Safety Science 62 (2014) 312–318

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Warning signs at beaches: Do they work?

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ARTICLE INFO

Article history:
Received 6 February 2013
Received in revised form 24 July 2013
Accepted 8 September 2013
Available online 8 October 2013

Keywords:
Drowning prevention
Beach safety
Warnings
Risk communication

ABSTRACT

Aquatic safety signs are widely used to alert potential users to hazards such as strong currents (rips), submerged rocks or dangerous marine life. To assist in providing guidance on the way such signage should be deployed the present study asks to what extent warning signs on the approach to some popular beaches add to the existing knowledge of beachgoers exposed to such signage. Interviews were conducted with 472 users at four beaches in the Australian state of Victoria. Three different signage conditions were used; no signage, a single standard composite signboard, and signage spatially separated into four types of signs; location name and emergency information, safety hazard symbols, lifeguard service information, and prohibitions. The interview investigated hazard identification, signage recalled, comprehension of that signage and, to elucidate a question about the shape of warning signs, whether users noticed whether warnings were in a triangle or diamond shape. Currents/rips was the hazard foremost in respondents minds regardless of whether signage was present warning of this danger. Less than half of the respondents (45.0%) reported observing any signage. Of those that did report observing signage the majority noticed the hazard related symbol signs above any other information provided. Neither composition of the sign (i.e. separated or composite/standard sign) nor symbol shape affected recognition. Strategies to direct beachgoers to read and heed the information on aquatic safety signage are discussed.

1. Introduction

Beaches can be dangerous places. In Australia the crude coastal drowning rate is 0.43 per 100,000 population (Surf Life Saving Australia, 2012). It is estimated that from 2002 to 2007 an average of 53 people drowned each year at Australian beaches (Franklin et al., 2010). In addition, for every reported death there were over 260 rescues on Australian beaches in 2009/2010 (Surf Life Saving Australia, 2010a).

The many authorities having responsibilities associated with beaches have implemented a wide range of actions directed towards reducing the potential effects of dangers on beachgoers. Actions range from the standard supervision of beaches by professional lifeguards and volunteer lifesavers to beach safety campaigns (Hatfield et al., 2012). One almost universal approach is to display safety-related signage at the approaches to beaches. Such signage is designed to alert potential users to aquatic-related hazards such as strong currents (rips), submerged rocks or dangerous marine life. Signage present on beaches also typically includes regulatory information and information on what to do in case of emergency.

It is often held that warnings should be designed to alert the potential audience, to provide information about the hazard, about its potential consequences and about appropriate behavior to avoid those consequences. These components are outlined, for example, in the US Standard ANSI Z535.4 (2011b). The alerting function is often conveyed through relevant signal words such as danger or caution and ANSI Z535.4 (2011b) provides details of a range of words to be used. The alerting function can also be conveyed through the use of symbol signs involving various colors and shapes. For example, a black symbol on a yellow triangle or diamond shape with a black border defines a color and shape combination that is well-known as providing a warning. The international standard ISO 3864-1 (2011) provides design rules for the shapes and colors of this and other safety-related symbol signs as does ANSI Z535.3 (2011a).

Information about the hazard (such as rips on beaches), the possible consequences and the appropriate behavior to engage in or avoid can be transmitted with appropriate text. However, in order to avoid the necessity for text which may be required in several languages, a pictorial symbol using an appropriately-shaped and colored symbol format is often used. Another reason for using pictorial symbol signs is that they can increase the likelihood that the warning will be noticed. A symbol sign can usually be recognized at a greater distance than the equivalent sign in words (Jacobs

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http://dx.doi.org/10.1016/j.ssci.2013.09.003

et al., 1975), and has better visibility for viewers of all ages, particularly in the reduced light of dusk (Kline et al., 1990).

In order for a symbol sign to be effective it must be comprehended appropriately. The international standard ISO 9186-1 (2007) and the US ANSI Z535.3 (2011a) both provide details of testing methods that can be used for determining the extent to which a safety sign that uses only a pictorial symbol is comprehended as intended.

