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Challenges and Feasibility of Applying Reasoning and Decision-Making for a Lifeguard Undertaking a Rescue

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ABSTRACT: *In areas where lifeguard services operate, less than 6% of all rescued persons need medical attention and require CPR. In contrast, among areas where no lifeguard services are provided almost 30% require CPR. This difference indicates in importance of the lifeguard. Lifeguard work requires effective problem identification, diagnostic strategies and management decisions to be made in high-risk environments, where time is of the essence. The purpose of this investigation was to assess all variables involved in lifeguard work related to a water rescue, and how the information obtained could inform lifeguard training and therefore performance.* ***Methods:*** *By using the drowning timeline, the authors explored all variables involved in a single rescue event by inviting 12 lifeguards to complete a survey of their professional role using a three-round Delphi survey technique. The total potential number of decisions for each phase and sub-phases, the number of variables, the probability of a single event repeating, the duration of each sub-phase and amount of variables demanded per minute were measured. Each sub-phase was presented as predominantly rational (if less than 1 variable per/min) or intuitive (if more than 1/min).* ***Results:*** *The variables identified in sub-phases were: "preparation to work" (8 variables and 0.0001 variables/min) and "prevent" (22 variables; 0.03 variables/min); these sub-phases were predominately considered to lead to rational decisions. The variables identified during "rescue" (27 variables and 2.7 variables/min) and "first-aid" (7 variables and 1.7 variables) were predominantly considered intuitive processes.* ***Conclusion:*** *This study demonstrates the complexity of a decision-making process during the quick, physically and mentally stressful moments of rescuing someone. The authors propose better decision-making processes can be achieved by reducing the time interval between identification of a problem and making a decision. Understanding this complex mechanism may allow more efficient training resulting, in faster and more reliable decision-makers, with the overall benefit of more lives saved.*

KEYWORDS: *Drowning, Prevention, Preparation, Rescue, Mitigation, Decision-making, Reasoning*

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What is known about this topic?

- Worldwide there are approximately 42 drowning deaths per hour each day. Drowning is a major cause of death especially among children.
- In areas where lifeguard services operate, less than 6% of all rescued persons need medical attention and fewer (0.5%) require CPR. In contrast, in areas where no lifeguard services are provided almost 30% of drowning victims require CPR. This difference indicates the importance of the lifeguard's role and the quality of their training in early detection of drowning.
- Lifeguard work requires effective problem identification, diagnostic strategies, and management decisions to be made in high-risk environments where time is of the essence.
- A plethora of decisions are required to execute a single rescue event implying a high risk of error.

What the paper adds

- For the first time, this study clarifies and demonstrates the complexity of a lifeguards' decision-making process during the quick, physically and mentally stressful moments of rescuing someone.
- The authors propose better decision-making processes suggesting to a good (but not ideal) outcome can be achieved by reducing the time interval between identification of a problem and making a decision.
- The understanding of this complex mechanism and associated variables may result in more efficient training to develop faster and more reliable decision-makers, and consequently enhance the odds of successful rescue.

INTRODUCTION

Worldwide there are approximately 42 drowning deaths per hour each day. This is probably an underestimation of the problem, even for high-income countries (World Health Organization 2015). Where lifeguard services operate, less than 6% of all rescued persons need medical attention and 0.5% require CPR (Szpilman et al., 2012). By contrast, Venema reported almost 30% of persons rescued from drowning by bystanders required CPR (Venema et al., 2018). This difference may be because rescue is delayed when bystanders undertake a rescue (Szpilman et al., 2012).

Lifeguarding represents a major mitigation of drowning deaths. However, this is a complex, physically and mentally demanding task. Following a period of quiet surveillance an emergency situation arises in which critical decisions must be made and intense physical actions are completed, many of which must be conducted sequentially for a successful outcome. Other physiological, cognitive and experiential factors in a successful rescue include: the lifeguard's level of experience (Page et a., 2011; Barcala-Furelos et al., 2014) mental and physical preparedness; levels of cognitive and physiological arousal (influenced by sleep adequacy for example); levels of energy and hydration and other cognitive and emotional factors including underlying levels of stress, cognitive workload, presence of distractions and the lifeguard's mind-set.

