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Prevention of drowning: visual scanning and attention span in Lifeguards

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ABSTRACT

The safety of the bathing public is dependent upon effective continuous scanning techniques by lifeguards (professional) or lifesavers (voluntary) patrolling the area. Similar scanning skills are needed in other professions needing concentration for repetitive, monotonous and/or boring tasks: This includes airline pilots, air search and rescue personnel, and long-distance train or bus drivers.

To date, very little has been published on effective methods for lifeguards to use to scan their area of responsibility, particularly in water, be it surf, inland waters or swimming pools. Techniques that may positively or negatively influence visual scanning techniques, or that may affect concentration spans, or assist in the prevention of boredom and improvement in attention spans, are discussed and presented.

Key words: vision, attention span, lifeguard, safety, drowning

INTRODUCTION

Surf Life Saving Australia (SLSA), through its voluntary lifesavers and professional lifeguards, seeks to prevent the unnecessary loss of life from drowning - principally in the sea, but also in some inland water areas, including swimming pools. All SLSA lifeguards in Australia are, or have been, volunteer lifesavers, the word `lifeguard' used in this article being almost synonymous with both Australian professional career lifeguards and voluntary lifesavers.

Rescue Statistics

In Australia, drowning represents the fifth most common "external" cause of death after suicide, motor vehicle accidents, accidental falls and homicide.[1] Circumstances surrounding drownings indicate that most drownings are due to carelessness and ignorance, rather than being freakish in nature. As such, they are largely preventable.[2]

There were a total of 11,158 rescues for the 1996/97 surf season. SLSA's total number of rescues now exceeds 410,000 since its inception in 1906. There were 143,983 preventative actions (interceptions to prevent rescues or problems occurring) in the 1996/97-surf season (start of October to the end of April), an increase of almost 3,000 on the previous year. Prevention of drowning (or injury) is one of the most important aspects of the role of a lifeguard.

Unfortunately, scientific evidence to support the essential aspect of surveillance and prevention is surprisingly flimsy. The authors assessed the scanning techniques of many organisations. The poor scientific evidence concerning the effectiveness of various aspects of surveillance prompted Surf Life Saving Australia to initiate their own research.

Discussion

Drowning

Frank Pia in the United States researched and filmed real-life drownings and rescues.[3] From these extensive studies he suggested that people who get into difficulty, struggling on the surface of the water, exhibit several types of behaviour. He suggested that there are both "distress" situations and "drowning" situations.[4]

A distress situation involves a swimmer who is unable to return to safety without assistance, but because of their floating or swimming skills, is generally able to summon aid by waving, or calling out for help – i.e. they have voluntary control of their actions and could actually assist the rescuer. These actions will also make it easier for them to be seen by the patrolling lifeguard.

Drowning situations can be subdivided into ***passive*** and ***active*** victims: -

- The ***passive*** victim slips under water without waving or calling out for help or struggling on the surface of the water - usually because of a sudden loss of consciousness. Causes may be a heart attack, stroke, hyperventilation, blow to the head, cold water immersion, or excessive drinking of alcoholic beverages. These actions are very difficult to observe. The lifesaver should mentally note such potential victims about to enter the water and carefully observe them in case they should develop any difficulty.
- The ***active*** conscious, drowning non-swimmer exhibits a struggling behavior that an attentive, properly trained lifeguard can detect. Importantly they characteristically flail their arms sideways in the water, extend their head backwards but, importantly, **do not call for help**. To the average untrained person they may appear to be "playing, and enjoying themselves in the water". However, they are drowning and desperately need to be saved. Pia discovered that victims usually struggle for some 20-60-seconds on the surface of the water before slipping quietly under the surface. He called the characteristic motions they exhibit whilst drowning as the "Instinctive Drowning Response" and states that properly trained and supervised lifesavers/lifeguards could detect this behaviour and probably effect a rescue, prior to the victim's submersion. Pia describes the instinctive drowning response as having four basic distinguishing features.[3]

    1. A characteristic vertical body position in the water. However, the legs hang directly downwards, and no effort is made to kick them to try to keep the head above water. This action impedes the body's buoyancy.

