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An examination of the severity of aquatic incidents

Lyndsey K. Lanagan-Leitzel
Eastern Connecticut State University, lanaganleitzell@easternct.edu

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An examination of the severity of aquatic incidents

Cover Page Footnote

Correspondence should be addressed to Lyndsey K. Lanagan-Leitzel at Eastern Connecticut State University, Department of Psychology, Webb Hall room 122, 83 Windham Street, Willimantic, CT, 06226. Telephone: (860) 465-5065. Email: lanaganleitzell@easternct.edu.

Abstract

Lanagan-Leitzel (2012) found that lifeguards do not consistently report incidents when free-viewing aquatic scenes and miss some incidents that should be considered critical. This could have been because they did not know what incidents were critical to monitor or because they were busy monitoring other incidents. In the current study, lifeguards and non-lifeguards were presented with video clips of isolated incidents and rated the severity of each on a scale of 0 – 7. The lifeguards reported greater mean and maximum incident severity than non-lifeguards. Further analyses of lifeguard responses revealed that severity ratings were only moderately correlated to the report rate in Lanagan-Leitzel (2012). Some of the incidents, though under-reported in Lanagan-Leitzel (2012), were given high severity ratings when isolated in the current study. It is proposed that lack of report in Lanagan-Leitzel (2012) may have occurred due to attention being diverted to other critical incidents. Future research should utilize eye-tracking to assess the relationship between severity and monitoring.

Keywords: lifeguarding, drowning, distress, incident severity

What incidents and behaviors should a lifeguard monitor? A lifeguard's primary task is to prevent drowning incidents, but they are also responsible for preventing other physical injuries to patrons. Because the risk for drowning and injuries stems from personal characteristics (e.g., physical weakness, lack of swimming skill), risky behaviors (e.g., horseplay, venturing into deep water without appropriate skill), and even environmental conditions (e.g., inclement weather, rip currents), open water lifeguards have numerous diverse things to monitor that may happen concurrently. How they balance these diverse factors has not been thoroughly explored, although in theory, the task is monumentally difficult due to several known cognitive limitations (see Lanagan-Leitzel, Skow, & Moore, 2015 for a review).

Allocation of attention from moment to moment during surveillance is most likely a product of personal judgment of the relative severity of incidents occurring at any particular moment. An actual drowning incident warrants an immediate rescue, but most incidents that lifeguards face are only *potential* drowning incidents that contain risk factors that may increase the likelihood of drowning. Lifeguards are often faced with large numbers of patrons (Griffiths, Steel, & Vogelsong, 1996) engaging in a myriad of activities. The incident-related factors highlighted above (e.g., insufficient swimming skill, horseplay, encountering deep water) are likely very common. Lifeguards must prioritize these incidents in order to have any chance of success at preventing drowning and injury; those behaviors and conditions that are most severe must be monitored more often and with more attention, and those that are less severe should be monitored but perhaps less often and with less focused attention. It is unclear how lifeguards learn to judge the severity of incidents and prioritize accordingly; no explicit guidance is given in several prominent lifeguard manuals (American Red Cross, 2007; Brewster, 2003; YMCA 2001). It is possible that they acquire these judgment skills by trial and error once they begin work or may not acquire them at all.

How might the acquisition of judgment and prioritization skills affect performance in the field? Submersions, for example, must be monitored to ensure that the person returns to the surface. However, a lifeguard cannot stare at the location of a single, briefly-submerged person because s/he will miss other incidents occurring simultaneously. The severity of any submersion incident likely is low the moment it occurs but grows as the time spent underwater increases. Other critical incidents occurring while the patron is submerged may compete for the lifeguard's limited attention and may lead to a disruption of monitoring or an impairment in priority assessment. In order to perform the task well, lifeguards must rely on their short-term memory to keep track of patrons. Short-term memory has been shown to be limited in capacity (e.g., perhaps as few as four items by Cowan, 2001 to as many as seven items by Miller, 1956), but almost all short-term memory studies have used naïve participants in laboratory studies and not trained professionals in the field.