Laughery and Wogalter (2013) have pointed out that warnings can be seen as fulfilling a variety of roles. They may be there to provide information, to influence behavior, or simply to be a reminder. In each of these roles differing emphasis may be needed on each component of the warning. In particular, where a warning relates to a danger that is not well understood it may be necessary to provide more information, but where everyone who encounters the warning has had, for example, a work-related induction involving learning about the relevant dangers then all that may be required is a reminder. In a public situation such as a beach the question arises as to what people already know prior to attendance and what they can infer from warnings that might be presented. For example, if there is a warning symbol sign showing sharks it may be assumed that those seeing it would know that the appropriate behavior is to remain alert for shark warnings and not to enter the water. On the other hand, one of the warnings commonly shown on the approach to Australian beaches relates to dumping waves, which are waves that break right at the water's edge and are thus likely to drop an unsuspecting body surfer precipitously, and with some force, onto the sand possibly resulting in serious injury. These waves are commonly poorly understood but the relevant standard requires only the symbol sign with no further explanation.

There are two conventions for the way a warning pictogram or symbol is displayed. One is in a yellow triangle with black border, as used in Europe and as shown in ISO 20712-1 (2008). The other is within a yellow diamond with black border as traditionally used in Australian and US public and roadway warnings. When Australia and New Zealand adopted ISO 20712-1 (2008) the triangle-shaped warning signs shown in that standard remained. Research suggests that when the color of a well-known symbol sign is changed it is very readily noticed (Adams and Hsu, 1981). Shape changes are also noticed but less reliably so. The question remains in the present context as to whether a change from diamond to triangle will be noticed and, more particularly, whether it will cause confusion.

There has been much research into safety and risk communication generally (e.g. Lundgren and McMakin, 2009) but very little has focused on the specifics of effective aquatic safety signage. A major reason for this lack of evidence is that warning signs are rarely evaluated in the context of actual use. The current study was therefore conducted within the environment in which aquatic safety signage is used, namely at local beaches near the major Australian city of Melbourne. The research was designed to extend the evidence on aquatic signage by answering the following questions:

- To what extent do beachgoers have a prior conception of the hazards at beaches?
- Do beachgoers who pass warning signs on their approach to a beach become more aware of the dangers depicted on those signs than beachgoers who do not encounter such signs?

There were two subsidiary questions to be answered:

- There was an opinion within the Australian safety community that warning signage would be more effective if its components were spread out spatially instead of being grouped on a single large signboard. The present study aimed to investigate this.
- The present study also aimed to determine whether beach users notice the shape of the black-symbol on yellow background warning signs—whether that shape is the European triangle shape or the US/Australian yellow diamond shape.

2. Method

The design involved administering a questionnaire to randomly selected respondents at four beaches. The main factor was presence or absence of signage. When signage was present it was in either a single standard composite signboard as shown in Fig. 1 or separated into its four components as described below (2.2 Signage). There were two types of beaches: bay and ocean. For one of each type of beach, when either type of signage was present, the warning symbols were shown within yellow triangles, for the other they were shown within yellow diamonds as shown in Fig. 1. Interviews were conducted in person by trained interviewers using a questionnaire designed for the purpose.

2.1. Locations and materials

Hazard symbols appropriate for beaches are listed in international standard ISO 20712-1 (2008) which has been adopted as Australian and New Zealand standard AS/NZS 2416 (2010). In order to provide for conditions both with and without signage it was necessary to select sites with no pre-existing safety signage. It was also necessary to select sites at which a range of standard hazard warnings taken from ISO 20712-1 (2008) would be plausible. Beaches which met this criterion, and for which appropriate permission could be obtained, included two bay beaches and two ocean beaches. All the beaches had a hazard rating of 3 or 4 on the 10-level beach classification scale developed by Short (1996) in which the least hazardous beaches are rated 1 (safest) through to the most hazardous 10 (least safe). The beaches used in this study are thus classified as presenting low to moderate hazards. The bay sites were Brighton and Seaford and the two ocean beaches were Point Leo and Balnarring, all being within 100 km of the city of Melbourne.

2.2. Signage

In the no-signs condition the beaches remained as they were. There were no hazard signs but there were some local authority regulatory signs, for example regarding dogs not being allowed on the beach or not removing shellfish. These remained in place. As the main questioning of respondents was in relation to hazard signage these regulatory signs, unrelated to the present study, were not considered to pose a concern for the design.

