

Surfers' perceptions of safe-surfing mobile application

Elena Vlahu-Gjorgievska^{1,*†}, Yahya Saad Y Alhatem^{1,†}, Noel Silvernus Galasau^{1,†},
Umaima Zahra Halim^{1,†}, Norah Makhdoor O Almeahmadi^{1,†} and Khin Than Win^{1,*†}

¹ University of Wollongong, Northfields ave 2500 Wollongong, Australia

Abstract

This paper aims to explore the surfers' perceptions and requirements for safe-surfing mobile applications. For the purpose of the study, interviews with 13 surfers were conducted. Results identified 3 themes (App Content, App Design and App Features) with 8 subthemes and 25 initial codes. In-time information regarding the weather conditions, and surfers education for beginners are the main information required by the surfers. Another important aspect is the app design or how the information is presented in the app; while personalised notifications were identified as the main feature of a safe-surfing app. Using the Persuasive Systems Design (PSD) model, the codes were mapped into the persuasive principles. Most of the identified features can be implemented using the PSD principles of reminders, personalisation and social facilitation. A safe-surfing app providing users with real-time information on weather/surfing conditions can be instrumental for the surfers, enhancing the surfing experience and cultivating safe surfing practices.

Keywords

safe surfing, mobile app, notifications, personalisation, persuasive systems design

1. Introduction

Surfing is a popular recreational sport with a current estimated number of 35 million surfers and a growth of 15% per year [1]. Surfing is beloved by many due to its thrilling nature, giving the sense of feeling and knowing the danger [2]. However, there are also risks and injuries associated with surfing such as lacerations, fractures and dislocations [3]. A surfer's environment is greatly responsible for a surfer's safety; the ocean and weather conditions are extremely unpredictable which can put surfers at risk of injury [4]. Furthermore, surfers also need to be aware of the marine animals (like sharks, stingrays, jellyfish, and saltwater crocodiles), and the composition of the sea floor which may contain hard sand, coral reefs, and submerged rocks, all of which are risks and can also cause injuries [3].


Surfers are expected to be acquainted with their surfing environments and conditions by checking the weather and getting information about marine life and other dangers [5]. They should be able to evaluate their surfing skill levels and choose designated spots accordingly. According to Surf Life Saving (SLS) Australia, the behaviour of surfers is influenced by several

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* Corresponding author.

† These authors contributed equally.

✉ elenavg@uow.edu.au (E. Vlahu-Gjorgievska); y.syahya1408@gmail.com (Y. S. Y. Alhatem); nsg361@uowmail.edu.au (N. S. Galasau); uz442@uowmail.edu.au (U. Z. Halim); nmoa329@uowmail.edu.au (N. M. O. Almeahmadi); win@uow.edu.au (K. T. Win)

 0000-0001-6160-5343 (E. Vlahu-Gjorgievska); 0000-0002-7810-6388 (K. T. Win)



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factors including physical ability, capability, motivation, opportunity and the level of social influence [6]. However, due to high confidence levels and physical ability, surfers may become unrealistic about the limitations of their abilities [6]. This may be associated with risky behaviours such as surfing under dangerous weather and wave conditions.

The best way to avoid these potential risks is by knowing the surfing location and environment conditions suitable for one's skill level and ideally following them, as a surfer's behaviour is the first step of enhancing safety. Technological advances in weather, tide and wave forecasting have improved surfers' information access and provided new capabilities to plan and determine optimal surfing conditions [7]. Additionally, the new technologies, such as social media, web and mobile applications give an opportunity for surfers to access and share important information that enhances their surfing activities anywhere at any time [8].

There are many web and mobile applications used in the surfing sport that provide information on weather conditions, beach safety details and guidelines [9]. However, such information is scattered and not always comprehensive to the surfers. The information provided in mobile applications are general and most of the applications lack features that meet the specific needs of the surfers [8]. Also, there is limited research conducted in the field of surfing, especially regarding surfing applications that have the ability to disseminate tailored real-time information, thus enabling surfers to sense and respond to coastal threats [10].

The aim of this study is to explore surfers' perceptions of a safe-surfing app by identifying the information and features that are required and needed by surfers, so those can be embedded in a safe-surfing mobile application. The use of persuasive technologies has driven effective technology solutions that increase self-awareness, facilitate self-management, and encourage positive behavioural change [11-13]. Getting accurate and timely information as well as tailoring the information based on surfers' attributes and abilities is necessary to leverage the planning, motivation and interaction for safe surfing. In this context, the study explores the persuasive principles that can be applied in the design of a mobile application for safe surfing.