The mental and physical demands of lifeguarding require a high level of emotional resiliency and commitment to undertake rigorous physical training. The risk of failure can be mitigated by frequent skills training and implementation of effective systems that reduce the likelihood of systematic error, such as: limiting surveillance times to reduce fatigue; the use of elevated lifeguard towers to improve surveillance effectiveness and the use of hazard signs to restrict access to beach dangers. Despite such mitigations, the criticality and complexity of a lifeguard's role can induce tremendous internal pressures. In contrast to a normal healthcare setting, the environments lifeguards operate in are largely uncontrolled, chaotic and include many complicating uncontrollable variables such as surf, rip currents, wind and others.

During a rescue, lifeguards are required to identify problems, execute diagnostic strategies and select appropriate management decisions. They must make numerous complex decisions quickly in a high risk environment that engenders physical and mental stress with high potential for failure and negative consequences (Page et al., 2011; Lanagan-Leitzel et al., 2010). The drowning process from immersion to cardiac arrest usually occurs within seconds to a few minutes (Szpilman et al., 2014). Early and effective rescue may interrupt this process and prevent serious consequences, including the need for resuscitation and life-long medical complications (Szpilman et al., 2012).

The total number of decisions made by a lifeguard during a single rescue has never been measured. This number must be large given that each decision may have at least two alternative options. Some decisions will be conscious (*rational*) and others more subconscious (*intuitive*) and developed over time due to conditioning and training ("experience"). Subconscious decision-making is often described as 'rule-based reasoning' and is an effective and cognitively efficient method of decision-making (particularly under duress and for solving familiar problems) compared to a slower and deliberate conscious decision-making process known as 'first principle reasoning' (Reason et al., 1990). Reasoning and decision-making can be divided into analytic (rational) and intuitive (naturalistic). According to Legrenzi P. et al. "reasoning and decision-making" are alike in that they both depend on the construction of mental models. One of the most important mechanisms for effective decision-making is that individuals are likely to restrict their thoughts to what is explicitly represented in their models. Reasoning is a cognitive process by which people start with information and come to conclusions that go beyond that information. Psychological heuristic methods (intuitive) are used to speed up the process of finding a satisfactory solution via mental shortcuts to ease cognitive load (Reason et al., 1990). Heuristic refers to experience-based techniques for problem solving, learning and discovery that find a solution which is not guaranteed to be optimal, but good enough for a given set of goals (Legrenzi et al., 1993; Wu et al., 2012) and without too much effort. However, success solving one type of problem does not predict success solving another (Ilgen et al., 2012). Currently lifeguards are advised to "think carefully" when confronted with a problem (i.e., employ analytical reasoning). Based on cognitive load theory (Van et al., 2010) it is possible that this advice may overwhelm working memory (Cognitive overload) and therefore be detrimental, especially when conducting a task such as surveillance as detriments in signal detection can occur when the observer is engaged in more than one cognitive task.

The purpose of this investigation was to assess the variables involved in lifeguard work related to a water rescue in the context of the drowning timeline (Szpilman et al., 2016) and consider how the information obtained could inform lifeguard training to and consequently improve performance. This is the first time such a paradigm-based conceptual analysis has been undertaken with lifeguarding; therefore no previous literature exists on this subject for lifeguards.

METHODS

Drowning Timeline

The Drowning Timeline is a model (Szpilman et al., 2016) that provides a description of every component of the drowning process (e.g., highlighting triggers, actions and interventions from a temporal perspective). It has a three phase temporal sequence. The phases are described as "Pre-event", "Event" and "Post-event". The Pre-event phase includes all preparations required to understand, plan and implement prevention strategies, reaction and mitigation, and the necessary preventative actions (Active or Reactive) to minimize the probability of an incident occurring. The Event phase begins with identification of the need for rescue and the rescue itself. The mitigation begins during the Event phase and continues after extrication has ended during the Post-event phase. The Post-event phase includes the provision of first-aid and medical care (mitigations). Using the Drowning Timeline we explored all of the variables involved in these three phases. The Pre-event phase was further subdivided into two sub-phases: Preparation to work and Preparation to prevent/anticipate the rescue. The event phase included all variables relating to the rescue and the Post-event phase included all the actions related to mitigation (first-aid and medical care).

Survey of the Lifeguard Tasks

Following ethical approval from the scientific committee at the Brazilian Lifesaving Society, 12 Brazilian surf lifeguards each with more than ten years of experience (average age 33 years, SD 6 years) were selected to participate using a purposive sampling strategy. An electronic information sheet was distributed to each lifeguard and written informed consent was obtained.