For the composite signage condition temporary signs were designed according to ISO 20712-3 (2008), a separate one for each beach, as shown in Fig. 1, with content relevant to the foreshore environment and beach conditions at each selected site. In the separated signage condition the composite sign was broken down into its four separate panels as described in ISO 20712-3 (2008) namely the location name and emergency information on the first panel, the safety hazard symbols on the second, the lifeguard service information on the third and prohibitions on the fourth. At each beach the path from the car park to the beach was through foreshore vegetation so it was possible at each beach to separate the four components with at least 5 m between each.

The signs were located so as not to obstruct access or interfere with beach activities but so as to appear to be standard beach signs. The number of signs placed at each site was variable and based on the length of the immediate beach face and number of

Fig. 1. Signs used in the present study.

defined access paths leading to the beach face. Of the three beaches, only Point Leo had one primary defined access point onto the immediate beach face. The other sites required multiple signs to be placed at entrances (for composite sign variable) and along the access paths (for the separate sign variable). Based on the symbol height of 84 mm, a permissible viewing distance of 5 m was provided (refer to clause 5.1.4, AS/NZS 2416, 2010). This symbol height would allow observations by multiple beach visitors converging at a particular access point.

All signage was consistent with the hazards applicable to each site. Hazards included on the signage were selected based on a risk assessment of each beach, as recommended in the Australian and International Standards, AS/NZS 2416 (2010). Four hazard symbols were included on each sign. The sharks and currents warnings were selected as constant for all four beaches. The other two were site specific. The wording chosen adjacent to the safety hazard symbols were as typically used at Australian beaches. At one of each type of beach the warning signs were in the diamond shape, at the other they were in the triangle shape.

The risk assessment guided by AS/NZS 2416 (2010) (clause 4.1) requires consideration of hazards and associated risks of the aquatic environment, regulations or legislation, operation and

management of the aquatic environment, and users and their foreseeable behavior. In carrying out the assessment the beach geomorphology characteristics as outlined by Short (1996), and an overlay of spatial contours of the ocean floor at each beach, were used to assist in listing possible hazards and their associated risks. Expert advice regarding foreseeable behavior at each site was sought from colleagues familiar with each site. Finally, site specific data and geomorphology characteristics, ranked on a likelihood and consequence outcome rating, using a methodical risk management process (AS/NZS ISO 31000, 2009) were used to determine the hierarchal placement of symbols for each beach.

2.3. Questionnaire

A questionnaire was developed to measure hazard identification among beachgoers both from a general point of view and also in relation to the specific beach where the interview took place. Further questions asked the interviewee to describe any signs they remembered seeing that day, including their location, and to describe what they thought the signs meant. They were then asked whether they remembered the shape in which the symbol was enclosed (triangle or diamond). Following this they were shown a sheet which included images of the four symbol signs they would have passed that day plus two additional distractors, each in both diamond and triangle form making 12 symbol-sign images in all. Respondents were asked to identify any signs they remembered seeing and to give their meaning. They were also asked for demographic information: age range, gender, country of birth, language spoken at home and years lived in Australia and for visitation information: how often they visit the beach over the summer months and what activity they were using the beach for on the day they were being interviewed. There was a total of 18 questions in the questionnaire (refer Appendix) which took on average eight minutes to complete. This paper analyses some of the questions from this questionnaire.

2.4. Respondents

A total of 472 interviews across the four sites were conducted between 8am and 7 pm on weekends and weekdays from February to April 2012. Interviews were not limited to water users as aquatic-related incidents such as slips, trips and falls can occur when there is no intent to enter the water (Life Saving Victoria, 2007).

Trained interviewers invited people aged 18 years or over to participate in the study. Respondents were targeted at random once they had passed a beach entry point and had settled themselves at the beach. Each interviewer started at a designated location on the beach and selected participants on the basis that they were the next nearest person to the interviewer after each interview was completed. Any refusals, including the reason for refusal where possible, were recorded. Interviewers were asked to record the respondent's entry point and, for the purposes of a separate report, they also recorded the actual location of the interview using a 20 m $\times$ 20 m grid reference system.

2.5. Ethics

The study was approved by the RMIT University Human Research Ethics Committee.

3. Results

3.1. Response coding

Coding was routine for most responses. However, the coding of two types of responses requires special mention.