Lanagan-Leitzel (2012) asked lifeguards, lifeguard instructors, and non-lifeguards to view videos of regular aquatic activity from several venues (i.e., ocean, lake, swimming pool) and to identify all the incidents that they thought were critical for a lifeguard to monitor. The responses by the experienced lifeguard instructors were considered to be a baseline. Only a few incidents were identified by a large proportion of the lifeguard instructors (i.e., 14 incidents were identified by at least 70% of the instructors). The lifeguards did not always report these same incidents and as a group were largely inconsistent in the incidents that they identified. The incidents identified in that study were primarily submersion, unattended children, weak swimmers, water depth, and horseplay. These incidents were consistent with guidelines taught to lifeguards, yet, the inconsistency of reporting them among the lifeguards was troubling.

One explanation for the reporting inconsistency in Lanagan-Leitzel (2012) was that lifeguards (at least the ones in that study) may not have known which incidents were critical to monitor. Although this explanation seems unlikely, it should be considered because as a group they had only an average of 2.5 years of experience as lifeguards. The study participants were Connecticut lifeguards viewing local facilities, so it was possible that some of the incidents were so commonplace in their experience that they did not attend to or report them. A

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second explanation, consistent with the previous review, could have been that the lifeguards did not report all of the incidents because they were too busy paying attention to other incidents, even ones that were less severe. In other words, perhaps the lifeguards did not have the skill to judge and prioritize incident severity and their short term memory was overloaded due to the multiple incidents occurring at each point in time. The videos contained many swimmers and it certainly was impossible to attend to everything all the time, given the limited attention capacity of humans. Even studies in the fields of radiology and cognitive psychology (see Cain & Mitroff, 2013 for a review) have shown that when two targets are presented concurrently, people often fail to identify one of the two, even if they look directly at it (Hout, Walenchok, Goldinger, & Wolfe, 2015). Although these studies are laboratory experiments of single trials as opposed to a surveillance task, it is reasonable to suppose that the same cognitive mechanisms could be affecting performance here.

To explore the possibility that lack of report by lifeguards in Lanagan-Leitzel (2012) was due to *attentional engagement* as opposed to *knowledge failure*, several critical incidents were isolated from the stimulus videos used in that study. A new sample of lifeguards and non-lifeguards viewed these isolated incidents and provided a rating of severity for each. It was expected that there would be a relationship between the ratings of severity and the reporting rates in Lanagan-Leitzel (2012). A strong relationship would indicate that reporting rates in Lanagan-Leitzel (2012) were due to severity. A weaker relationship would indicate that reporting rates in that study were unrelated to severity. If so, this would suggest that failure to report the incidents found in Lanagan-Leitzel (2012) may have been due to limited capacity attention being diverted to other, potentially less severe, incidents which would be a symptom of attentional engagement across the scene and not a lack of knowledge about the severity of those incidents (i.e., knowledge failure).

Method

Participants

Students at Eastern Connecticut State University who were lifeguards (N = 23, 20 females, average age 20.7 years) and non-lifeguards (N = 62, 49 females, average age 19.5 years) participated in this study in exchange for psychology department research credit. One additional lifeguard (male, age 21 years) and three additional non-lifeguards (two males, age 19 and 20 years, and one female, age 18 years) had to be excluded from the study due to computer error. The lifeguards completed a demographic questionnaire prior to participation. They reported an average of 2.9 years of lifeguard work experience (range: 1 – 7), although 14 of the lifeguards reported only summer work, so this estimate of work experience is skewed high. Their typical work day was between six and eight hours in length, three to seven days per week. They were asked to indicate all types of aquatic environments in which they worked; overwhelmingly, they reported exclusively pool experience (N = 12) or pool experience along with other venues (N = 6) including open-water venues such as rivers, lakes, or the ocean. Only two had experience in exclusively open-water venues. Most (N = 19) reported certification by the American Red Cross, while three reported certification with Ellis and Associates and one did not provide a certifying agency.