2. Background

The high likelihood of developing risky surfing behaviours arises from overconfidence, physical ability, familiarity with coastal conditions, bad influences, and strong internal motivators [4-6]. Therefore, it is necessary to support positive behaviour by advising surfers regarding the importance of checking and monitoring weather/coastal conditions before and while surfing and assessing their own (and others') surfing abilities.

In the surfing sport, besides the potential introduced by mobile technologies in accessing information on surfing sites and weather forecasts [7], there are many surfing apps. To have a better insight regarding the content and options included in these applications, the top five applications used by the surfers were selected and reviewed. The selection criteria included: app popularity among surfers, high ratings in online reviews, and positive feedback from users. The applications (presented in Table 1) were installed on Android and iOS devices and were reviewed based on the information and features included.

In general, the apps include weather forecasts, wind speed, swells, sun heat, livestreaming and options for social interaction. The reviewed applications also have some form of notifications or alerts like sending messages via email, SMS (text messages), pop-ups, and chats.

All the applications, except SurfTrackr, include information regarding the weather, temperature, wind and waves. The Surfline app additionally presents surfing news, events and activities. Surfline, Windfinder and Surftrackr support some kind of live streaming of users' surf sessions or live feeds from events and beach web cameras. Surftrackr is more like a diary app where the user can store information about their surfing sessions, as well as share those with friends. Surfline also supports social interaction by sharing surfing experiences with friends via social media.

Regarding notifications, most of the apps include notifications in the form of alerts. The WindFinder and iWindsurf applications support wind speed and direction alerts. Beachsafe presents general weather warnings, while Surfline provides surf alerts for good surfing conditions at selected spots.

Table 1
Characteristics of the reviewed applications

Application	Information			Features			
	wind	waves (tide and swell)	weather temp/sun	events & activities	live stream/webcam	social interaction and networking	notifications
Beachsafe	√	√	√	X	X	X	√
Surfline: Wave & Surf Reports	√	√	√	√	√	√	√
Windfinder	√	√	√	X	√	X	√
iWindsurf	√	√	√	X	X	X	√
SurfTrackr	X	X	X	X	√	√	X

Based on this review it can be noted that although the applications provide real-time reporting on weather forecasting, wind, waves and temperature, the supported notifications are non-customisable and lack personalisation. Limitations are identified in terms of tailoring the information based on the personal context (surfers' attributes, motivation and ability) or surfer's specific needs [9].

Mobile applications can support intention and encourage engagement in behaviour change by offering educational materials and features such as goal setting, self-monitoring, notifications, reminders and personalized feedback [14-16]. Therefore, understanding the information and features needed by the surfers is paramount for providing positive influence in all dimensions of safe surfing.

3. Research methodology

To explore the surfers' perceptions of a safe-surfing mobile application, a qualitative study was conducted. The data collection was done by semi-structured interviews with surfers. The eligibility criteria for the interview participants were to be above 18 years old and have surfing experience. The recruitment of interviewees was from the Illawarra and South Coast (NSW, Australia) surf zone. The interviews stopped at 13 participants, as the results started to be saturated. The interviews were voice recorded and scripted using the Otter App.

The qualitative analysis of the interview scripts was done using NVivo 12 software. The interview data was coded and organized into themes, subthemes and codes that reflect emergent topics. Coding reports were summarized and cross-checked to ensure consistency of interpretation. Whenever the authors disagreed on the codes, sub-themes, or themes transcripts were reviewed again and discussed until consensus was achieved.

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

4. Results

The interviewees were mostly surfing at North Wollongong, Towradgi, Kiama and Shellharbour beaches (in NSW, Australia). The participants were between 19 and 62 years old with a mean age of 31.3 years and a standard 10.7 years deviation. Out of 13 participants, 4 (31%) were females and 9 (69%) were males.

The introductory part of the interview had general questions regarding the surfing conditions including the elements that affect surfing, reasons for surfing in extreme weather conditions, the risks and accidents related to surfing and the use of any surfing app. All participants agreed that the wind (speed and direction) as well as the swell size affect surfing. Most of them also mentioned that the swell direction and tide are also important. Although few of the interviewees stated that they do not prefer surfing in extreme weather conditions, 8 (62%) of them had surfed in extreme conditions because of fun, motivation (from friends), competition, confidence and self-esteem. Most of the participants, 9 (69%), reported that had low or medium-level surfing accidents, 1 (8%) participant had high-level accidents and 3 (23%) reported no accidents. Most causes for surfing injuries, according to the participants, were surfboards and other surfers, reefs/rocks in the water, weather conditions (such as big swell and weaves), shark attacks and lack of surfers' knowledge and physical ability. 9 (69%) participants stated that they are using (or used in the past) some kind of weather or surfing websites and apps, but mostly to get information about the weather and surfing conditions.