3.2. Coding of stated hazards

Although responses given by interviewees regarding hazards were recorded verbatim, they were coded using Surf Life Saving Australia's Coastal Public Safety Risk Assessor guide (Surf Life Saving Australia, 2010b) which includes a table of 11 risk types each broken down into specific hazards found in the beach environment. For example, the risk type of Surf Conditions includes the hazards of Tidal Currents, Surf Zone Currents/Rips, High Surf and Dumping Waves. The risk type of Dangerous Animals and Marine Life includes Sharks, Stinging Fish/Rays and Jellyfish. General Hazards include Litter, Syringes, and Fishing Line/Fishing Hooks. Although both risk type and specific hazards were encoded only risk type will be mentioned below as it is at the level of specific risk that warning signage is targeted.

3.3. Coding of stated symbol sign meanings

When respondents were asked what particular symbol signs meant, their responses were again recorded verbatim but often these responses posed difficult coding decisions. Consider, for example, the Submerged Sandbars warning symbol sign (Fig. 1) which is described in the standard as having the function, "To warn of a hazard from diving onto submerged objects in open water." It was decided that the respondent had to make it clear that there was a relationship between diving and hitting an object in order for the response to be scored as correct. As another example, the function of the Currents warning symbol sign is given as, "To warn of the hazard from strong currents." If respondents said it meant currents or rips the response was deemed correct, but not if they said it meant drowning or danger of drowning or man waving. The concept of currents had to be incorporated for the response to be deemed correct.

3.4. Demographic characteristics and beach visitation information

A total of 472 beachgoers agreed to be interviewed representing a response rate of 89.9% of those approached. The main reasons for refusal were: 37.7% language difficulty, 22.6% lack of time and 15.1% not interested.

Table 1 shows the total number of respondents that were questioned broken down by location and the type of signage used.

After assigning everyone a mean age from their age range comparisons using a one-way ANOVA indicated that, at $\alpha = .05$ and using the Scheffé post hoc test, the mean ages of those at Brighton, Seaford and Point Leo did not differ, ranging from 40.1 to 42.0, but that these differed from the mean age at Balnarring which was 48.1. SDs ranged from 12.1 to 14.1. The ratio of females to males ranged from 1.18 to 2.00. Those born in Australia constituted 51.2% of respondents at Brighton and between 64.9% and 73.0% at the other beaches. Those who had lived in Australia for at least 10 years constituted 62.0% (at Brighton) and between 85.2% and 89.8% (at the other beaches). Between 79.6% and 95.1% of respondents spoke English as their main language at home. Visitors from overseas constituted 20.7% of respondents at Brighton (almost half of those were from the United Kingdom, the United States of Amer-

Table 1
Number of respondents questioned.

Location	Standard sign	Separated sign	No sign	Total
Balnarring	34	30	47	111
Brighton	37	45	39	121
Point Leo	47	32	43	122
Seaford	61	14	43	118
Total	179	121	172	472

ica and Canada) and between 0.9% and 4.1% at the other beaches. Visitors from other states in Australia constituted 0.8–3.3% of the sample.

In regards to prior exposure, 89.0% of respondents had previously visited a beach at least once a month over the summer months. Activities most beachgoers were intending to partake in were swimming (61.2%) or walking (33.5%). The majority of beachgoers were intending to enter the water (65.0%) for swimming, surfing, boating, fishing or a combination of these activities.

3.5. Perceived hazards at beaches in general

The first substantive question was, "When you think of beaches in general what potential dangers or hazards come to mind?" Respondents were encouraged to give as many responses as they could think of to this question with up to nine recorded. Valid responses were given by 447 respondents with a total of 1124 responses being given in all. Table 2 shows responses that were given by at least 10% of the respondents, separated into responses given in the signs-present and signs-absent conditions.

Note that when symbol signs were present the signs at all four beaches included both a currents and a sharks warning, yet the overall percentages of the interviewees who mentioned currents or rips was significantly greater under the no signs conditions (two-tailed Fisher's exact test $p < .001$). None of the other differences was significant.

