obtained for each subject by summing the T-scores on the following items: (1) American crawl (distance); (2) inverted breast stroke; (3) trudgen stroke; (4) obstacle course; and (5) treading water. The composite T-score was then correlated with the total judges' rating. The correlation coefficient resulting from this computation was .7026. This coefficient represented an acceptable level of significance for the validity of the objective test battery (7).

NORMS

T-scales were constructed for each item in the final objective test battery. These scales were based on the data obtained during the initial testing session. The T-scores were determined by use of the graphic method described in Scott and French (7). The T-scores were used to establish a composite battery score on the objective test. These scores were also used to indicate tentative norms for the objective test items. The T-scores for the final five objective test items may be found in Table VIII in the Appendix.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to develop an objective test of swimming achievement at the advanced level for college women. A secondary purpose was to establish tentative norms for this test.

The subjects were volunteers from the undergraduate classes at the University of North Carolina at Greensboro. All subjects participating in the study were enrolled in or had been members of one of the following groups at the University: (1) advanced swimming class; (2) water safety instructor's course; or (3) physical education major's course.

Ten students enrolled in an advanced swimming class served as subjects in a pilot study group. Thirty-seven students participated as subjects in a regular testing program.

An objective test was devised by the writer and used to measure achievement. A panel of three qualified judges rated the subjects on each of ten items of a subjective test. These ratings served as the criterion for establishing test validity. The initial test was followed by a re-test for thirty-one of the subjects within a period of three to seven days. The final version of the test consisted of the following items: (1) American crawl (distance); (2) inverted breast stroke (distance); (3) trudgen stroke (distance); (4) obstacle course (time); and (5) treading water supporting weight (time).

Measurements were treated statistically to ascertain the acceptability of the objective measure as a means of determining achievement in advanced swimming for women at the college level.

Conclusions

In view of related literature and the findings of this study, it may be suggested that it is possible to determine achievement in advanced swimming by means of an objective measure. The objective test battery devised for this study has acceptable reliability and validity for use at the advanced swimming level for college women. The results of the present study have found the obstacle course to be the best single item measure of advanced swimming achievement.

The objective test battery used in this study seems practical in terms of time, equipment and ease of administration. Further refinement of the mechanical aspects of the test should improve its convenience for use.

The T-scores shown in Table VIII, page 47, provide some basis for comparison if the objective test battery is used under conditions similar to those described in this study.

The writer wishes to recommend that further research be conducted as to the standardization of an objective measure of advanced swimming achievement. The following items might serve as areas for further study: (1) application of the regression equation to determine possible weightings of the test items; (2) investigation of the obstacle course as a single measure of advanced swimming ability; and (3) testing of additional subjects to standardize the norms. It is hoped that further research would facilitate the establishment and utilization of a standard objective measure of achievement in advanced swimming.

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APPENDIX

TABLE VIII

T-SCORES FOR THE ITEMS IN THE OBJECTIVE TEST BATTERY

T-Scores	American Crawl (distance) N = 37	Inverted Breast Stroke (distance) N = 37	Trudgen Stroke (distance) N = 37	Obstacle Course (time) N = 35	Treading Water (time) N = 37
98		51			10:56
97					10:42
96		50			10:32
95					10:20
94					10:10
93		49			10:00
92					9:46
91					9:36
90		48			9:26
89					9:14
88					9:04
87		47			8:52
86					8:40
85					8:30
84		46			8:20
83					8:06
82					7:54
81		45			7:44
80					7:32
79					7:22
78		44			7:10
77					7:00
76		43			6:48
75					6:36
74					6:26
73		42			6:14
72					6:02
71				53.0	5:50
70		41		53.2	5:40
69				53.5	5:30
68				53.9	5:18
67		40	36	54.3	5:08
66	36			54.7	4:56

TABLE VIII
(continued)

T-Scores	American Crawl (distance) N = 37	Inverted Breast Stroke (distance) N = 37	Trudgen Stroke (distance) N = 37	Obstacle Course (time) N = 35	Treading Water (time) N = 37
65			35	54.9	4:46
64	35	39		55.4	4:29
63				55.7	4:22
62		38	34	56.1	4:10
61	34			56.3	3:58
60				56.7	3:48
59		37	33	57.2	3:36
58	33			57.5	3:26
57				57.8	3:14
56		36	32	58.1	3:02
55	32			58.5	2:50
54				58.9	2:40
53		35	31	59.2	2:25
52	31			59.7	2:22
51			30	59.9	1:59
50		34		60.3	1:49
49	30			60.7	1:45
48		33	29	61.1	1:31
47				61.2	1:15
46	29			61.5	1:05
45		32	28	62.0	:53
44				62.3	:49
43	28			62.7	:42
42		31	27	63.1	
41				63.3	
40	27			63.6	
39		30	26	64.1	
38				64.4	
37	26			64.7	
36		29	25	65.1	
35				65.4	
34	25	28		65.9	
33			24	66.1	
32				66.4	
31	24	27		66.9	

