A Study of Situational Awareness in a Small Group of Sea Kayaking Guides

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Abstract

Situational awareness, which informs the decisions made by sea kayaking guides, is a critical safety factor in guided sea kayaking experiences. This study examines the situational awareness of a group of sea kayak guides operating in moderate water conditions. Utilising virtual reality technology, a freeze probe technique was employed with a small group of sea kayak guides. The findings suggest that the guides' recognition and understanding of key informational cues lacked both comprehension of their meaning and the ability to project their future impact on the situation. It is proposed that sea kayaking guide training needs to provide better comprehension of the (emerging) situations guides may experience as well as a capacity to predict the potential impacts of those situations. Improvements in metacognition and perception/action associations, rather than simple attention to the situation, are also a useful potential avenue to explore.

Keywords; Guide development, Adventure Leadership, Adventure-sport Coaching

Introduction

In recent years, adventure recreation has become a growing global phenomenon (Wolf-Watz, 2010), and sea kayaking is an adventure activity that has gained widespread popularity (Aadland, Noer, & Vikene, 2017). Accordingly, there has been a commensurate growth in the demand for adaptable outdoor professionals, including sea kayaking guides, to facilitate those experiences (Valkonen, Huilaja, & Koikkalainen, 2013), The abilities of these guides, as with other outdoor professionals, are dependent on the development of effective judgement and decision-making skills (Priest & Gass, 2005; Collins & Collins, 2014). In-context experience is important in the development of these skills, as it allows people to more effectively and efficiently obtain and utilise critical information (Endsley, 2006). However, these experiences are often gained in relatively ad-hoc ways (Collins, Amos, Carson, & Collins, 2017). Consequently, in an effort to ensure that the guides situational awareness is refined and judgements are robust, certifying bodies stipulate a prerequisite number of days and experiences in an attempt to ensure that an adequate breadth and depth of experience is achieved prior to training and between training and assessment. To date, however, there has been no empirical investigation of situational awareness in sea kayak guides that could inform the training of potential guides in the future. Thus, the current study aims to increase our understanding of the situational awareness of small group of neophyte guides operating in 'moderate' water conditions.

The Role of Sea Kayaking Guides

Sea kayaking guides work in complex, dynamic environments in which they regularly encounter novel situations (Collins & Collins, 2016a; Collins, Simon, & Carson, 2019). As such, it would appear logical that these guides need to be adaptive rather than routine experts (Hatano & Inagaki, 1984) in order to respond skilfully and successfully to these novel situations (Tozer, Fazey, & Fazey, 2007). Such adaptability is built on a capacity to make

effective decisions in a timely manner in response to changes in the situation as a result of high levels of situational awareness (SA) (Zsambok & Klein, 2014). Additionally, these decisions are built on a clear understanding of the situational demands the aims and objectives of the activity or of a given event, group or activity (Abaham & Collins, 2015; Endsley, 2006, Flach, 1995).

Situational Awareness

SA is a useful concept for understanding human cognition, with a large body of research in a range of domains, including aviation and the military (Salmon, Stanton, Walker, & Green, 2006). It has stimulated debate (Carsten & Vanderhaegen, 2015), and there have been many attempts to define SA. For instance, Dekker (2015) suggests that SA is being used as a post-event way of explaining human error, while Endsley (2006) highlights SA as part of how an expert integrates the different sources of information they have at hand. Wickens (1992) describes SA as the ability to access relevant information about an evolving situation, and Crane (1992) links SA with expert performance, suggesting that this may be based on the maintenance of SA during highly demanding tasks. The most widely accepted definition, however, is that devised by Endsley (1995), who states that SA is 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (p. 97). While these definitions do not align completely, a common theme is the comprehension of a dynamic situation and its effects on an activity in the short, mid and longer term, and we concur with this theme. Wickens (2008) supports this notion, stating that SA is primarily applicable in dynamic situations, especially those with ever-changing variables. Sea kayak guiding, therefore, seems a context ripe for understanding SA.

Endsley (1995) moves beyond a basic definition of SA, attributing three 'levels' to an individual's situational awareness: (1) perception, or the ability to perceive the relevant

information, (2) comprehension, or the ability to understand the information, its significance to the task and (3) projection, or the ability to forecast the future situation based on the information at hand. Adventure sports have several attributes that require SA (Uhlarik & Comerford, 2002): (1) dynamic, information rich environments, (2) high levels of cognitive load, (3) a requirement for extensive training, (4) the nature of the problem is often ill-structured and (5) there are often time constraints.