Another way of looking at the data is to consider only the first-mentioned hazard for each person, that is, the hazard that is foremost in the respondent's mind. Of the 300 interviewees who passed signs on their way to the beach 67 (22.3%) gave currents/rips as their first-mentioned hazard with 21 giving sharks as their first. Of the 172 interviewees who did not pass any signs on their way to the beach 74 (43.0%) gave currents/rips as their first-mentioned hazard with 12 (7.0%) giving sharks as their first. For currents there were significantly more mentions in the no-signs condition (two-tailed Fisher's exact test $p < .001$). For sharks there was no significant difference (two-tailed Fisher's exact test $p = 0.15$).

3.6. Perceived hazards at specific beaches

After the question about beaches in general respondents were asked, "When you think of this particular beach what potential dangers or hazards come to mind?" The purpose of this question was to determine whether beachgoers choose a beach based on their assessment of the hazards each beach presents or whether they group all beaches together as all presenting certain hazards.

At each beach there were two symbols that were specific to that beach. Table 3 gives details of the frequency that hazards related to those two symbols were mentioned at each beach under signs-present and signs-absent conditions.

Table 3
Frequencies with which specific hazards related to each beach were mentioned under signage present and absent conditions.

Location/additional symbol	Signs present	Signs absent
Balnarring/sudden changes in depth	1/64[a]	2/47[a]
Balnarring/boats in area	1/64	2/47
Brighton/sudden changes in depth	0/82	0/39
Brighton/submerged sandbars	3/82	1/39
Point Leo/shorebreak	10/79	7/43
Point Leo/submerged objects or rocks	0/79	1/43
Seaford/shallow water and sandbars	8/75	1/43
Seaford/change of depth	1/75	0/43

Note that at point Leo the hazard of "Rocks" (without mention of their being submerged) was mentioned by 27/79 people when signs were present and by 4/43 when absent, a significant difference (two-tailed Fisher's exact test $p = .008$).

[a] The denominator in each case is the number of people interviewed at the beach, and under the signage conditions, mentioned.

Note that at Point Leo the hazard of "Rocks" (without mention of their being submerged) was mentioned by 27/79 people when signs were present and by 4/43 when absent, a significant difference (two-tailed Fisher's exact test $p = .008$).

3.7. Were the signs that were there noticed?

Respondents were also asked about what, if any, signage they had seen as they approached the beach on that occasion. The first such question was, "As you walked down to the beach today did you see any signs?" Of the 300 respondents interviewed under the signs-present condition only 135 (45.0%) said that they had seen any signs. Of the 172 respondents interviewed under the no-signs condition 45 (26.2%) said they had seen signs. The difference was significant (two-tailed Fisher's exact test $p < .001$) however some of the second group may have seen local authority regulatory signage unrelated to the present study.

3.8. What signs were noticed?

Respondents were then asked what signs they had seen. This question was asked of everyone as there was always at least one local authority sign present even when study signage was absent. Table 4 shows the types of signs that were correctly recalled.

There were 71 respondents (23.7%) who were in the signs-present condition and who were able to state what specific symbol signs they had seen. The only specific symbol signs that were reported more than twice, and these were signs that were present in one form or another at all four beaches, were: Sharks (8–15 times), Currents/Rips (3–7 times), Sudden changes of depth or

Table 2
General beach hazards mentioned by at least 10% of those who responded, ordered by overall response frequency.

Response	Signs present ($N = 278$)			Signs absent ($N = 169$)[b]		
	N[a]	Percent of responses	Percent of cases	N[a]	Percent of responses	Percent of cases
Currents/rips	127	19.3	45.7	106	22.8	62.7
Litter (e.g. glass)	76	11.5	27.3	36	7.7	21.3
Sharks	57	8.6	20.5	38	8.2	22.5
Waves/surf	48	7.3	17.3	24	5.2	14.2
Drowning	38	5.8	13.7	28	6.0	16.6
Needle sticks	33	5.0	11.9	26	5.6	15.4
Jellyfish etc.	29	4.4	10.4	24	5.2	14.2
UV Radiation (sun)	28	4.2	10.1	18	3.9	10.7
Rocks	28	4.2	10.1	18	3.9	10.7

[a] Note that this N refers to the number of times that hazard was nominated—each person could nominate more than one hazard. The total number of hazards mentioned when signs were present was 659, when signs were absent, 465.