TABLE VIII
(continued)

T-Scores	American Crawl (distance) N = 37	Inverted Breast Stroke (distance) N = 37	Trudgen Stroke (distance) N = 37	Obstacle Course (time) N = 35	Treading Water (time) N = 37
30			23	67.1	
29				67.5	
28		26		67.9	
27			22	68.2	
26				68.5	
25		25		68.9	
24			21	69.3	
23				69.6	
22		24		69.9	
21			20	70.3	
20				70.6	
19		23	19	70.9	
18				71.3	
17		22		71.7	
16				71.9	
15				72.3	
14		21		72.8	
13				73.0	
12				73.3	
11		20		73.7	
10				74.0	
9				74.4	
8				74.7	
7				75.1	
6				75.4	
5				75.7	
4				76.1	
3				76.4	
2				76.8	
1				77.1	

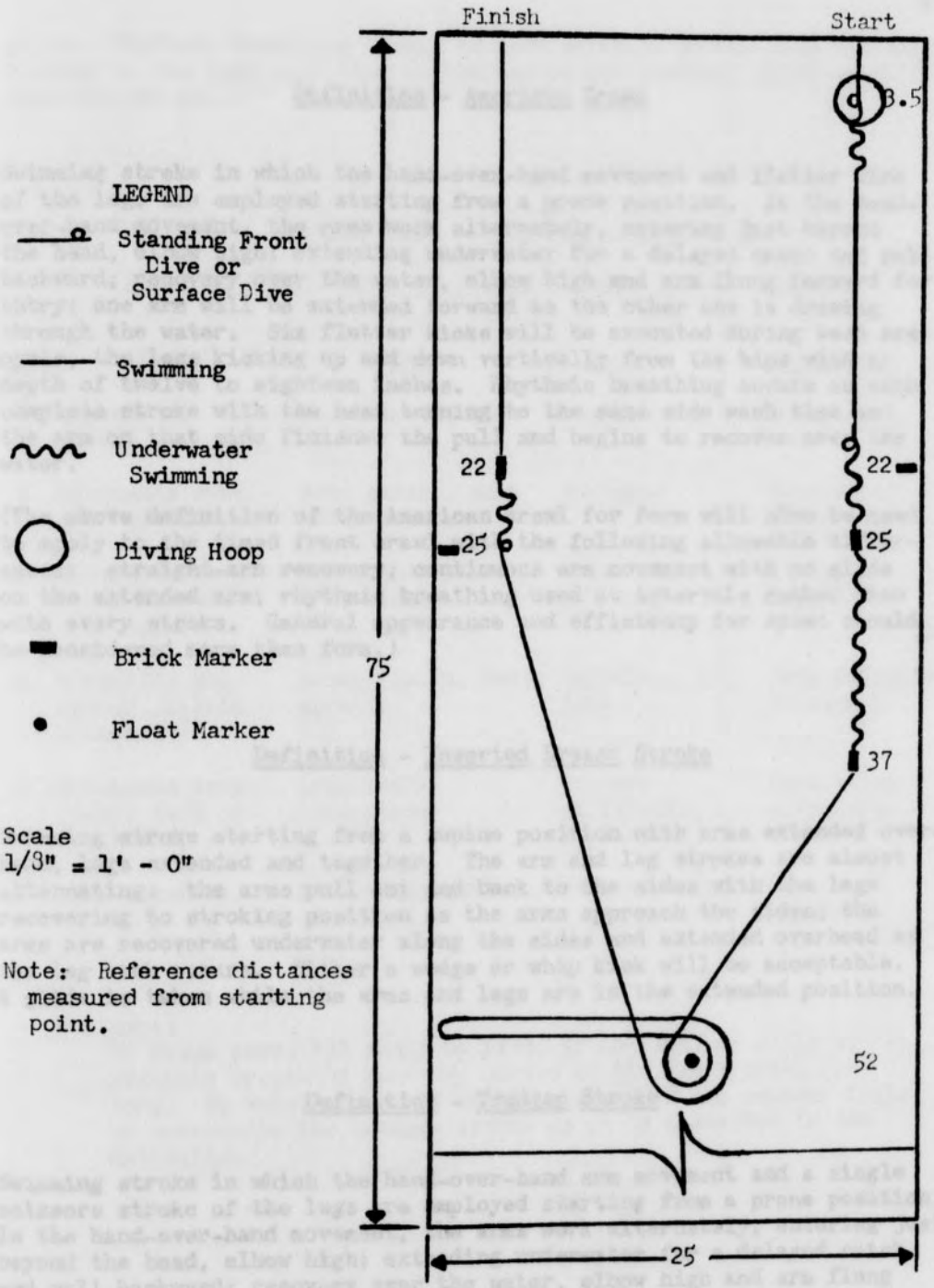

FIGURE 1

OBSTACLE COURSE

Definition - American Crawl

Swimming stroke in which the hand-over-hand movement and flutter kick of the legs are employed starting from a prone position. In the hand-over-hand movement, the arms work alternately, entering just beyond the head, elbow high; extending underwater for a delayed catch and pull backward; recovery over the water, elbow high and arm flung forward for entry; one arm will be extended forward as the other one is drawing through the water. Six flutter kicks will be executed during each arm cycle, the legs kicking up and down vertically from the hips with a depth of twelve to eighteen inches. Rhythmic breathing occurs on each complete stroke with the head turning to the same side each time as the arm on that side finishes the pull and begins to recover over the water.

(The above definition of the American crawl for form will also be used to apply to the timed front crawl with the following allowable differences: straight-arm recovery; continuous arm movement with no glide on the extended arm; rhythmic breathing used at intervals rather than with every stroke. General appearance and efficiency for speed should be considered more than form.)

Definition - Inverted Breast Stroke

Swimming stroke starting from a supine position with arms extended overhead, legs extended and together. The arm and leg strokes are almost alternating: the arms pull out and back to the sides with the legs recovering to stroking position as the arms approach the sides; the arms are recovered underwater along the sides and extended overhead as the leg kick occurs. Either a wedge or whip kick will be acceptable. A glide is taken while the arms and legs are in the extended position.

Definition - Trudgen Stroke

Swimming stroke in which the hand-over-hand arm movement and a single scissors stroke of the legs are employed starting from a prone position. In the hand-over-hand movement, the arms work alternately, entering just beyond the head, elbow high; extending underwater for a delayed catch and pull backward; recovery over the water, elbow high and arm flung forward through the water. One arm stroke is combined with a narrow scissors kick, the leg on the same side of the body as the stroking arm moves forward in the scissors kick with the power phase of both arm and leg strokes finishing together. On the other side, the arm strokes