The main part of the interview was to explore surfers' perceptions and opinions of a safe-surfing application, without specifying any particular app.

The qualitative data analysis derived three themes: the app's content, design, and features (Table 2). The "App Content" theme includes 2 subthemes: "Information Needed by Surfers" and "Surfers Education", with 5 and 2 codes respectively.

Participants expressed the need for in-time information in the form of notifications [P6] about the weather and surfing conditions. They noted that this information can be especially helpful for inexperienced surfers [P2]. Additionally, the participants agreed that the app should

include information about wind direction and speed [P5], Tide [P3], Swell and Waves size [P12] and Weather conditions [P4].

Table 2

Themes, subthemes, codes and transcripts examples of the qualitative analysis

Themes	Sub-themes	Initial codes	Examples of references from the interview transcripts
App Content	Information Needed by Surfers	In-time	<i>P2</i> "... especially if you don't know how to surf, ... to have something on your phone that you can look at ... the in time information is good"
		Information	<i>P6</i> " I think it could be good if it notifies you, you know it pops up with a, you know, a notification says, you know, a change in wind direction."
		Wind direction and speed	<i>P5</i> "... live wind update which is really handy.. you can actually see in time" <i>P9</i> " and then the wind direction is super important as well."
		Tide	<i>P3</i> "For me tide, tide is most important, and wind," <i>P6</i> "check what time the high tide is, the low tide..."
		Swell and Waves size	<i>P10</i> "Yeah, so the swell direction and the wind would be the most important things for me" <i>P12</i> "I like to see the tides, the wind. The swell direction. What is one other yeah wave height" <i>P13</i> "Yeah, tide, swell and wind direction"
	Weather conditions	<i>P2</i> "...and weather if its sunny or rainy or cloudy..." <i>P4</i> " you can like have a look on the forecast and choose like the best spot to surf depend on the weather..." <i>P7</i> "Do you have the water temp? The temperature of the water? the outside temperature".	
App Design	Surfers Education	Information for Beginners	<i>P4</i> "...you know learn tip... sit down with somebody and watch videos and you got to go out there and then experience that..." <i>P8</i> " Well, I think it would be helpful if there was an app function that said, Oh, you're a beginner surfer so you should get to this, this location, because ... this is where it's good today these times..."
		Information for Reading a weather map	<i>P3</i> "... if you don't understand how to read a weather map... about low pressure systems, high pressure systems, wind fetches and all that stuff you won't understand how waves are generated..."
	Information Presentation	Minimize the Amount of information	<i>P7</i> " ... helpful pretty easy to use... there's so many that are simplified, which are good, ... if I want to just make a decision in like 10-15 minutes ... those simplified apps are good..." <i>P10</i> "... it gives me, like the right amount of information..."
		Using Simple Terms	<i>P4</i> "... most of the things just common sense like you read and see the beaches and stuff, easy to understand" <i>P5</i> " ... really simple message if you could get that to these inexperienced surfers .. it definitely could prevent, you know some of the accident yeah stuff that occur ... In simple terms..."