Surprisingly, research directly relating to SA and adventure sport professionals is limited, even though SA is frequently implicitly considered in relation to decision-making. For example, Aadland and colleagues (Aadland, Noer, & Vikene, 2017; Aadland, Vikene, Varley, & Moe, 2017) explored how SA might relate to decision-making within the discipline of sea kayaking and offered a checklist as a tool to aid SA. Both these studies offered guides and recreational sea kayakers a potential framework to help them structure their assessments of risk, rather than explicitly considering SA. Aadland et al. (2017) noted that a lack of information on the sea state and tides within their data meant they were unable to make an assessment of the paddlers' SA.

There must also be an understanding of the objective constraints of the given situation as well as a comprehension of the environment. For example, an understanding of the task, or situational demands, is required (Flach, 1995; Abraham & Collins, 2015). Therefore, the aims and objectives of a given activity are relevant to the decisions stemming from the SA, and the relationship between SA and situational demands are synergetic. For instance, the aim may be to travel a particular length of coastline because of the client's aspirations, which may only be possible at particular times due to the tidal and weather conditions.

Decision-making in Adventure Sports

Collins and Collins (2012, 2013, 2015, 2016, 2017) have conceptualised the judgement and decision-making of adventure sports coaches and leaders as the notion of

professional judgement and decision making (PJDM). Furthermore, Collins and Collins echo the explicit links highlighted by Endsley (2006) between SA and decision-making, proposing that judgement and decision-making are comprised of two nested, synergetic decision-making processes: classic (CDM) and naturalistic decision-making (NDM). The proportion of classic and naturalistic aspects in a given judgement is dependent on the context of the decision. Planning (Collins & Collins, in review; cf Klein 2008) and 'on-action' reflection are predominantly CDM, while judgements 'in-action' are predominantly naturalistic (Collins & Collins, 2014). However, NDM often leads to sub-optimal decisions, where the decision maker must 'satisfice' rather than optimise (Simon, 1997). Current research (Collins & Collins, in review) suggests that the NDM aspect of the planning process and on-action/in-context reflection may be greater than anticipated. It may also be a significant aspect of an initial information and conditions audit that is based on the decision-maker's experience, which connects the planning and initial active aspects of the decision-making process. The link between the decision-making process and situational awareness has been highlighted by many investigators (e.g., Endsley, 2006; Taylor, 1990), all of whom recognise that effective decision-making is not possible without high levels of SA.

However, situational comprehension directly influences the judgements and decision-making of outdoor leaders and coaches (Collins & Collins, 2015, 2016, 2017).

Factors Reducing Situational Awareness

A reason for reduced SA is a failure to perceive the situation correctly (Endsley, 1996). Such limitations in perception could include factors such as (1) attention narrowing, that is, the involuntary failure to process information even when it is critical to safety or (2) high task or cognitive load (Prinet, Mize, & Sarter, 2016). Additionally, an individuals perception of a situation may influence both working and short-term memory (Endsley, 1999). A possible three-part cyclical link (Adams, Tenney, & Pew, 1995) may be as follows:

(1) the object, that is, available information in the external environment, (2) the schema, which is the internal knowledge that has been generated as a result of training and/or experience stored in long-term memory and (3) exploration, or scanning of the environment. We propose that situational demands as conceived by Flach, (1995) and Abraham & Collins, (2015) may add a fourth aspect to this cycle in this context. For example, if a group engages in the task of rock hopping to hone their skills, the guides understand that they must offer advice or a brief, manage the space, position themselves in an appropriate place, limit the consequences and deal with incidents while also providing effective feedback on performance. As a result of the exploration and feedback phases, the guides may need to modify their actions and decisions if the environmental conditions change and as the client's skills develop. This aspect of situational demands requires further investigation.

In an effort to catalyse research into SA in adventure sports, we aimed to increase our understanding of the SA in a small group of sea kayak guides operating in 'moderate' water conditions. The aim of the current study was to (1) examine the level of SA in a small group of sea kayaking guides operating in a moderate conditions by comparing their responses with those of expert sea kayaking guides, (2) identify and highlight the differences and (3) consider how SA may be better developed in sea kayak guides.

Method

This study employs an adapted freeze probe technique utilising virtual reality technology to examine a small group of sea kayak guides operating in moderate conditions. Following Harwood, Barnett, and Wicken's (1998) recommendations, a preliminary study was conducted to refine the freeze probe instrument as a tool for measuring SA.