alone. Rhythmic breathing occurs on each complete stroke with the head turning to the side each time as the arm on the combined stroking side finishes the pull.

Rating Scale - Swimming Strokes

American Crawl, Inverted Breast Stroke, Trudgen Stroke

Value	Rhythm	Form	Power	Relaxation
5	Movements smooth	Consistent stroke	Maximum	Effortless ease
4	Movements even, some hesitation	Good stroke, some inconsistency	Adequate	Occasional tenseness
3	Movements uneven, hesitation apparent	Acceptable minor variations	Apparent, but weak	Tiring apparent
2	Movements segmented, little continuity	Recognizable, very erratic	Definite lack	Very definite tenseness
1	Movements very jerky, lack of continuity	Completely inadequate	Extreme difficulty in moving	Struggling movements
0	None apparent	Not recognizable	None apparent	None apparent

Footnote:
No value above "3" shall be given if the swimmer fails to use rhythmic breathing on every stroke of the front crawl for form. No value above "2" shall be given if the swimmer fails to coordinate the trudgen stroke as it is described in the definition.

Definition - Standing Front Dive

Method of entering the water head-first starting from a standing position at the edge of the deck, feet together and arms at the sides. Arm pull, body lean and leg spring are used to lift the diver from the deck to a position in the air with legs together, toes pointed, body extended, and head between arms stretched overhead. This position should be maintained for entry into the water as near the vertical as possible. Smoothness and continuity of diving movements are desirable.

Rating Scale - Standing Front Dive

Value	Rhythm	Power	Position in air	Entry
5	Movements smooth, continuous	Full arm lift and spring, maximum height	Full extension	Vertical position little splash
4	Movements even, some hesitation	Partial lift and spring, good height	Good extension, slight body or knee bend	Nearly vertical, some splash
3	Movements uneven, hesitation apparent	Lift and spring outward little height	Some extension, but body bend apparent	Body slant, more splash
2	Movements segmented, little continuity	Very little spring or height	Body semi-folded, little form apparent	Body folded, large splash
1	Movements very jerky, lack of continuity	No spring or height apparent	Body folded, no form apparent	Nearly horizontal position, great splash
0	None apparent	None apparent	None apparent	Not recognizable as a dive

Footnote:
No value above "3" shall be given if the diver fails to dive through the hoop.