		Percentage and Rating	<p><i>P7</i> "... I think, having like a percentage like one to 100 if it's good or not. So, say like it's like 80% Good, ..."</p> <p><i>P12</i> "like an average... on average, today the swell is like this ... The winds like this... and the people have rate it three out of five stars"</p> <p><i>P13</i> "...oh you surfed in these conditions before and this is your rating..."</p>
	Layout	Simple Layout	<i>P8</i> "Well, just always the simplest thing is the best. So just simple layout"
		Graphics	<i>P9</i> ".. like has some very good graphics ..."
		Maps	<i>P2</i> "I think the maps good because it can tell you where to go to the surf spot, Like directions..."
		Font for Notification	<i>P6</i> "...probably a bigger thing font that I just thought about is um, bluebottles..."
		Colour	<p><i>P2</i> "... you want something that's colour, something that's really easy to read..."</p> <p><i>P12</i> "I think the colour coding helps so you directly see okay. Could it be good or not. ... when the conditions are good it's green when the conditions aren't great, it turns orange and when the conditions are bad, it turns red."</p>
App Features	Notification	Alert for Sharks	<i>P2</i> "it'll definitely stop me going out there, which is good. If it gives me a notification saying yeah sharks spotted "
		Surfing Condition Notification	<p><i>P5</i> "... it's more for the inexperienced surfers that would want that notification of such that, you know, don't go to the beach today don't go surfing..."</p> <p><i>P6</i> "...you know it pops up with a, you know, a notification says, you know, wind direction this"</p>
		Real Time Notification from Wearable Devices	<i>P7</i> "Yeah, definitely. That's good. Um, yes, notifications sensor shocks, real time notification."
	Social Interaction	Sharing Surfing Condition	<p><i>P2</i> "...If people write comments on there saying, oh, sharks today or is a bit of a rip current out today little things like that is a good thing..."</p> <p><i>P10</i> "I think it could be helpful in some situations because you can know like where the waves were good, or whatever. But yeah, but some people also don't like that because then some spots will get crowded".</p>
		Sharing Experiences	<p><i>P2</i> "Yeah, I would share it with people. Because sometimes my friends are at home. ... So I think the app would achieve that."</p> <p><i>P8</i> " Sharing my experiences Yeah, just just wtih friends. more like just face to face."</p> <p><i>P12</i> "Just tell your closest mates"</p>
	Personalisation	Preferred Locations	<i>P8</i> "...Maybe set a favourite surf spots"
		Experience Level	<i>P8</i> "... you're a beginner surfer so you should get to this, this location, because it's easy swell or anything like that"

	Preferred Surfing Condition	<i>P13</i> "...like you know the exact same conditions come up a different day and tell you, oh you surfed in these conditions before and this is your rating"
Integration with other Apps and Devices	Beach Cameras	<i>P5</i> "I like real time data to show you because it's gonna be able to show you what it is doing at the exact point ... you can also get surf cameras that can actually stream the beach for you as well." <i>P7</i> "... it's like the surf cam they are good, because you can just be like looking at it without having to go down to the beach"
	Wearable Devices	<i>P7</i> "...you have a smart watch ... tells you live updates of the surf conditions... " <i>P10</i> "...The speed of like how many waves he caught, like the speed that he went. ... just like let's you know break down how you did."

Another important content that the safe-surfing app should include is Surfers Education. The participants highlighted that information or some kind of recommendations or tips for beginners would be beneficial [P8]. The participants also noted that it is important to know how to read the weather maps, since that information is very relevant to surfing [P3].

Two subthemes "Information Presentation" and "Layout" were identified within the theme "App Design". In general, participants agreed that the amount of information in the app should be minimal indicating "the right amount of information" [P10]. Also, the information should be presented using simple terms [P4] and percentage or rating [P12], so the surfers can easily understand it and make quick decisions.

According to the participants' opinions, the application should have a simple layout [P8], including good graphics [P9] and maps to display the surfing spots and directions [P2]. It would be beneficial and easy to read if the presented information were colour-coded [P2, P12], using a bigger font to present notifications for danger [P6].

The participants clearly identified several subthemes within the "App features" theme. Participants agreed that Notifications are very important and helpful features, especially for a safe-surfing app. Several types of notification (codes) were highlighted within the "Notification" subtheme, such as Alerts for Sharks [P2], Notifications for Surfing Conditions [P5], as well as Real-time Alerts from wearable devices [P7].

Based on the participants' opinions, including features supporting "Social interaction" can enhance the communication between the surfers. The surfers found the option for sharing information regarding the surfing conditions useful [P2]. However, the participants noted that some surfers are hesitant to share when the conditions are very good because the surfing spot may become very crowded [P10]. Interestingly, most of the participants stated that they would like to share their surfing experience using a surfing app, but they would prefer to do that only with (closest) friends [P12].

According to the participants, the app for safe surfing needs to introduce a certain level of personalisation. The application should allow the user to set favourite surfing spots [P8], personalize the recommendation for surfing spots based on the user's surfing experience and weather conditions [P8], as well as make recommendations for surfing spots based on the user's preferred surfing conditions [P13].

In today's digital world, when users are using different gadgets, it is inevitable for the application to be compatible and enable integration with other digital devices. In this context, the participants supported the app's live streaming of the beach camera recordings [P5]. They found it useful in obtaining additional information about weather conditions. Another useful option is the connectivity with the user's smartwatch, so the surfers can get alerts [P7] or record surf conditions/experiences while surfing [P10].

5. Discussion

In this study, surfers' opinions and preferences regarding the safe-surfing application were presented. The participants' perceptions regarding the app's content, design and features were classified into 8 subthemes that can be mapped into the persuasive system design principles [17].