Stimuli

One hundred video clips of critical incidents identified in Lanagan-Leitzel (2012) were prepared. In that previous study, participants had viewed 20 videos that were two minutes in length each. The original videos were recorded of normal swimming activity at five different venues across Connecticut: two ocean beaches, two lake beaches, and the indoor recreational swimming pool at the author's university (four videos per venue). The ocean beaches border Long Island Sound and are low surf, with very large designated swimming areas demarcated by buoys. The lakes had relatively small designated swimming areas demarcated with buoys and ropes, with fishing and watersport areas outside the ropes. Lifeguards were on duty at all but one venue (a lake). The clips in the current study were prepared by isolating a brief segment (3 – 20 seconds) from a particular stimulus video and overlaying a yellow ring over one incident in the clip at that time. The purpose of this ring was to draw the participants' focused attention directly to that incident for evaluation. Each of the original stimulus videos from Lanagan-Leitzel (2012) contained between one and nine of the isolated incidents tested in this study.

Task and Procedure

The 100 video clips were displayed on a Dell desktop computer running Matlab with the Psychophysics Toolbox (Brainard, 1997; Pelli, 1997). Participants watched each of the video clips in a shuffled order, promoting variation of venue from trial to trial. Each participant was asked to report the severity of the incident in the yellow circle via key press using a scale of 0 – 7, where 0 indicated that the incident was not severe/dangerous at all and a 7 indicated that it was extremely severe/dangerous. Pressing the 9 key allowed the participant to repeat the clip to facilitate their judgment, and they were allowed to do this on any clip as many times as they wished. This was done because some of the clips were very short. Participants used this replay option most often in the short clips. Each session began with administering informed consent and the demographic survey assessing lifeguard experience. This study was approved by the university's IRB.

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Results

There were several differences observed between the lifeguards and non-lifeguards in the severity ratings. The lifeguards had a higher mean severity rating (2.93) compared to the non-lifeguards (2.43, $t(83) = 2.33$, $p = .023$) and a higher maximum severity rating (average 6.78) compared to the non-lifeguards (6.42, $t(83) = 2.07$, $p = .042$). Eighteen (78%) of the lifeguards used the highest severity rating at least once whereas only 37 (60%) of the non-lifeguards used the highest severity rating. Despite these differences, the severity ratings reported by lifeguards to the individual video clips were highly correlated to the severity ratings reported by the non-lifeguards to those same clips, $r(98) = .948$, $p < .001$. This high degree of correlation suggests that lifeguards and non-lifeguards were similar in their determination of which events were more severe than others; they differed only in their assessment of the *degree* of severity, with lifeguards favoring slightly higher severity ratings than non-lifeguards.

Lifeguard Severity Ratings

The primary goal of this study was to determine whether severity ratings of the incidents reported in this study correlated with the rate of reporting of those same incidents in Lanagan-Leitzel (2012). This was done to examine whether severe incidents were missed in that study due to attentional engagement with other incidents or simply lack of awareness of the incident severity. The average severity ratings provided by lifeguards in this study correlated with the percent of lifeguards who reported those same events in the previous study, $r(98) = .223$, $p = .026$, the percent of instructors who reported them in the previous study, $r(98) = .325$, $p = .001$, and also the percent of non-lifeguards who reported them in the previous study, $r(98) = .208$, $p = .038$. Although the correlation between severity ratings in the current study and lifeguard report rates in the previous study is statistically significant due to sample size, it is fairly weak, accounting for only 5% of the variance for lifeguard reports in the previous study and only 11% of the variance for lifeguard instructor reports in the previous study. This may indicate that some of the severe incidents (at least as identified in the current study) had gone unreported in Lanagan-Leitzel (2012) and that other factors besides severity could have led to reporting in that study.

Non-Lifeguard Severity Ratings

The severity ratings provided by non-lifeguards in the current study also correlated to the percent of non-lifeguards who reported those same events in the previous study, $r(98) = .240$, $p = .016$, as well as the percent of lifeguards who reported those same events in the previous study, $r(98) = .212$, $p = .034$, and even the percent of lifeguard instructors who reported those same events in the previous study, $r(98) = .348$, $p < .001$. As with the lifeguards, these correlations are statistically significant due to sample size, but weak, accounting for only 6%

of the variance for non-lifeguard reports in the previous study. Recall that the correlation between lifeguard severity ratings and lifeguard report rates in the previous study was r = .223 and the correlation between non-lifeguard severity ratings and non-lifeguard report rates in the previous study was r = .240. These correlations are not very different, suggesting that very little of the variance in reporting rates can be explained by differences in assessments of severity, for either group of participants.

