VirtualEye - Life Guard For Swimming Pools To Detect Active Drowning

Abstract

Lifeguard surveillance is a complex task that is crucial for swimmer safety, though few studies of applied visual search have investigated this domain. This current study compared lifeguard and non-lifeguard search skills using dynamic, naturalistic stimuli (video clips of confederate swimmers) that varied in set size and type of drowning. Lifeguards were more accurate and responded faster to drowning targets. Differences between drowning targets were also found: passive drownings were responded to less often, but more quickly than active drownings, highlighting that passive drownings may be less salient but are highly informative once detected. Set size effects revealed a dip in reaction speeds at an intermediate set-size level, suggesting a possible change in visual search strategies as the array increases in size. Nonetheless, the ability of the test to discriminate between lifeguards and non-lifeguards offersfuture possibilities for training and assessing lifeguard surveillance skills.

Introduction

Drowning incidents are potentially severe but thankfully rare for most lifeguards. Due to the infrequency of drowning incidents, the visual search for such occurrences is challenging. The difficulties involved in detecting infrequent drowning targets are reflected in other areas of real-world visual search with uncommon target items, such as airport security screenings. For example, Wolfe et al. found low-prevalence targets were missed more frequently than high-prevalence targets (occurring on 50% of trials), with error rates of 30% and 7%, respectively. In regards to lifeguarding, visual search has been defined as observing part of an aquatic environment (beaches, pools, open water), and processing and assessing the events happening within that locationWhile this definition suggests that the surveillance ofthe water is a fundamental and critical role of the lifeguard, there is relatively little focus on training in these areas This is reflected in the UK National Pool Lifeguard Qualification (NPLQ) training manual where only 6 out of 214 pages are dedicated to the education of scanning and observation behaviours With this limited focus on visual training, lifeguards may be underprepared for detecting struggling swimmers in a timely manner.

Within the limited training that lifeguards do receive, one key method that is taught is the 10:20 scanning technique. This technique recommends that a lifeguard has 10 seconds to scan their aquatic zone in search of target behaviours, then 20 seconds to respond to an individual whom they have identified as a potential drowning target, so that no swimmer is drowning for longerthan 30 seconds In support of the 10:20 scanning method, lifeguards are trained to detect specific behavioural characteristics of distressed swimmers. These includetwo distinct types of drowning: active and passive.

Why is the visual search task of a lifeguard so difficult?

Many factors have a negative impact on successful target detection in basic studies of visual search, including crowding,target- distractor similarity and attentional set.

These factors are also likely to play a negative role in the visual search oflifeguards**.**

For instance, crowding is typically defined as an effect that limits perception of objects' features when surrounded by neighbouring distractors. The ability to recognize and respond tocrowded targets is dramatically reduced during visual search. The negative impacts of crowding overlap considerably with the related concept of *visual clutter*. As the number of items in a search area increases, the space between items becomes smaller and this limits the searcher's attention to smaller areas. This phenomenon of crowding has obvious relevance to lifeguarding, for example, with increased numbers of swimmers, physical space within the zone of supervision will become visually cluttered, causing delayed reaction times in visual searches . This problem of visual clutter is also noted in other research studies, both in the laboratory and in applied settings. For example, found that individuals were better at detecting targets in rural scenes with limited clutter, compared to urban city scenes with high rates of visual clutter. Ho et al.,found similar effects in young and old people in their visual searches of roads, with more clutter in the search area having a detrimental effect on searches of road signs.

Similarly passive drowning can be mistaken for intended submergence or floating face down in the water.The inclusion of extra target behaviours alongside those of drowning and distress also add to the complexity of lifeguard visual search: not only must they keep alert for drowning targets but they must also be attentive to risk-taking behaviours, rule-breaking, and the quality of the water. Research into attentional set suggests that the greater the number of target features thatmay define a target, the less efficient visual search is Recent research argues that this is because differentfeatures in the search set need to be searched for sequentially . A related problem is termination of search due to the detection of a task-relevant (but non-drowning) target: if a lifeguard identifies swimmers engaging in risk-taking behaviours, they would need to interrupt their scan of the pool to intervene and stop any potentially dangerous actions thus possibly missing a drowning target..