A three-round Delphi survey technique was employed. The Delphi survey is a group facilitation technique which is an iterative multi-stage process designed to transform opinion into group consensus (Hasson et al., 2000). During round one, lifeguards were shown the drowning timeline in an adapted format including all the phases and sub-phases described above that related to their duties (actions). Each action-based facet of daily work corresponded to one phase or another. Participants were asked to identify all the variables in each group (and alternatives) that would require a decision (YES or NO). The adapted drowning timeline model was presented as groups of action variables defined below:

a. Pre-rescue phase-preparation to work: Lifeguard background (Emotional, physical and technical).

b. Preparation to prevent/anticipate rescue: Includes transit to work (how difficult and stressful), preparations on work day at headquarters (well-being and supported), arriving at the duty, patrolling and identifying the hazards, equipment availability during a rescue and the ability to identify the victim at risk.

c. The event phase (Rescue) includes: Calling back-up, running to the rescue, swimming to approach the victim, approaching the victim, towing and transporting from water to dry land (Barcala-Furelos et al., 2014).

d. The post-rescue phase includes: Any first aid actions (primarily the delivery of basic life support to the drowning victim) (ILS Board of Directors 2013).

During this round participants were also asked to include or suggest modification to any variable group or specific variables. Following the identification of the variables and any possible alternative responses in round 1, one of the authors (DS), who has 30 years of experience as a qualified lifeguard, collated the anonymous data and re-sent an overview to the same 12 participants. The possible responses for each variable were transformed into a dichotomous "Yes" or "No" answer. In round 2, participants identified any potential new variables, qualitative responses or both. In round 3, participants had a final chance to gain consensus. The responses were then collated and analyzed.

The Probability that the Same Event Response can be repeated

The probability that exactly the same event might be repeated was used as a way to measure how many variable responses were involved in each phase/sub-phase. This provided a means to correlate the difficulty to predict responses and therefore train lifeguards.

Duration Estimation of Each Phase/Sub-phases

The amount of time lifeguards spend in each phase or sub-phase was estimated based on the longest possible duration determined from the longest durations recommended by current best published evidence or practice, or from expert opinion. The duration of the Pre-event phase-preparation to work was established to be 110 hours (6,600 min), based on the minimum International Lifesaving Federation (ILS 2013) recommendation for a surf-lifeguard course. Preparation to prevent/anticipate a rescue was established to be 12 hours (720 mins) or a day on duty (personal reference from the longest lifeguard day shift at Copacabana Beach). The Event phase was estimated by the rescue time duration of 10 min (Reilly et al., 2006). For the Post-Event phase, first aid (basic life support), the mean time of 12 min was estimated based on the average time for an advanced life support ambulance to arrive on scene (Szpilman, 1997).

Table 1.
Lifeguard timeline conditions (variables) which may affect decision making.

Lifeguard timeline conditions (variables) which may affect decision making						
Phase	**SUB-PHASES** (variable group number; variables; probability to repeat the same event responses; and time spent) **Variables per minute to affect making decisions**	**Timeline action variables group (product of total qualitative response possibilities)** Variable – qualitative set of response – Yes or No (response number possibilities)				
Pre	**PREPARATION TO WORK** (1 group; 8 variables; 1/256 probability to repeat the same event response; and 6,600 minutes) **0,0001 variables/min**	**Lifeguard background (256)** Adequate technical training? Y *vs.* N (2) Adequate physical training? Y *vs.* N (2) Adequate work employee? Y *vs.* N (2) Adequate paid feeling? Y *vs.* N (2) Rest? Y *vs.* N (2) Fed appropriately? Y *vs.* N (2) Emotional balance? Y *vs.* N (2) Healthy - Y *vs.* N (2)				
	PREVENT/ANTICIPATE THE RESCUE AT DAY SHIFT (5 groups; 22 variables; 1/4.2 million probability to repeat the same event response; and 720 minutes) **0,03 variables per minute**	**Transit to work (4)** Near (hours) from work? Y *vs.* N (2) Transit stressful? Y *vs.* N (2)	**Preparing on work day (HQ) (32)** Personnel locker? Y *vs.* N (2) Arrive on time? Y *vs.* N (2) Confortable environments (HQ)? Y *vs.* N (2) Daily briefing prepares for challenges? Y *vs.* N (2) Time for training/ working out before going on duty? Y *vs.* N (2)	**Arriving at the duty, Patrolling and identifying the hazards (1024)** Adequate transit time allowed to arrive at duty Y *vs.* N (2) Working with a partner? Y *vs.* N (2) Personnel fully equipped? (PPE) Y *vs.* N (2) Familiar with area ? Y *vs.* N (2) Adequate communication with partner/HQ? Y *vs.* N (2) Tower/vehicle comfortable and protective? Y *vs.* N (2) Adequate time to adjust to work? Y *vs.* N (2) Rough water conditions? Y *vs.* N (2) Support from other agencies - Y *vs.* N (2) Hazards signs available and appropriate? Y *vs.* N (2)	**Equipment availability to take to rescue (4)** Appropriate equipment (fins, board, PWC...)? Y *vs.* N (2) Difficulty of equipment choice? Y *vs.* N (2)	**Identifying the victim at risk (8)** Easy? Y *vs.* N (2) Early? Y *vs.* N (2) Good vision? Y *vs.* N (2)