Repeat Requests

Every trial afforded the possibility of repeating the video prior to making a judgment, giving the participant the opportunity to be "sure" of his/her response. For the lifeguards, the rate of repetition was uncorrelated with reported severity, $r(98) = .018$, *ns*, but was correlated with the length of the video clip, $r(98) = -.301$, $p = .002$. For the non-lifeguards, the rate of repetition was also uncorrelated with reported severity, $r(98) = -.012$, *ns*, but was also correlated with the length of the video clip, $r(98) = -.349$, $p < .001$. Thus, repetition was primarily a function of the length of the clip in the current study, with shorter video clips being repeated more often than longer ones, and not a product of severity.

Incident Length and Severity

One would expect that the length of an incident might have influenced whether or not that incident was reported in Lanagan-Leitzel (2012) and might influence severity rating. Presumably, short incidents might be easier to miss than longer ones and may be deemed less severe because they are over so quickly. Lifeguards' reported severity ratings in the current study were not correlated with the length of the video clip in the current study, $r(98) = .075$, *ns*, or with the length of the original incident in Lanagan-Leitzel (2012), $r(98) = .025$, *ns*, although the reporting rate in Lanagan-Leitzel (2012) was correlated to the length of the original incident, $r(98) = .069$, $p < .001$. A similar pattern was found for non-lifeguards, where their severity ratings were not correlated with the length of the video clip in the current study, $r(98) = .015$, *ns*, or with the length of the original incident in Lanagan-Leitzel (2012), $r(98) = .018$, *ns*, although the reporting rate in Lanagan-Leitzel (2012) was correlated to the length of the original incident, $r(98) = .410$, $p < .001$. Thus, likelihood of noticing an incident is due to how long it occurs and not its severity.

Qualitative Analysis of Severe Incidents

To further explore the possibility that severe incidents went unreported in Lanagan-Leitzel (2012) due to attentional engagement with other stimuli as opposed to a lack of knowledge about severity, individual incidents were selected and analyzed. There were a total of nine incidents that had an average severity rating of 5 or higher among the lifeguards in the current study (see Table 1). The

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most severe incident, according to lifeguards in the current study, was a group of approximately three to four swimmers far from the ocean shore, splashing and frequently submerging or disappearing behind the waves (mean severity 6.1 for lifeguards, 5.1 for non-lifeguards). This same event was reported by 60% of the lifeguard instructors but only 23.5% of the lifeguards and 15% of the non-lifeguards in Lanagan-Leitzel (2012). Two related incidents, involving more pronounced submersion and less splashing in perhaps the same swimmers, was also rated severely in this study (mean severity 5.4 and 5.0 by lifeguards, 4.7 and 4.0 by non-lifeguards). These incidents were highly reported by all participant groups in Lanagan-Leitzel (2012), most likely because the patrons truly appear to be struggling against the waves and do so for the entire two-minute video clip. As the previous analysis showed, the length of the incident often determined the likelihood that an incident was reported.

Five of the nine incidents were all of a small group of men taking turns backflipping off of their friends' shoulders (mean severity 5.7 by lifeguards, 5.0 – 5.2 by non-lifeguards) or trying to jump up on their shoulders (mean severity 5.0 – 5.1 by lifeguards, 4.0 – 4.2 by non-lifeguards). When isolated as in the current study, lifeguards (and non-lifeguards) appropriately rated each incident as at least moderately severe. In Lanagan-Leitzel's (2012) study, the three backflip incidents all occurred within approximately one minute of time, thus reporting of the initial backflip was high (90% of lifeguard instructors although only 52.9% of lifeguards) but reporting of the later flips was drastically reduced. The two incidents where they were jumping on each other's shoulders were in different video clips, so the reporting rate was moderate for both. In the field, a lifeguard would stop such dangerous behavior when it first occurred, if they correctly identified it as dangerous. Because these lifeguards were viewing only videos, they could not stop the incident from occurring again, even if they had identified it as severe.

