# The Aqualert II: An End-of-Lane Signalling Device for Swimmers Who Are Visually Impaired

(Reader's note: Figures are not included in this text)

Katherine M. Scheib
Paul E. Ponchillia
Western Michigan University
Department of Blind Rehabilitation

## Abstract

The purpose of this study was to test the effectiveness of the Aqualert II as an end-of-the lane alert system and to compare it to the present method of using a tap stick. Four swimmers who are legally blind participated in this study, which utilized a single subject alternating treatment design to compare elapsed times using the Aqualert II and a tap stick. Three of the four participants' timed swimming performances improved similarly with both treatments and two of four performed more consistently with the Aqualert II than the tap stick. This study demonstrated that not only can swimmers do as well with the Aqualert II as they can with the tap stick, but that the former treatment is preferred because of the independence and consistency it provides.

## Introduction

Nearly one-half-million individuals participate in the sport of swim racing each year (Larrabee, 1987). They attempt to beat their opponents by developing powerful strokes and by making flawless turns at lane's end. They are alerted to the upcoming end wall by either watching for it or by looking for a painted symbol on the floor of the pool just before the wall. Backstroke swimmers monitor the end wall by looking for a set of flags that hang overhead.

Individuals with visual impairments also swim competitively (Buell, 1983). Although swimming straight is a skill that must be developed in blind swimmers, the primary problem they face is monitoring the upcoming end wall. Several devices have been used to alert swimmers, including: sound beacons, tappers, and water spray alerts. Sound devices (American National Red Cross, 1977; Cordellos, 1976) are not practical because the acoustics of pools are generally poor and it is also extremely

difficult to determine the direction of a sound when swimming at top speed. The most commonly used adaptation is that of having a sighted aide tap swimmers between the shoulder blades just before they reach the wall (Paciorek & Jones, 1989). A tap stick, which is used for this purpose, is a three or four foot pole made of aluminum, wood, or bamboo with foam rubber or a tennis ball attached to one end. The swimmer needs the tapper during practice sessions and races, and must rely upon the tapper's good judgement regarding the accuracy of the tap. Mistakes by these tappers could cause the swimmers to either initiate the turn too soon, costing some race time, or too late, causing injury.

Patten (1990) first tested the idea of using a water spray alert. He mounted a simple in-line lawn sprinkler on a board and directed the spray down onto the swimmer's back (see Figure 1). With one of these

Insert Figure 1 about here

devices at each end of a pool in a side lane, blind swimmers could race or practice without the assistance of a sighted aide. Coe (1991), seeing the social advantages of this system over the tap stick, tested the effect of the spray device and the tap stick on turning efficiency among three sighted, blindfolded swimmers. Turning efficiency was increased by the spray device in each case and the swimmers reported favoring its use over that of the tap stick. Some questions remained unanswered however. Particularly: would swimmers who are visually impaired also benefit from the water spray alert?, and would a highly engineered version of the system be practical and effective? Therefore, the purpose of this research was to develop a more sophisticated model of the Aqualert and to compare it with the tap stick as an end-of-lane signalling device for swimmers who are blind or visually impaired.

## Materials and Apparatus

The Aqualert II (see Figures 2 and 3) consisted of a plastic spray boom with two support poles and a motorized pump (Ponchillia, 1992). For the purposes of this study, the device was erected at only one end of the pool, 20 feet (6.1 m) before the end wall. The support system included galvanized steel poles, a wench and a steel cable. The braced support pole of each side was anchored in the hole which the back stroke flag pole usually occupied and the cable was pulled tightly across the pool's width to the other pole with a boat trailer type wench.

The spray boom was suspended on the cable, in the fashion of a suspension bridge, 1.6 m above the water surface. The boom

was 14.6 m long and was composed of six 2.4 m lengths of 3.8 cm polyvinyl chloride tubing. The six sections were locked together by clamps and each had two brass spray nozzles which projected a fan-shaped spray onto the water's surface. The 1 horsepower

Insert Figures 2 and 3 about here

swimming pool pump pulled water from the pool through a hard plastic tube (3.8 cm by 1.1 m) and a 0.7 m soft plastic hose, and drove it to the boom through another 1.2 m soft hose.