However, unlike the static images used in surveillance based visual search tasks (such as airport security and radiology), lifeguards are faced with the challenge of dynamic scenes. Lifeguardsare required to observe swimmers moving around a pool. The scene they observe constantly changes. This creates difficulties in using memory as a swimmer that has already been checkedmay later begin to drown or move into an area that has already been scrutinised. What may bemore relevant to the searches of lifeguards is the theory behind *Multiple Object Tracking*. This theory suggests that searchers are able to track a small number of multiple moving objects around a screen by pre-attentively tagging them. In recent research ithas been shown that expert sportsmen, such as basketball players who need to be able to followthe ball and other players in a game, have substantial superior visual skill in complex neutral dynamic tasks after training in three dimensional multiple object tracking. It was also found that these expert sportsmen have a greater capacity for learning these skills compared to amateur and non-athletes. Regular surveillance of swimmers may help to improve lifeguards' search skills in tracking multiple objects at a time, resulting in an increased ability to detect drowning swimmers in the search zone.

Procedure

In order to recruit lifeguards, the experimenter arranged testing sessions at various pools and leisure centres around Nottingham and Leicester, with a quiet office or side-room acting as the laboratory. Control participants were tested under similar conditions. Participants were given written instructions and asked to fill in a consent form and demographic questionnaire. Prior to the study, participants were made aware that they would be searching for any potentially drowning victims from a lifeguard's perspective, and that the study may contain a drowning.

They were told to press the space bar on the laptop upon identifying a drowning target that would require lifeguard assistance or intervention, and were also told that this would terminate the clip (preventing detection of a subsequent drowning target should their first response have been premature). Participants were then given a practice trial followed by a final opportunity to ask any remaining questions before the trials began. Once the test had ended participants were fully debriefed and thanked for their time and participation. This research was conducted with approval obtained from the University ethics committee and run in accordance with British Psychological Society guidelines.

Discussion

The results of the current study have found the predicted advantage for lifeguards in spotting and responding to drowning targets in a swimming pool situation. They identified both active and passive drowning targets more frequently and more quickly than control participants, which suggest that experience and/or training have positively influenced the visual search and target processing skills of this specialist group. Lifeguards also appear to have a higher threshold for responding to a drowning target. This may reflect their greater sensitivity to visual cues that discriminate between drowning and normal swimming. Additionally, lifeguards may be more aware of the dangers of committing to a potentially drowning target. Once a response is initiated in a pool situation (e.g. entering the water to rescue the drowning swimmer) the lifeguard is limited in their ability to spot secondary drowning targets. Thus lifeguards may need greater evidence before responding, though this did not negatively impact on their time to respond when they chose to do so.

lifeguards should still be able to respond to fully submerged targets, even those who are prone at the bottom of a pool. Brener and Oostman (2002) demonstrated the difficulty of spotting submerged targets when they timed lifeguard responses to unexpected manikins that were allowed to sink in pools. Fourteen percent of lifeguards failed to spot the submerged manikin with three minutes, with 90% of them failing to spot the manikin within the industry standard 10 seconds. While a surface-based training tool may increase the detection of drowning targets prior to complete submergence, if this is not 100% reliable, then it may result in those few submerged targets who slip through the net of vigilance being even less easy to spot due to emphasis in training being on rescuing victims at the surface of the water, and always being given a warning before practicing deep water rescues.

Nonetheless, the current study has demonstrated a valid testing paradigm that can be extended to include the above suggestions. The method holds promise as a form of assessment, and could lead to the development of more useful training techniques, while simultaneously providing greater insight into visual search skills in complex, real world scenes.