A surfer's environment greatly affects the surfer's safety. The typical information that is significant in surfing are the wind strength and direction, swell size, tide, and weather forecast [18]. The findings of this study confirmed that the safe-surfing app should include in-time information about the weather conditions, wind directions and speed, tide and swell within the app content. It was also identified that including the learning tips for beginners, as well as information on how to read a weather app can be useful for surfers. A safe-surfing app providing users with real-time information on weather/surfing conditions can be instrumental for surfers, enhancing the surfing experience and supporting safe surfing practices.

However, the findings suggested that how the information is presented to the user is very important. Namely, the participants strongly indicated that the presented information should be short, simplified, and in the form of percentages and ratings. They also recommended visual presentation using graphics and maps, as well as different font sizes and colours. These well align with the persuasive system design principles of reduction and liking [17]. The reduction feature has been introduced in other applications to reduce complexity, easy navigation, and user-friendliness [19] while liking was implemented for presenting information or feedback as aesthetic and visually appealing to users [20, 21].

Based on the study results, there are several app features that the participants perceived as useful. Most of the identified features can be implemented using the Persuasive Systems Design (PSD) principles of reminders, personalisation and social facilitation.

The PSD principle of reminders can be implemented as different prompts (messages or notifications) that encourage the user to continue to use the application, perform required tasks and maintain the motivation for reaching a particular goal [13, 20]. Based on the findings, the safe-surfing application should include real-time notifications regarding the surfing conditions and sharks' appearance in the surfing areas. Surfing conditions vary depending on the weather conditions, location, and nature of the beach, so this information surfers recognize as essential in improving their surfing experience. Delivering these notifications by wearable devices was perceived as additional support. In this context, needs to be mentioned that some of the participants find notifications unnecessary and distracting. However, they all agree that notifications can be a good way of educating inexperienced surfers.

Personalisation can be applied in various contexts. It can be in the form of personalised content, services, feedback or suggestions [15, 22]. In our case, the notifications need to be related (personalised) to the current location/surfing spot of the user. However, the study

results also suggest that users prefer to mark their favourite surfing locations, as well as to receive personalised recommendations. The recommendations should be customised based on the surfer's experience level (so the surfing conditions will match the user's skills) or based on the previously top-rated surfing conditions (such as wind/wave/swell) by the user.

The social interaction regarding surfing activities can be observed in terms of surfing alone or with friends, being part of a surfing club, using social media platforms for sharing surfing information/experiences, as well as the reasons driving such social behaviours. According to the study findings, surfers prefer to surf alone more than being in a group, however, when being in a group, they prefer to be with their friends other than people they do not know. Similarly, the surfers would like to share their experience mostly with their closest friends. The effects of social facilitation can occur with the passive or active presence of others in the same activity, thus the PSD principle of social facilitation allows users to encourage and support each other by observing the activities of other users [23-25]. So, this principle can be used to implement the social interaction features required in the safe-surfing application. One interesting observation is regarding sharing information about best surfing spots, or current good surfing conditions at a particular place. Based on the results, sharing this information is not only challenging from a social aspect but also for safety reasons since the spot can become crowded. When the surfing locations are overcrowded, the risk of accidents is increased. Therefore, implementation of the social facilitation feature should have some constraints regarding the sharing (e.g. allow users to indicate with whom they want to share) or include additional information regarding the number of visitors in the surfing area.

Besides the requirement of app integration with beach cameras, so the surfers can have real-time updates on the surf zone conditions without being physically present, integration with wearable devices can be observed from a self-monitoring aspect. Some wearable devices, like smartwatches, allow the creation of recordings during surfing. These recordings can capture the surf conditions and surfer's behaviour. So, integrating features that will enable users to watch the recordings and reflect on their behaviour is aligned with the PSD self-monitoring principle [26].

6. Conclusion

In this paper, we are presenting the results from the 13 interviews with surfers from the Illawarra and South Coast (NSW, Australia) surf zones. The study aimed to obtain the surfer's perceptions and identify the information and features required in the safe-surfing mobile application. Besides the information that are significant for surfing, such as weather conditions, wind strength and direction, swell size, and tide, the participants expressed their opinion about the application design – the layout and presentation of the information. Regarding the app's features, results show that they are well aligned with the persuasive system design principles such as reduction, liking, reminders, personalisation, social facilitation, and self-monitoring. Reflecting on the previously reviewed surfing apps, analyses highlighted the importance of in-time information and the need for personalised notifications and recommendations.

Future work should include the co-design and development of the safe-surfing app, and usability testing within the surfing community.

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