The tap stick used for this study was constructed from a 1.2 m bamboo pole. A tennis ball was attached to the end with duct tape.

## Method

### Participants

Four legally blind athletes served as participants for the study. They all were actively involved in sports, but none was swimming competitively. None had previously used an end-of-lane signalling device.

#### Participant 1

Participant 1 was a 19 year old male who had an acuity of 20/600 and a visual field of 30 degrees due to retinitis pigmentosa. His swimming experience was limited to taking lessons as a child and swimming in a physical education class in high school. He kept his eyes closed while swimming.

#### Participant 2

Participant 2 was a 19 year old female who had an acuity of 20/200, a field of eight degrees, and loss of depth perception as a result of Leber's disease. She took a swimming class when she was 10 years old. She also swam with her eyes closed.

#### Participant 3

Participant 3 was a 27 year old male who had only light perception due to uveitis and secondary glaucoma. His swimming experience included lessons in third grade and competitive swimming from the fourth through sixth grades.

#### Participant 4

Participant 4 was a 24 year old female who had only light perception due to detached retinas. She began swimming lessons when she was 5 years old and swam competitively for 3 years in high school. Never able to count her strokes well, she often trailed the edge of the pool to find the end wall.

### Design

The effect of the type of signalling device was determined by employing a single subject experimental design that used

individual participants as their own control. Over six sessions the Aqualert II and the tap stick method were alternatively presented, first the tap stick, then the Aqualert II, etc., and their effects on performance were measured.

Procedure

The experiment was conducted in two phases, training and testing. Training consisted of practicing a consistent straight-line swimming technique and learning to use the tap stick and the Aqualert II. The tapper and the swimmers worked together to develop a method of tapping that was considered reliable by the swimmer. The Aqualert II, because it was placed in the backstroke flagpole holes, was 20 feet (6.1 m) from the end and training consisted of establishing the number of strokes taken by each swimmer between the time the spray struck them and the time they reached the end wall. When swimmers were able to consistently swim the pool length without being slowed by contact with the side wall or the rope lane markers, and they were confident in the signalling devices, the testing phase began.

The testing phase required six sessions. Each session consisted of six pool-length timed trials with rest periods between each, three trials using the Aqualert II and three using the tap stick method. The participants completed a set of three trials with one device, then switched to the other for the remaining three. Most sessions took one evening, but two sessions were done per night when swimmers were able. With each new session, the first signalling device to be used was alternated, first the tap stick, then the Aqualert II, then the tap stick, etc.

Swimmers were placed at the starting end of the pool one at a time. Some began from a standing position at the pool's edge and some began in the water. When they indicated they were ready, the starter spoke the cadence: "Mark, set, go." All the swimmers used the crawl stroke and timing was stopped at the moment the swimmers' hand contacted the end wall. Trials that were interrupted by the swimmers contacting the side wall or becoming entangled in the lane markers, were aborted and redone. As is traditional in single subject research, data were analyzed visually by graphing.

Reliability and Validity

All stop watches were found to be reliable and were determined to be accurate. Reliability was established by calculating inner observer agreement. A primary observer timed and recorded each swim trial to an accuracy of 0.1 seconds, while a secondary observer timed 30% of the 144 trials. The secondary

observer's timings were unannounced and spread across all of the trials.

The percentage of agreement between observers was calculated by comparing the shared observations of primary and secondary observers. The shorter accumulated time was divided by the longer and multiplied by 100.

Social validity was determined by asking the participants' opinions of each device following completion of the experiment.

## Results

Each point on the graphs in Figures 4 through 6 represents the mean of three trials for that treatment and session.

### Participant 1

As can be seen in Figure 4, Participant 1 decreased his lap times over the duration of the experiment. The graph shows that he _____ Insert Figure 4 about here _____improved with both signalling devices, but the five seconds improvement using the Aqualert II appears to be greater than for the tap stick. He performed similarly with both devices until Session 6, in which he was two seconds faster with the Aqualert II. Note also that he started slowly with the Aqualert II, but by Session 2 appeared to be more comfortable with it.