2. Instinctive arm movements. Victims attempt to lift their head upward in the water by thrashing with both arms extended outwards, pressing the water down for support. However, they cannot raise their arms sufficiently to wave for help. They may appear to the unwary as if they are simply playing in the water, enjoying themselves.

3. The head is extended back, attempting to keep the face above the water whilst trying to breathe. Whilst trying to breathe, no attempt can be made to call for help. The drowning person is rarely able to call out. As breathing, not speech, is one of the primary functions of the body and respiratory system[5], in time of extreme peril in water, breathing takes precedence over any speech - even calling for help. An active drowning victim is fighting for breath and so cannot call for assistance, even though it may be only a few feet away. Untrained observers will often watch a person drown, unaware that they are drowning, because at no time does the victim cry out for help.[6]

4. Struggling at the surface for 20 to 60 seconds, unable to make forward progress, the victim will finally submerge.

Visual scanning and visual attention

Visual scanning and attention (by lifeguards) can be described as observing, recording and making an assessment of the water area that is being surveyed. This includes both surf and pool environments, together with the surrounding beach or area where patrons are present, often preparing to go swimming. Thus scanning is the use of the visual system to feed information about the outside world to the brain, allowing strategic planning and management functions for the lifeguard that result in a safer environment for the patrons.

Visual attention encompasses many areas of the human brain. Visual information bombards the retina, but using selective mechanisms this information is broken down to allow the higher levels of the brain to process only the most important facts. Visual attention has been likened to a spotlight, where the area of the spotlight has the majority of the information processed in some detail, whereas the rest of the area has much less information available to be processed.[7] Before each new area is to be assessed, the attention has to be directed to that specific area and be primed to notice significant features or events. Thus the bombardment of information in a visual scan is intense and an alert and trained brain is essential for successful and efficient scanning.

Scanning an area brings conflicting ideas. It was shown that a longer learning phase (i.e. the time spent scanning a designated area of a lifeguard's area) led to clearer mental scanning effects.[8] However, there is also the need for a "speedy scan" of the area, as drowning can occur in just 20-60 seconds[6]

Visual acuity is stated to best occur in the central 10-15^{o} of vision.[9] Thus the victim's facial features are more likely to be seen in greater detail when the lifeguard's head rotates to look directly at that person in the water. This forms the basis for the statement by many lifeguard agencies that the head should swivel to look directly at each area during scanning. If the head doesn't turn and the victim located in the frontal plane, then a non-moving victim may not be noticed. Although motion such as a distressed swimmer waving his arms to attract attention, or the characteristic arm movements of the drowning victim is best recognised by central vision, peripheral vision assists, and should not be obstructed by inappropriate sunglasses.

Factors affecting vision and scanning

Many factors affect the process of seeing. Time and events may reduce vigilance and concentration spans.[10] Experiments with undergraduates showed that the longer the distance between 2 points, the longer the scanning time for this distance. It was also shown that a longer learning phase (i.e. the time spent scanning and noting a designated area, such as lifesaving) led to clearer mental scanning effects.[8] However, in lifesaving scanning a number of other important factors must be taken into consideration, which are discussed below.

Recent research has suggested that as the level of environmental bombardment (e.g. noise, activity or any other distraction) increases, the level of its usefulness decreases. It is believed that as environmental bombardment increases, people become less aware of peripheral objects and events (i.e. those to the side).[11] Thus, whilst music playing may help prevent a lone lifeguard getting bored, at a certain point this arousal will become detrimental, resulting in a worsening concentration span. If, added to this there is other background noise or stimulation occurring, these effects may accumulate, thus causing further deterioration in the lifeguard's concentration span and scanning ability.

Analyses of scanning strategies in airline pilots revealed that experts had shorter dwelling time on an area, adapted their scanning methods more flexibly in response to changing task demands, or problems, demonstrated a better mental model of cross-checking and showed more frequent checking of areas whose values remained constant.[12] Other results suggested that visual scanning of instruments in a controlled task may be an indicator of both workload and skill levels, with novices being affected by additional tasks, more so than experts.[13] Results suggest that visual scanning in a controlled task may be an indicator of both workload and skill.[14] The same would probably be true for lifeguards, with the expert being able to pick anything unusual (e.g. a distressed or drowning person) in the water, more quickly than the newer recruits.