[b] The criterion of being mentioned by at least 10% of all respondents gives the same nine items for both lists, although in a slightly different order in each.

Table 4
Types of signs that were correctly recalled.

Type of sign	*N*	Percent of responses (%)	Percent of cases (%)
Emergency locator reference	9	6.5	10.7
Beach name	2	1.4	2.4
Hazard	81	58.3	96.4
Information/service	5	3.6	6.0
Regulation	16	11.5	19.0
Other (including council, beach flags)	26	18.7	31.0
Total	139	100.0	165.5

Sandbars (4–5 times), Emergency services (1–5 times) and Swim between the flags (1–5 times). Signs that were only at some of the beaches were No Alcohol (mentioned 9 times) and Dog restrictions (5 times).

3.9. Did spacing out the sign components make any difference?

Considering separately the two signage conditions, 80 (44.7%) of the 179 who walked past a standard sign reported seeing signs and 55 (45.5%) of the 121 who walked past separated signage reported seeing signs. Of the 135 who passed by signage and who said they had seen signage, 115 (85.2%) were able to identify the location of the signage correctly.

3.10. Did changing the shape of the symbol make any difference?

Respondents were asked to identify which type of warning signs they had seen on their approach to the beach that day (triangle or diamond). Of the 135 respondents who passed by signage and who said they had seen signage, only 36 (26.7%) were able to correctly identify the shape of the symbol. When the warning signs were diamond shaped 20 were correct, 5 were wrong and 25 were unsure. When the signs were triangles 16 were correct, 10 were wrong and 32 were unsure.

4. Discussion

This study is the first, to our knowledge, to assess aquatic safety signage in the field and therefore to assess directly the effectiveness of signage on beachgoers.

4.1. Demographic characteristics

The typical respondent was aged in their 40s, had lived in Australia for more than 10 years and spoke English as their main language at home. The relatively-large number of beachgoers who refused to respond because of language difficulties indicates a need for more work to test the effectiveness of aquatic safety signage in culturally and linguistically diverse communities.

4.2. Perceived hazards at beaches in general

The danger of being caught in currents or rips was the hazard foremost in the minds of the beachgoers, regardless of whether or not signage was present warning of this danger. The next most frequently mentioned dangers, referred to significantly less often, were those of litter such as broken glass and sharks (Table 2). Again, there did not appear to be any relationship between the frequencies with which these dangers were mentioned and the presence or absence of related signage. Indeed, the second or third most reported danger, that of litter such as broken glass, was not mentioned at all in any of the study's signage.

When symbol signs were present, the signs at all four beaches always included two warning symbol signs, one warning of currents/rips and a second warning of sharks, yet the proportion of respondents who mentioned either of these hazards was no greater under the signs-present conditions (Table 2). There was thus no evidence that the signs relevant to these two hazards increased the likelihood of their being mentioned.

4.3. Perceived hazards at specific beaches

At each beach there were two warning symbol signs that were specific to the hazards at that beach. When results for each beach were considered in relation to specific hazards the resulting data (see Table 3) show that the highest percentage of interviewees who mentioned any danger covered by the specific signage were the 10 (12.7%) who mentioned the hazard of shallow water and sandbars. At the one beach where there was a rather unusual warning sign—one probably not encountered by beachgoers before, namely the "Boats in area" sign—only 1/64 or 1.6% of interviewees mentioned this hazard. Whether these figures are taken as reassuring—that the signage is noticed by at least some, or disheartening—a much higher percentage would be expected, will be a matter of individual judgment. The frequencies of 'hits' are too low for statistical comparisons to be meaningful but to the present authors the figures are discouragingly low.

At one beach (Point Leo) the hazard of "Rocks" (without mention of their being submerged) was significantly greater when signs were present ($p = .008$). The mention of rocks without their being submerged was deemed as an incorrect response as this was not within the definition given in the Standard (AS/NZS 2416.1, 2010) which is to "warn of a hazard from diving onto submerged objects in open water". However, as some interviewers did not further explore the details of each of the hazards mentioned it is possible that the respondents may have been referring to 'submerged rocks' without explicitly stating this.