### Participant 2

Figure 5 demonstrates graphically that Participant 2 continually improved over the duration of the experiment. Session 1 shows _____

Insert Figure 5 about here _____that she had little confidence in the Aqualert II at first, but by Session 2 she had begun to feel comfortable with it. In addition, she improved more from beginning to end with the Aqualert II (12 seconds) than with the tap stick (8 seconds). Note also that her performance was more erratic using the tap stick than with the Aqualert II.

### Participant 3

As was the case with the first two participants, the third swimmer generally improved his skills over time (See Figure 6). _____ Insert Figure 6 about here _____Interesting ly, every session yielded opposite results, but note that again performance appeared to be more erratic using the tap stick.

### Participant 4

Little can be concluded from the performance of Participant 4. The mean elapsed times for beginning and ending sessions were nearly identical for both devices. In addition, there was so much variability in performance among sessions that any conclusion would be suspect.

Reliability and Validity

Agreement between the primary and secondary observers was 99%. All four of the swimmers preferred the Aqualert II over the tap stick for the following reasons: (a) they stated that they had a better idea of the location of the wall, (b) they consistently trusted it more than the tap stick, (c) they felt that the sound of the Aqualert II spray striking the water gave them an added benefit in orientation, (d) they felt more independent since a sighted tapper was not needed, and (e) they liked the advanced warning of 6.1 m better than the 1.2 m provided by the tap stick. One participant mentioned favoring the gradual spraying of the water across his body compared to the abrupt nature of the tap stick. As a result, he found himself anticipating the tap more which he felt hurt his swimming concentration.

## Discussion

The results clearly show that the Aqualert II is as effective as the tap stick as a signalling device. It appeared to result in less erratic performance in Participants 2 and 3. It also appears that initial performance with the Aqualert may not be indicative of a swimmer's ultimate performance, since both Participants 1 and 2 had very poor Session 1 times, but improved quickly in Session 2. The Aqualert II had clear social benefits when compared to the tap stick. All the participants considered it to be a better signalling device and certainly a device promoting independent swimming. Participants in a sports camp that is held annually for young athletes with visual impairments also echoed these positive feelings about the Aqualert II.

The device is obviously more expensive than a tap stick. However, it was built for less than $1000 per unit, which would appear to make it more than practical for an organization sponsoring swim racing for athletes with visual impairments. In the case of an individual swimmer who wants to compete against sighted swimmers in open meets, Patten's original version of the Aqualert is inexpensive and performs as well as the Aqualert II as a signalling device. It can be placed at each end of a side lane and allow a blind swimmer to compete or to practice without sighted assistance.

The independence offered by either Aqualert is certainly in keeping with the present-day philosophy of including

individuals with disabilities into mainstream activities. We sincerely hope the devices will become standard for swimmers who are blind or visually impaired.

References

American National Red Cross. (1977). Adapted aquatics: Swimming for persons with physical or mental impairments. Garden City, NY: Doubleday.

Buell, C. E. (1983). Physical Education for Blind Children (2nd ed.). Springfield, IL: Charles C. Thomas.

Coe, D. (1991). The effectiveness of the Aqualert on a blind swimmer's turn during competitive swimming. Unpublished research paper, Western Michigan University, Kalamazoo.

Cordellos, H. C. (1976). Aquatic recreation for the blind. Washington, DC: American Alliance for Health, Physical Education, and Recreation.

Larrabee, J. G. (1987). Coaching swimming effectively. Champaign, IL: Kinetics.

Paciorek, M. J., & Jones, J. A. (1989). Sports and recreation for the disabled: A resource handbook. Indianapolis, IN: Benchmark Press.

Patten, D. B. (1990). The Aqualert: An aid for increasing turning efficiency of swimmers with visual impairments. Unpublished research paper, Western Michigan University, Kalamazoo.

Ponchillia, P. (1992). Aqualert Grant Proposal. Unpublished grant proposal, Western Michigan University, Kalamazoo.