Event	**RESCUE** (6 groups; 27 variables; 1/134 million probability to repeat the same event response; and 10 minutes) **2,7 variables per minute**	**Calling back up (4)** Easy? Y *vs.* N (2) Quick? Y *vs.* (2)	**Running (4)** Easy to run? Y *vs.* N (2) Easy to choose water entrance? Y *vs.* N (2)	**Swimming to approach the victim (256)** Properly equipment-Y *vs.* N (2) Waves dificulties? Y *vs.* N (2) Comfortable water temperature – Y *vs.* Not (2) Good vision? Y *vs.* N (2) Calm weather conditions – Y *vs.* N (2) Easy entrance? Y *vs.* N (2) Victim Near? Y *vs.* N (2) People in the way obstructing? Y *vs.* N (2)	**Approaching the victim (128)** Lifeguard appropriate equipment? Y *vs.* N (2) Victim Unconscious? Y *vs.* N (2) Victim react? Y *vs.* N (2) Good victim flotation Y *vs.* N (2) Easy assessment to the victim? Y *vs.* N (2) In water treatment needed? Y *vs.* N (2) Easy signaling condition from water to shore? Y *vs.* N (2)	**Towing (8)** Near to dry land? Y *vs.* N (2) Other guard support? Y *vs.* N (2) Difficulty to tow ? Y *vs.* N (2)	**Transporting from water to dry land (32)** Near? Y *vs.* N (2) Easy? Y *vs.* N (2) Light victim? Y *vs.* N (2) Easy to position to BLS? Y *vs.* N (2) Help available? Y *vs.* N (2)
Post	**FIRST AID** (1 group; 7 variables; 1/128 probability to repeat the same event response; and 12 minutes) **1,7 variables per minute**	Supported by other guard/assistance? Y *vs.* N (2) Basic life support? Y *vs.* N (2) Advanced life support available? Y *vs.* N (2) Advanced support needed? Y *vs.* N (2) Need to call ambulance? Y *vs.* N (2) Laypersons helpful? Y *vs.* N (2) Confident of ability to provide life support? Y *vs.* N (2)					

Effort and Process for Decision-Making (Intuitive *vs.* Rational) (Drew et al., 1985)

Following identification of the number of variables and their responses, the probability of repeating an event and estimation of the duration of each phase, the authors estimated the predominance of rational (less than 1 variable per minute) or intuitive (more than 1 variable per minute) decision-making. Rational decisions encompass a range of predictable aspects of day-to-day actions and decision-making, where the element of time is less critical. Variables categorized as "Rational" were those that were expected, easy to predict or train for where time is available to make evaluations or to conduct training. Variables categorized as "Intuitive" were those that were unexpected but not necessarily novel and where time to respond is limited. Intuitive decision-making (heuristic) is cognitively flexible under stress and where time is limited.