Evidence from prior research demonstrates a precedent for the overall poor figures. Previous studies have reported that familiarity with a product or environment can reduce the likelihood of seeking out or reading a warning related to hazards associated with that product or environment (Laughery and Wogalter, 2013). A familiarity with the beach environment, with the majority of the present respondents having visited a beach at least once a month over the summer months, may have reduced the likelihood that the beachgoers who were interviewed would have noticed any warning signage.

From the theoretical perspective of the Communication-Human Information Processing (C-HIP) model (Wogalter et al., 1999), which integrates communication and information processing components specifically aimed at the risk communication process, the Attention stage may have been affected by the Beliefs/Attitude stage in that beachgoers may have formed their own belief that the beach was relatively safe, or that the potential hazards would not happen to them. Beachgoers who were regular visitors may have believed that they had sufficient knowledge and ability to avoid or deal with any hazards that may have been present and thus did not need to pay attention to hazard-related signage. Perloff's (1993) Third Person Effect characterizes this finding, namely that we tend to overestimate the effect of persuasive communications on others, and underestimate our own susceptibility to them. Future studies should assess the effects of relevant prior experience such as swimming expertise on perception of aquatic risks. It also important for authorities to consider the concept of prior perception of risk and the subsequent influence on people's concerns and therefore their visualization of hazards and any warning of those hazards (Slovic et al., 1982). Overall, the present findings

suggest that beach signage may have less of an immediate effect on beachgoers than the responsible authorities may assume.

Another factor in relation to the present findings is that they may reflect the success of education campaigns advising people of the dangers of rip currents at beaches in Australia (Hatfield et al., 2012). The beachgoers in our sample may thus have been already aware of the associated hazards with the result that they simply did not notice relevant warning signage. The fact that the one symbol sign which would seldom appear at beaches, namely the "Boats in area" sign, and which might therefore be expected to command attention and be noticed as a hazard, was mentioned by very few beachgoers, suggests that there was a general lack of attention to the warning signage at these beaches.

4.4. What signs were noticed?

Less than half of beachgoers (45.0%) observed any signage. However, when signage was noticed, beachgoers were more likely to notice hazard symbols (96.4%) rather than regulation or other information. This provides support for the evidence of hazard symbol signage in gaining attention. Whether this translated into specific knowledge of the hazard is unclear as only 23.7% of those who had seen any signage when it was present recalled specific symbol-signs.

Warning communication domain experts advocate the notion of a hierarchy of hazard controls in which design and other engineering-like controls are preferred, with signage a lower order control measure (Wogalter et al., 1999). The present study reinforces the view that signage is less effective than might be imagined. Given the nature of beach environments, where it may be impossible to implement design solutions to hazards, warning signage may be one of the only remaining avenues for risk control. The other remaining strategy is the implementation of public awareness and related campaigns. The fact that a relatively large number of the present interviewees mentioned relevant aquatic hazards even when signage was absent indirectly suggests that such campaigns in the past have been relatively effective. These findings are particularly relevant given that only 3% of Australian beaches are patrolled or supervised (Sherker et al., 2010).

4.5. Did spacing out the sign components or changing the shape of the symbols influence recognition or recall?

The present results suggest that neither the composition of the sign (i.e. whether a standard composite sign or a sign separated into its four sections) nor the hazard symbol shape (triangle or diamond) significantly affected recognition or recall. The present study provides no evidence of additional attention-getting effects associated with erecting signage with the sections separated in space so that the additional cost associated with that style of presentation is not justified. Regarding the shape of the warning signs, the present findings support clause ZZ1 in the present Australian and New Zealand Standard AS/NZS 2416.1 (2010) which states that either the triangle or diamond shape may be used, so long as the one shape is used consistently within a single signage context.

4.6. Conclusion

This study assessed aquatic safety signage in the field and therefore directly assessed the effectiveness of signage on beachgoers. Currents/rips was the hazard foremost in respondents minds when they visited the beach, regardless of whether signage was present warning of this danger. While it was encouraging that hazard related signage received greater recognition than other information provided on aquatic signs, of concern was the number of beachgoers that did not recall seeing any signage prior to their entry onto the beach. This highlights the importance of multiple risk management strategies to prevent drowning and other aquatic injuries.

Acknowledgements

This study was supported by funding from the Surf Life Saving Australia Internal Research Scheme.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ssci.2013.09.003.

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