The remaining incident was a body floating in the ocean (mean severity 5.6 by lifeguards, 4.4 by non-lifeguards). The body floating was underreported in Lanagan-Leitzel (2012), perhaps because the incident was rather short (10 seconds) or because it happened within the first 15 seconds of the video clip and the lifeguards may have been trying to observe everything in order to orient themselves to the scene, which included patrons at a great distance from the shore and a watercraft speeding past them. This incident best highlights how lifeguards might *know* what is critical, but if their attention is focused on other incidents, they may miss these incidents when they occur in the busy context of the field. It is unclear whether this event would have been monitored in Lanagan-Leitzel's (2012) study had it lasted longer, and if so, how long it would have taken to draw attention.

Table 1. Incidents with the Highest Severity Rating

	Lifeguard Severity[a]		Non-LG Severity		Inst.[b]	LG	Non
Incident	**Mean**	**SD**	**Mean**	**SD**	**%**	**%**	**%**
Far from shore; splashing[c]	6.13	0.97	5.08	1.75	60.0	23.53	5.08
Shoulder stand/backflip[d]	5.74	1.57	5.15	1.51	90.0	52.94	50.0
Shoulder stand/backflip[d]	5.74	1.36	5.02	1.42	70.0	17.65	5.0
Shoulder stand/backflip[d]	5.70	1.74	5.19	1.53	70.0	0	0
Body floating	5.61	1.62	4.42	1.95	20.0	5.88	20.0
Far from shore; splashing[c]	5.43	1.65	4.74	2.01	70.0	29.41	35.0
Jumping on shoulders[d]	5.09	1.56	4.23	1.53	20.0	47.06	30.0
Far from shore; submersion/ splashing[c]	5.00	1.65	4.02	1.84	60.0	41.18	50.0
Jumping on shoulders[d]	5.00	1.81	4.03	1.44	40.0	29.41	15.0
Far from shore; large waves[c]	4.96	1.52	4.42	1.55	60.0	52.94	55.0
Child struggling; deep water	4.74	1.89	3.92	1.78	20.0	0.00	0.0
Far from shore; submersion	4.74	1.63	3.94	1.69	10.0	5.88	25.0
Far from shore; splashing	4.70	2.27	4.35	2.18	40.0	5.88	5.0
Throwing another person	4.61	1.83	3.50	1.39	20.0	0	0
Far from shore; submersion	4.30	1.77	3.34	1.85	30.0	11.76	15.0
Submersion; splashing	4.22	1.91	3.15	1.79	0	11.76	20.0
Hanging onto other's neck	4.22	2.26	3.32	1.81	40.0	17.65	15.0
Deep water; race toward buoy	4.17	1.67	3.21	1.69	80.0	11.76	5.0
Large group; high waves	4.09	2.00	2.97	1.82	60.0	47.06	30.0
Throwing rock	4.04	1.61	2.71	1.70	30.0	0	20.0
Submersion; delayed surfacing	4.00	1.88	3.15	2.00	0	52.94	5.0

[a] Maximum severity rating is 7; 0 = no risk
[b] Percent of participants (instructors, lifeguards, non-lifeguards) in Lanagan-Leitzel (2012) reporting this incident
[c] These incidents were the same patrons
[d] These incidents were the same patrons

An additional 12 incidents were rated between 4 and 5 on the severity scale, making them moderately severe. Two of these incidents were highly reported in Lanagan-Leitzel (2012) as participants indicated a large group of people in very wavy water (one incident involved the same patrons who were splashing in the incidents above). Ocean waves make it hard to see patrons clearly and can obscure submersion and thus drowning incidents. The clarity of the video at that distance did not compare with the resolution of the human eye, so this incident was harder for them to monitor. The additional concern reported by many in that study was that such a distance increased the difficulty of a rescue. This suggested that the judgment of severity may take into account not only the visual assessment of the scene (the patron's current behavior, past behavior, and environmental conditions) but perhaps also the lifeguard's knowledge of and confidence in their own physical capabilities. I did not study this intriguing possibility in this study, but that is a question that future research ought to explore.