From the perspective of prevention, scanning is the most important part of a lifeguard's job. It may detect a person, or persons who are, or may be, in a high-risk category and more likely to get into trouble in the water, or in assessing developing problems, both in or out of the water.

Boredom

Boredom is a complex mental phenomenon involving the attention span, emotional influences and thinking components - such as creativity, understanding, thinking, problem solving and memory (i.e. solving a problem by assessing the stimulus and the response).[15] Boredom is associated with monotony in a job (such as lifeguarding in quiet periods), and may be associated with a high degree of frustration.[16] Boredom and monotony are generally considered to be negative factors that can have adverse effects on morale, performance, and quality of work. This, together with a need to maintain high levels of alertness (such as in lifeguarding) may combine to cause considerable stress.[17] This is very applicable to the lifeguard scanning many people, whether it be in a small, or large area, knowing there are too many people to be assessed efficiently.

Performance of a job under demanding tasks (e.g. scanning in crowded or too large an area) caused significant deterioration in the functions of the mind and in scanning. Lifeguards with high stress levels caused by failure, or perceived failure in life (e.g. failed rescue, or resuscitation) are likely to experience a greater narrowing of their peripheral vision, and slower response in their central vision reaction time during stress, than did those with life events that were low in stress levels.[18]

Lifeguard restlessness and fatigue will increase dramatically the longer the time of scanning in all conditions, and stress effects are most obvious during visual monitoring. However, these factors were not related to variations in events. Thus, the stress of sustained attention spans causes greater stress, rather than being associated with the number of tasks that lifeguards had to perform (i.e. the number of potentially-worrying occurrences, such as people swimming on the bottom, diving under the surface or behaving in a dangerous manner).[19]

Lifeguard rostas and shifts are important, as during the usual waking day the body's circadian rhythm usually causes sleepiness in the early afternoon and alertness in the early evening, with vigilance, or sustained attention peaking in the morning. However, ability to do simultaneous task seems to reach its best level in late afternoon, or evening.[20] Daily or circadian rhythmical variations include variable levels of sensory, motor, perception, and attention performance as well as several neuromuscular, behavioral, cardiovascular, and metabolic variables. Circadian rhythms can be accentuated by workload, psychological stress, motivation, "morningness / eveningness" differences, social interaction, lighting, sleep disturbances, the "post-lunch dip" phenomenon, altitude, dietary constituents, gender, and age. These rhythms can significantly influence performance depending upon the time of day at which the lifeguard is on duty.[21]

Thus, lifeguards should have an active input into their own rosta, allowing them to take their individual circadian rhythms into consideration, judged on their own assessments. Even the hypothesis that extraverts needed more variety in their performance as efficient lifeguards performing a monotonous task than introverts, is confirmed.[22]

Prevention of scanning and attention span deterioration

Fatigue is an important cause of deterioration of lifeguard scanning and may be caused by the actual work of lifesaving, such as dehydration, tiredness (caused by actual rescues), eyestrain and exposure to the sun, the wind, or both. This would be worse in tropical areas.

Lifeguards need to come to work well rested and not suffering effects from a previous night's alcohol consumption, and should avoid medications influencing their brain efficiency - caused by both prescribed medication and non-prescribed medication.

Whilst on duty lifeguards must ensure that they drink enough water, use adequate protection against the sun and wind, and rotate tasks or areas, ensuring they get sufficient breaks from continuous scanning (see below). They must adjust their position to offset the detrimental effect of glare, and wear polarised sunglasses with clear peripheral vision, unless the weather is too overcast and their vision is reduced. They must be aware of the fact that ultraviolet light intensity often remains high when it is cloudy, and that UV light causes skin cancer and premature development of cataracts.[23]

Effective scanning

The view from an elevated area is superior to that at ground level, or even an IRB (Inshore Rescue Boat, or "rubber duck") in the water. Therefore, the lifeguard in the patrol tower is the most important part of the surveillance system and elevated viewing areas, such as towers, should be used wherever possible, even if only one swimmer is using the facility.