Data Analysis

The data were tabulated according to the drowning timeline and the maximum total number of groups and variables was presented numerically. The possible responses to each variable within each group of variables (in each phase/sub-phase) were calculated based on the probability of a singular combination of events repeating. Each individual response (Y or N) created multiple combinations of alternate pathways. The probability of one unique event being repeated was calculated by multiplying all the variable response possibilities within each sub-phase together to give the total number of possible pathways. Assuming all potential options have been included and that all pathways are equally likely, then the probability of one pathway (X) being repeated is calculated as 1/X. The total number of variables for each separate sub-phase was divided by the estimated duration of that sub-phase: each sub-phase was then presented as predominantly rational (if less than

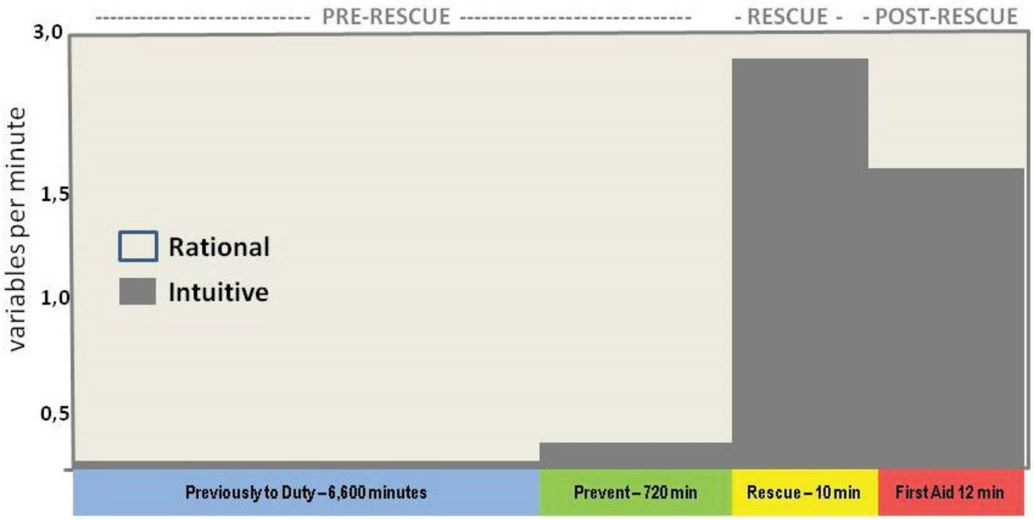

Figure 1. Shows variables/min with predominantly rational or intuitive decision making.

1 variable per minute) or intuitive (if more than 1 variable per minute).

RESULTS

All phases, sub-phases, groups of variables, individual variables, and their responses throughout a lifeguard's professional life, and each probability of a singular event repeating are listed in Table 1. The total variables (n=64) that may affect or need a lifeguard to engage in decision-making were considered.

The variables identified in the sub-phases as preparation to work (8 variables and 0.0001 variables per min) and prevent (22 variables and 0.03 variables per minute) were predominately categorized as rational decisions as they involve less than 1 variable per minute. The variables identified during rescue (27 variables and 2.7 variables per minute) and first-aid (7 variables and 1.7 variables per minute) were predominantly categorized as intuitive process (if any decision-making was required as a response) as they involve more than 1 variable per minute. Figure 1 shows variables per min indicating when it is predominantly rational or intuitive decision-making.

DISCUSSION

This theoretical study has, for the first time, identified millions of potential decision pathways and an extremely low probability of exactly repeating a rescue event using the same decision pathway. This complexity presents challenges to lifeguard instructors. In theory, experienced lifeguards reason more effectively, however, non-technical skills such as effective reasoning (intuitively or analytically) take time to develop. Is there a method to develop and train lifeguards to be more effective decision-makers earlier in their career progression?

Parallels could be drawn between Emergency Medicine and lifeguards as they share the common goal of saving lives. During the professional development of emergency department physicians, learning originates from didactic presentations, role modeling, case discussions and real-life exposure. Novices integrate networks of information, associative links, and memories of real patient encounters to form unique clusters of information for each diagnosis. Barrows, H.S, & Feltovich, P.J, coined the term "illness scripts" for these complex collections of data. The illness script theory assumes that knowledge networks adapted to clinical tasks develop through experience and operate autonomously beneath the level of conscious awareness (intuition) (Charlin et al., 2000; Durning et al., 2013). By contrast, the ocean environment is less controlled and can be hazardous to lifeguards. In this regard we can also draw parallels to pre-hospital emergency workers, where operating in a dangerous environment requires quick decisions and actions and it is essential to rapidly egress the environment for the rescuer's or patient's safety. Paramedics describe this doctrine as "load and go" (quickly loading a patient into an ambulance and departing). The antonym to this doctrine "stay and play" involves remaining *in situ* to carry out interventions. Work as a lifeguard is therefore more akin to the doctrine "load and go" versus "stay and play" (Wilmink et al., 1996).