Discussion

Lanagan-Leitzel (2012) asked lifeguards and lifeguard instructors to identify incidents that were critical for a lifeguard to monitor from a series of video clips of swimming activity. Lifeguards were inconsistent in reporting these incidents; several purportedly-severe incidents (as rated by lifeguard instructors) were not reported by the lifeguards, nor did a high level of agreement exist across lifeguards in which incidents were reported. Lanagan-Leitzel (2012) offered two potential explanations – lifeguards may have lacked the knowledge of what was a critical/severe incident or they may have had their attention engaged in other simultaneous, but less severe incidents in the chaotic and busy aquatic contexts so that they missed these severe incidents when they occurred.

The results of the current study suggested the latter explanation. When viewed in isolation, many of the incidents that lifeguard instructors originally had identified as severe but the lifeguards overlooked in Lanagan-Leitzel (2012) were given appropriately high severity ratings in the current study. Thus, when attention was drawn to an incident, as it was in the current study, lifeguards were able to readily identify it as severe. Yet, when presented with the complex input that was characteristic of swimming venues presented in the original 2012 videos, lifeguards apparently made decisions about attention allocation from moment to moment that caused them to overlook potentially more serious incidents. This may mean that severe incidents regularly go unmonitored or unreported in real life situations, especially if there are other less severe incidents happening concurrently that divert attention. The lifeguard instructors in Lanagan-Leitzel (2012), being more experienced and expert than the lifeguards in that study, may have shifted attention more rapidly to cover more of the concurrent incidents and/or their experience may have allowed them to prioritize incidents more successfully. Those lifeguard instructors did report significantly more incidents on average than the lifeguards (instructors: $M = 52.9$ incidents, range = 25 to 121 vs. lifeguards: $M = 25.2$ incidents, range = 0 – 57), supporting the assessment that the experienced lifeguard instructors indeed had better and/or faster scanning skills.

Limited-capacity human attention is a blessing and a curse. It allows us to attend to important and novel events, but in doing so, we must remove attention from other events. This is a fundamental purpose and nature of attention. Studies, such as that conducted by Simons and Chabris (1999), have found that focusing attention on one event (a passed basketball) prevents participants from noticing a person dressed as a gorilla. Critically, the gorilla is obvious and detected if attention is not focused on the basketball. Lifeguards, despite their training received during certification and subsequent work experience, were affected by the same limitations of attention as non-lifeguards. The lifeguard's only hope is to rapidly and continuously shift attention to try to monitor every patron in a timely manner.

Attention can be driven to particular incidents of the lifeguard's choice ("endogenous" attention shifts) but attention can also be "captured" away from these incidents by other salient incidents ("exogenous" attention shifts; see Posner, Nissen, & Ogden, 1978 for several laboratory experiments investigating these shifts). These attention shifts are preceded by "disengagement" from one stimulus followed by "engagement" with a new one (Posner, Petersen, Fox, & Raichle, 1988). Laboratory research shows that expert pilots, for example, spend less time with their eyes stationary and make many more eye movements than novices (Bellenkes, Wickens, & Kramer, 1997). Because eye movements are often associated with attention shifts, this indicates that experts may be better able to disengage from one patron and shift their attention to a new one faster, permitting a better degree of coverage of a scene.

It seems likely that the highly-experienced lifeguard instructors in Lanagan-Leitzel (2012) may have had an easier time shifting their attention quickly, allowing them to identify many more of the severe incidents in the video contexts than the less-experienced lifeguards. With less experience, attention shifts may be slower and fewer, perhaps also making them more susceptible to disruption by salient incidents in the scene that trigger exogenous attention shifts (e.g., someone shouting or suddenly splashing). The advantage of the current study is that the incidents were isolated and circled, which ensured that the participants were focusing their attention on them.

Because lifeguards in Lanagan-Leitzel (2012) often reported that a patron's distance from shore would make it difficult to perform a rescue, severity assessment may not be merely a visual judgment as studied here but may take into account physical skills of the individual lifeguard and other contextual factors. In other words, an experienced lifeguard may view an event as more severe if s/he anticipates that a rescue resulting from such an event is likely to be physically difficult to execute and may judge an event as less severe if s/he anticipates an easier rescue. An intriguing study by Moran (2014) explored how people perceived their competence to exit a pool under various conditions. In general, participants tended to overestimate their competence to exit the pool, and this tendency was significantly stronger in males and when faced with a difficult exit (i.e., deep water bulkhead exit, after becoming tired from swimming, and when wearing clothing). Moran's results suggested that people tended to overestimate their own physical capabilities and that this effect was more pronounced among males. Although Moran (2014) did not examine lifeguards specifically and their capability to perform a rescue in his study, it is possible that an inflated sense of capability/competence could be associated with deflated assessments of severity and thus a lack of or a delay in attentional engagement with severe incidents. This question should be examined in future research.