Definition - Underwater Swimming

Any type of stroke will be acceptable for underwater swimming. The swimmer must stay completely under the surface of the water. Power and consistency of the stroke should be considered.

Rating Scale - Underwater Swimming

Value	Power and Consistency
5	Maximum power from arm and leg strokes; consistent stroke pattern.
4	Good power from arm and leg strokes; fairly consistent stroke pattern.
3	Adequate power from arm and leg strokes; inconsistent stroke pattern.
2	Little power from arms and legs; very erratic stroke pattern.
1	Very weak arm and leg movement; struggling to submerge and/or stay underwater; no stroke pattern apparent.
0	Not recognizable as an underwater swimming stroke.

Footnote:

No value above "2" shall be given if the swimmer fails to stay under the surface of the water.

Definition - Surface Dive

Method of entering the water head-first starting from a prone position on the water. Arm pull, body rotation and leg extension are used to bring the body to a vertical position for underwater entry and depth of dive. Either the pike or the tuck form of surface dive will be acceptable. Smooth transition and continuation of momentum from swimming stroke to dive is desirable.

Rating Scale - Surface Dive

Value	Rhythm, Entry and Power
5	Smooth transition from stroke to dive; clean, sharp entry in vertical position; maximum power and depth.
4	Some hesitation going into dive; body nearly vertical on entry; good power and depth.
3	Hesitation apparent going into dive; entry in slanted position; fair power and depth.
2	Momentum almost stopped before diving; very splashy entry; little power or depth.
1	Momentum stopped before diving; body thrown forward on the water; struggling kick to gain underwater position, no power.
0	Not recognizable as a surface dive.

Footnote:
No value above "2" shall be given if the swimmer fails to submerge completely on the dive.

Definition - Swimming with Weight

According to the test directions, the last section of the obstacle item consists of recovering a ten-pound weight from the bottom of the pool and swimming on the side to the finish mark carrying the brick on the upper hip. Any type of side stroke in which the brick is carried in the prescribed manner will be acceptable. Power and consistency of the stroke should be considered.

Rating Scale - Swimming with Weight

Value	Power and Consistency
5	Maximum power from the stroke; consistent stroke pattern.
4	Good power from the stroke; fairly consistent stroke pattern.
3	Adequate power from the stroke; variations in the stroke pattern.
2	Little power from the stroke; very erratic stroke pattern.
1	Very weak arm and leg movement; no stroke pattern.
0	Not recognizable as a swimming stroke.

Footnote:
No value above "2" shall be given if the swimmer fails to keep her face above the surface of the water while swimming.

Definition - Obstacle Item - Overall Course Ability

The obstacle item encompasses a wide variety of aquatic skills which advanced swimmers should be capable of executing. A general impression of familiarity in the water should be available after having observed the swimmers' progress through the obstacle course. Such factors as power, ease of performance, transition from one skill to the next, coordination, general efficiency and "test-sense" should be considered.

Rating Scale - Obstacle Item - Overall Course Ability

Value	
5	Smooth coordination and skill transition; maximum power and efficient use of skills.
4	Good coordination, little hesitation in skill transition; good power and use of skills.
3	Adequate coordination, hesitation apparent in skill transition, fair power and use of skills.
2	Little coordination or continuity of movement; power very weak; some recognizable skills.
1	Movements very jerky, definite lack of continuity; difficulty in moving, very little recognizable skill.
0	No coordination or continuity apparent; power completely inadequate; struggling movements with no apparent skills.

Footnotes:

No value above "2" shall be given if the swimmer fails to complete the course. This rating should be circled to differentiate from the ratings given for completed courses.

A whistle signal will be used to notify the swimmer of any error made during progress through the course. The swimmer will be asked to return to the deck and start again after a rest. Any ratings given on the first try should be erased and all final ratings made on the re-trial.

Definition - Treading Water

Method of supporting the body in an upright position using only the leg strokes as a source of power. Head should be kept just above the surface without bobbing up and down. Any leg stroke employed by the individual will be acceptable.

(According to test directions, the upper arms will be at the sides, both hands holding the rubber brick next to the body.)

Rating Scale - Treading Water

Value	Kick, Power and Breathing
5	Smooth, relaxed kick; even power thrust keeping head just above surface; easy breathing.
4	Consistent kick; good power, little bobbing; easy breathing.
3	Tense, strained kick; uneven power thrust, bobbing apparent; breathing uneven.
2	Weak, uneven kick; little power, head barely above surface; hard breathing.
1	Very weak, jerky kick; struggling to keep head out; labored breathing.
0	Not recognizable as treading.

Footnote:
No value above "3" shall be given if the swimmer fails to keep both hands on the brick while treading.