Ground level lifeguards have a limited view of the area with bathers shielded from view, especially in more crowded conditions, and when people swimming are obscured by waves. Also, ground-level lifeguards are closer to the patrons and are thus more prone to distractions, such as questions asked by other patrons regarding the state of the water, or any dangers. The dress and behaviour of some patrons can also cause its own distractions to some lifeguards, and must not be allowed to occur.

However, if advice, cautions or reprimands to patrons are needed, the ground level lifeguard should be the one to attend to this, leaving the lifeguard in the tower to maintain vigilance. This is difficult if only one lifesaver (e.g. the professional lifeguard) is on duty and care must be taken to maintain vigilance in simultaneously scanning and talking, particularly bearing in mind the relatively brief 20-60 second surface struggle of the drowning non-swimmer. If explanations must be given, they should be kept as brief as possible and whilst the lifeguard continues to scan the bathing area.

Whilst on active scanning duties, no lifeguard must assist with any other activity non-service-related activity – whether this is talking to the public without good reason, or training themselves, or others. Nor should they perform any maintenance work, or handing out tickets for activities or other operations that should be performed by specially employed people. Any distraction may allow a drowning or accident to occur, thus increasing their own, and their employer's legal liability.

Because of the known deterioration in the attention span, these exacting standards of care cannot be met unless lifeguards receive regularly scheduled breaks from their surveillance duties. The Unites States Red Cross Lifeguard service recommends that their lifeguards have a 15-minute break every hour. The strongest reason for advocating this standard of care is that the lifeguard must detect the surface struggle of the drowning non-swimmer within 20 to 60 seconds, or a routine rescue may become a submersion or fatality.[24]

CONCLUSION

There are many important factors needing careful and skillful observation in all occupations requiring this proficiency, particularly those involved with the safety of the public. Such skills do not come naturally, nor with experience. They must be taught and learnt carefully before attempting to apply them in a practical manner. This particularly applies to such jobs as professional lifeguards who frequently have to operate alone, with no back-up support.

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[The following is a letter to the editor in reply]

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I was most inspired to read the excellent article on visual scanning and attention span in lifeguards by my colleagues Dr Peter Fenner et al *U Occup Health Safety - Aust* NZ 1995, 15(l): 61-66). This is a subject that deserves much greater study than it has received.

Lifeguards, perhaps more than any other public safety providers must maintain the utmost level of attention and the keenest possible observation skills. A lifeguard may watch over the water for many days without a significant event, which is a recipe for boredom, but a mere moment of inattention when a swimmer encounters distress may mean the difference between life and death.

The article referenced observations of Frank Pia regarding "active drowning" and identification of victims in this state. According to the article, "Pia discovered that victims usually struggle for some 2060 seconds on the surface of the water before slipping quietly under the surface". While this may be true at still-water (inland) beaches, it is rarely the case at surf beaches. In fact, there are significant differences in victim identification techniques required at the two venues.

At still-water beaches, many patrons are poor or nonswimmers. Those with even rudimentary swimming skills can usually rescue themselves. The classic rescue at a still-water beach is a non-swimmer who, whilst wading, takes one step too many and, in water that is suddenly overhead, rapidly struggles and submerges, or simply submerges without struggle. The need for instant recognition and response by the lifeguard in these cases is paramount for victim survival. Unfortunately, the lifeguard has few clues to which patron is the swimmer and which the non-swimmer until they have demonstrated this ability or lack thereof. As such, everyone must be presumed a nonswimmer until proven otherwise.

Conversely, at surf beaches I have visited, most water users appear to have at least basic swimming skills. Those without them are typically intimidated by the waves or pushed back by them, and stay in shallower water. Certainly the weak or non-swimmers may be swept off rocks or walk off sandbars into deep water, but at surf beaches many rescue victims are actually good swimmers.

So, what is the primary cause of distress at surf beaches? The United States Lifesaving Association reports that 80% of rescues at US surf beaches are caused by rip currents, a phenomenon absent at stillwater beaches. So in one environment the primary focus is poor or non-swimmers suddenly over their heads, while at the other it is the swimmer, perhaps even a strong swimmer caught in a rip. Victim identification techniques in these two cases differ accordingly.