Recommendations

The results of this current study support two primary recommendations. First, it was clear that assessment of severity must rely on how attention is guided through the complex aquatic scene, and how that guidance changes as the incidents in the scene change. Future research should explore how expert lifeguards evaluate these incidents. Rather than simply teach lifeguards-in-training the behaviors associated with drowning and the environmental conditions that should cause them to worry (such as rip currents), explicit instruction should be offered on evaluation of severity changes over time and how the lifeguard should allocate attention across the area for which they are responsible. Essentially, what is needed is experiential *decision-making* training. The aquatic scene is constantly changing, and the assessment of severity changes from moment to moment; thus an effective lifeguard is one who can continually track multiple events by rapid shifts of attention as well as evaluate what is most severe *at that moment* and then monitor and respond to it accordingly. Future research should determine first how expert lifeguards adjust their surveillance (i.e., attention, scanning) according to their severity assessment. Then lifeguard training agencies need to explore how to best teach this process to new lifeguards so they have more advanced scanning/surveillance skills by the time they achieve certification.

A second recommendation that emerged from the results of this study was that future research should attempt to study severity assessments at the moment they are occurring rather than rely on conscious behavioral report. Eye-tracking technology, for example, can record whether an incident is monitored, and if so, for how long. This research would enable a better distinction between incidents that are monitored but deemed non-severe and incidents that are never monitored at all. This sort of study also would be able to address the question of whether a scan path, as recommended by most lifeguard training manuals, is necessary for good surveillance or if it inappropriately locks lifeguards into an artificial pattern of monitoring that may disrupt their fluid severity assessments, obscure the timely attention to severe incidents, and ultimately impede them from acting promptly.

Limitations

There are several prominent limitations of this study. First, the stimuli were videos on a computer screen. This precluded the possibility of a rescue, so it doesn't fully engender the motivations that face lifeguards on the stand and may not adequately reflect their normal on-the-job surveillance performance. Due to mechanical limitations, the videos were not as clear as the human eye can see, making it more difficult to identify incidents that occurred in the distance. Of course, the advantage of using videos instead of live-action incidents was that it ensured that each lifeguard and non-lifeguard participant received the exact same input and so that differences in their performance could be directly compared.

Second, the lifeguards who participated were fairly uniform in their limited experience. Because the convenience sample was comprised of students taking psychology courses, many of these participants were freshmen or sophomores taking an introductory psychology course. Thus, they were young and the lifeguards had had relatively little lifeguarding experience (less than three years, on average, with over half reporting only summer work; using "years" as the temporal unit for quantifying experience likely resulted in over-estimating the actual time spent lifeguarding). Most of them had very little experience with open-water environments, and almost all were certified by the American Red Cross whose mission is focused primarily on certifying lifeguards for swimming pools. Thus, it is possible that different results might be achieved by studying lifeguards with more experience in other venues and who were certified by other agencies (such as the USLA or Ellis and Associates).

Despite these limitations, I believe this study has begun to address the question of how lifeguards rate the severity of incidents as part of how to monitor them effectively. One likely explanation for missed incidents is attentional engagement on other incidents that distracts attention from a more severe incident. This finding, if supported by subsequent research, is more reassuring than a widespread lack of knowledge about what incidents are critical to monitor; however, this lack of knowledge gained from training points out the need to study this specific question further. Although people cannot simultaneously pay attention to everything, given the limited capacity of attention, experts are able to allocate their attention more effectively and rapidly to the most severe incidents and respond more quickly. Future research must explore this process and discover how to provide lifeguard candidates with more adequate observational surveillance training that will improve their attentional capacities and competence as they perform their surveillance duties.

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