Lifeguard work encompasses three main clusters of tasks that follow the drowning continuum timeline (Szpilman et al., 2016). Each of these should be optimized by appropriate institutional polices and training if the highest level of performance is going to be achieved by lifeguards. Firstly, there is a preparation phase which includes personal physical and mental well-being, promoting preventative education, rescue and mitigation. Secondly, a pro-active phase encompasses prevention and risk management. Thirdly, a reactive phase includes the rescue and first aid actions. Experienced lifeguards accumulate a vast "library" of response options that can be rapidly and subconsciously (intuitively) accessed for the purpose of generating hypotheses and diagnostic decision-making under pressure (Schmidt et al., 1990). These automatic reasoning processes (intuitive) are non-analytical, rapid, and require little cognitive effort (Stanovich et al., 2000; Evans, 1984; Evans, 2008; Kahneman, 2011; Sloman, 1996; Croskerry, 2000). In contrast, rational thinking is effortful and employs a deductive search for a fit between the available information and appropriate scripts which cannot fit a dynamic scenario (Stanovich et al., 2000; Evans, 1984; Evans, 2008; Kahneman, 2011; Sloman, 1996; Croskerry, 2000; Stanovich & West, 2000). Novices employ this analytic mode of reasoning more frequently than their experienced counterparts. Experienced lifeguards therefore may have already turned some of the “unpredictable” into “anticipated” variables and have a potential optimal response ready. However, while intuitive reasoning is a hallmark of those with experience, errors may result from overreliance on automatic reasoning (Eva & Cunnington, 2006).

The authors propose that during most rescue scenarios lifeguards (like emergency workers) use both systems of thought, a process known as “dual processing” as this offers the best chance of success, even for the novice (Norman, 2009; Norman & Eva, 2010; Eva, 2007). It is possible that the combination of automatic and analytic thinking is more beneficial for complex versus simple cases (Mamede et al., 2008) or when one anticipates difficulty (Mamede, 2008; Gonzalez, 2004). A flexible, adaptive, robust approach that considers multiple criteria and possibilities and uses rational methods to generate a set of scenarios (or hypotheses) potentially selected from intuitive reasoning may be more desirable. In the context of lifeguarding, multi-scenario analysis might use rational analysis to provide the decision-maker with multiple hypotheses (North Atlantic Treaty Organization, 2002), relevant systems (Allen et al., 2006) or “branches and sequels” of possibilities (North Atlantic Treaty Organization, 2004) versus an optimal or single answer. The key in decision-making system design is to provide enough information to give decision-makers a comprehensive view that mitigates the “fog of war” but not to overload them with so much information that it creates a “glare of war” – i.e., information overload.

Understanding the variables involved in the daily work of a lifeguard and expressing these against time may help the lifeguard training process (Barcala-Furelos et al., 2014). Lifeguard training should imitate real life and instructors focus on overarching principles and teach trouble shooting arising from application of these principles during various real life scenarios. For example, teaching basic principles such as keeping flotation between the rescuer and the victim, pausing for assessment a safe distance away is desirable as these principles are transferrable to a range of similar situations such as using a different flotation device as a barrier orb when other rescue techniques are used. Once general concepts are taught and practiced, maximizing teaching variables that are easily predicted, future decisions can be made more intuitively with less need for analytical thought, decreasing cognitive load during rescue and making reasoning more efficient. A decrease in cognitive load facilitates better capacity for analytical thought required to solve unexpected or hard variables.