A rip current pulls the victim offshore. It is like finding oneself on an invisible aquatic treadmill and having the treadmill move faster than one can swim. A major difference between rip current victims and still-water victims is that rip current victims can often stay afloat for quite a while, due to their swimming skills. This is fortuitous because surf rescue victims are often scores of metres offshore, requiring some time for the lifeguard to reach them.

Surf lifeguards are typically taught to identify the areas at their beaches where rip currents are most likely to present themselves and to key in on those areas for observation, though not to the exclusion of other water areas. Since the intensity of rip currents often varies continually due to a variety of factors, swimmers may at times swim in and out of a rip current area without event, then suddenly and unexpectedly be swept offshore.

The United States Lifesaving Association Manual of Open Water Lifesaving suggests some clues to signs of distress in swimmers, such as facing shore, low head, low stroke, lack of kick, waves breaking over the head, hair in the eyes, glassy eyes, two or more heads together, hand waving, fighting or being swept along by a current, erratic activity, and clinging to fixed objects. Most of these are different presentations than a lifeguard would expect to see in a distressed victim in still-water, who is too busy struggling to stay afloat to exhibit such behaviours. The typical surf rescue victim, who is able to fight a current for a period of time, would have no problem reaching shore at a still-water beach.

There have been a number of theories presented on lifeguard scanning procedures, some of which have evolved over many years and have passed the test of time. Nevertheless, there is a surprising paucity of objective study of the best methods of lifeguard surveillance and further attention to this issue seems much needed.

B Chris Brewster, President

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Reply

We would like to thank Chris Brewster for his kind comments and excellent additions to our article on lifeguard/lifesaver scanning. We totally agree with his comments. Rip currents are a major cause of rescue from Australian surf beaches, with 38% of rescues and 18.5% of resuscitation cases over the past 10 years being caused by rips.

Rip currents are large bodies of water moving back out to sea to equilibrate the large amount of water pushed up on to the beach by surf swells. Rips are dangerous in two main ways. First, side currents that travel parallel to the shore feed into the rips and may carry unsuspecting bathers into the rip (Figure 1). Here they may be swept quickly out of their depth and out to sea, causing panic despite the fact that they may be quite confident in the shallow water even when surf swells are present. Second, because the body of water in this rip moves quickly to sea, the water appears much calmer than the surrounding waves (Figure 2). Consequently many inexperienced surf swimmers, or non-swimmers, may actually enter I e water in this very area, probably the most dangerous on the beach. Here they are swept suddenly to sea, creating the need for a rapid response from the nearby lifeguard.

As rips are the most dangerous areas on a beach, patrol flags are erected in a safe area on the beach away from rips. However, most experienced lifeguards are aware of the danger and must continually scan to see if swimmers in their area, or just outside their area, are being swept towards such a rip. Also, unfortunately, many weak or non-swimmers do not bother to walk to a patrolled area, even though it may be within sight. In the 1998/99 summer season, 62.5% of deaths occurred in the surf within one kilometre of a lifesaving service. Such deaths are both tragic and preventable.

Our article focuses on how to scan. Scanning is an essential skill for the lifeguard. We note from our research that few rescues occur inside the patrolled area. In nearly 100 years of surf lifesaving, only a small number of people have actually lost their lives here. The vast majority of reactive rescues occur away from the patrolled area. Education of the bathing public of the dangers of rips and the need to "swim between the flags" is of paramount importance. It is here that lifeguards erect the red and yellow flags to delineate the safe area of the beach in which to swim, and one that is continually scanned by them. These patrol flags often mark the smaller areas between adjacent dangerous rips.

A training program to make both international and Australian tourists, as well as less knowledgeable locals, aware of the hazards of surf bathing is essential but can only be mounted when sufficient money and effort is channelled into such a scheme. This has been well proven just this year, when an injection of some $2m into an educational package on warnings reduced deaths on Victorian beaches from a record 34 last summer to none this summer. Money talks. What price a life?

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