Two epistemological perspectives, objectivist and constructivist are relevant to lifeguard reasoning. From the objectivist (or logical) perspective, there is one truth that is revealed or can be discovered (Driscoll 2005). Learning is considered the process of acquiring knowledge to discover the one truth. Experience is seen as less important and lectures presented by experts conveying their ideas of truth are the pervading instructional method. The constructivist perspective consists of a compilation of human made constructions (Tversky & Kahneman, 1974) and not the neutral discovery of an objective truth (Tversky & Kahneman, 1984). Teaching emphasizes providing representative experiences whereby learners can construct meaning. This point of view has led in part to the emergence of problem-based and case-based learning, a form of learning where the teacher facilitates learning versus conveying facts. Decision models must be considered within the context of the dynamic decision-dense environment lifeguards operate within. The authors propose that lifeguard education is suited to a constructivist approach and there is a benefit in constructing a series of rehearsed and tested scripts we have called “rescue scripts”. These scripts should focus on the context and “boundaries” or range of acceptable performance in an encounter versus a single best route.

A classic study by Elstein et al. demonstrated that experts have more knowledge than novices enabling a higher rate of diagnostic accuracy, rather than general problem-solving skills. The amount of knowledge and the manner that it is arranged in memory facilitates accurate diagnostic reasoning (Ilgen et al., 2012). Expert physicians are better able to access knowledge precisely because of experience. In contrast novices may be unable to connect existing knowledge to a “novel” clinical problem (Ilgen et al., 2012; Durning et al., 2013). Any constructivist approach must cater for the surrounding complex environment. Cognitive and task over-loading is common in the lifeguard environment as well as the emergency department. A study by a U.S. academic emergency physician (Brixey et al., 2008) demonstrated that 42% of tasks were interrupted before completion and when interrupted, emergency physicians completed one to eight additional activities before returning to the original task. “Thinking carefully” (using analytical thought) may contribute to cognitive over-loading in the emergency department and where lifeguards work, which could be detrimental. By presenting rescue scripts, novice lifeguards can acquire validated experiences from experts (who develop the scripts) and are able to develop individual variation (over time) in their practice within the acceptable range and boundaries defined within the rescue script. An expert’s performance by comparison may fall into one of several equally valid trajectories of acceptable performance that may not be the ‘one true pathway’ to a solution. In this regard, clearly defined decisions are probably unlikely for expert rescuers as he or she may have chosen any number of pathways (developed over time) to achieve a successful result.

Future Challenges for Lifeguard Education

Educating lifeguards to be effective decision-makers has cost implications. To our knowledge, no cost-benefit-time-effort analysis investigating the dividends of such training has been conducted. Unlike industries such as aviation (who invest heavily in such human factor training) many lifeguard services employ only part time or seasonal lifeguards. Thus, the potential benefits of such training may not be recognized as a value proposition, despite strong evidence that human factor training centered on effective individual and team decision-making processes reduces error and accidents and improves safety. Any investment that reduces the need for rescue and provides improved prevention must be of benefit.

Limitations

Dealing with so many variables, this study has several limitations. These include: the possibility of missing or misinterpreting a variable, the unbalanced weighting of those variables affecting decision-making or outcome, the over or under-estimation of the duration of sub-phases, and the self-reported data provided by ocean lifeguards may not be transferrable to a water park or swimming pool environment. Also the time duration of each phase/sub-phase is an estimation based on guidelines and expert opinion that may vary. Although lifeguard decision-making does involve a significant amount of variables, the exact number of variables per minute may vary, and may be different. Further limitations include that some variable responses were estimated as a dichotomous YES or NO response when there may be a more diverse range of possible responses. In all phases a summary of the conditions was made and some or many other variables that were excluded may play a role; as such our approach probably underestimates the decision-making task of lifeguards. At the preparation to work phase, we chose to focus strictly on training/formation time frame instead of including experience before commencing lifeguard training. Finally, the time spent on one particular action leading to a question may be much longer than others issues and some rational decisions may take longer by being more complex or perceived as more worthwhile or risky.

CONCLUSION

The study has identified that the shorter the time from problem identification to a decision leading to a good but not ideal outcome, the better the decision-making process. The authors propose that understanding this complex mechanism and all of the variables involved in a singular rescue event might result in more efficient training in order to produce faster and more reliable decision-makers, and consequently save more lives from drowning. Due to the large number of possible choices available to a lifeguard facing a single rescue event, the authors also propose lifeguards and lifeguard instructors develop a "rescue script" when training in order to build resiliency and transform unpredictable variables into more predictable variables that require less cognitive load to problem solve. Forging competent and professional lifeguards who make good decisions while under duress is a desirable objective but requires more attention. It is hoped that the present study in identifying the demands, decisions and conceptual model, will represent the first step in achieving this objective.

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