Developing a Freeze Probe Tool

A virtual reality video was created that showed a group in moderate water conditions. The intention was to ensure an immersive identical virtual experience for each participant that could be displayed via a headset. After receiving participant consent and institutional approval, a questionnaire (see Table 1) derived from Taylor's (1990) Situational Awareness Rating Technique was distributed to 26 sea kayaking guides, who were all working in moderate conditions (Britishcanoeing.org.uk)[1]. The participants completed the questionnaire following five different sea kayaking trips during one summer. The focus was on the breadth rather than the depth of the responses. The questionnaire was piloted, and follow-up cognitive interviews were conducted (Willis, DeMatio, & Harris-Kojetin, 1999) with a representative group of sea kayak guides (n=3), after which a nine-item questionnaire was finalised and distributed. The participants rated each of the nine questions using a seven-point Likert scale (1 = Low, 7 = High) based on their perceptions of their own SA during each sea kayaking trip.

Insert table 1 close to this point

Reflecting our aim to inform the freeze probe technique, the responses to the piloting process outlined earlier were analysed descriptively. Questions 1, 2 and 3 provided an indication of the demands on the guide, questions 4, 5, 6 and 7 were indicative of supply of information and questions 8 and 9 were indicative of understanding. The Likert ratings were combined for all five of the sea kayaking experiences to provide means and standard deviations for each participant to inform the nature, environment and content of a virtual reality experience to be utilised in the freeze probe technique (Table 2).

[1] A stretch of coastline with some areas where it is not easy to land, but there will always be straightforward landing points a maximum of two nautical miles apart. Crossings not exceeding two nautical miles. Up to 2 Knots of tide (but not involving tide race or overfalls). Wind strengths do not exceed Beaufort force 4. Launching and landing through surf (up to 1 metre, trough to crest height).

Insert table 2 close to this point

The questionnaire first provided a measurement of the participants' confidence regarding their SA (Wright, Taekman, & Endsley, 2004). Second, it highlighted the need for the virtual reality experience to be realistic to gain true and accurate data in relation to the participants' SA. We concluded that any footage must be non-simulated, and the context had to be accurate (i.e. moderate conditions with a group of realistic ability). For this purpose, we utilised a group of second-year undergraduate students, who were undertaking an outdoor adventure leadership degree. This echoed our pragmatic philosophy and desire to conduct real-world research (Robson, 1999). A virtual reality experience would allow for a more immersive virtual experience that would also give the participating guides time to absorb the simulation in a way that was consistent across participants. It would also allow the participants to become comfortable with the environment (Sarter & Wood 1991) and reduce the novelty of virtual reality, which, to our knowledge, had not been used with sea kayaking guides at the time of the study. Finally, the virtual reality approach would allow consistency between simulations as well as the collection and recording of in-action data points in real time.

Collection and Identification of Footage; Creation of the Ground Truth

After receiving institution approval and participants' and group members' consent for filming, virtual simulations were generated on a section of coastline with a group in moderate conditions. An initial selection (n= 12) of virtual reality experiences were created utilising a GoPro fusion 360-degree virtual reality camera. Several sections of footage were selected that explicitly met the definition of moderate water conditions. These simulations were piloted (n=8) by playing them through a virtual reality headset, and follow-up cognitive interviews conducted (Willis et al., 1999) with two senior guide trainers (see Table 3) in order to ascertain both the appropriate length of the video and the appropriate section of coastline,

conditions and group behaviours. A final simulation (see https://www.youtube.com/watch?v=k-Nam2I6Edw) was selected and a 'ground truth' established utilising the same group of subject matter experts (Endsley, 2006; Jensen, 2009).

Insert table 3 close to this point

Participants

A purposive sample (n =4) of sea kayaking guides was recruited to ensure a sufficient level of domain expertise, experience and quality in terms of the participants' self-reflective abilities (Marshall, 1996). The following criteria were applied: (1) a minimum of two years active guiding experience since certification as a moderate water guide, (2) actively engaged in a guiding role in moderate conditions and (3) a willingness to discuss their professional practice.(Table 4)

Insert table 4 close to this point

Procedure

Influenced by Endsley (2000) Situational Awareness Global Assessment technique. Once the ground truth for the video had been established, the footage was played to the participants at a time and place convenient to them.The simulation was played to each participant through a virtual reality headset (an Oculus Go 32GB VR). In keeping with the recommendations of Endsley (2000) the aim was to generate multiple "snapshots" of the guides SA as an index of the quality of SA overall the footage was paused at randomly selected points. The participants were then immediately queried as to their perception of the situation in that specific instant. These queries corresponded with the three aspects of SA highlighted by Endsley (2000): perception (what do you see? A descriptive response), comprehension (what does this mean? And what is the cause?) and projection (what will

happen next? What is the implication?) (see Table 5). These queries were first piloted and a cognitive interview conducted (Willis et al., 1999) with the representative group of sea kayak guides (n=3) utilised in part 1. This resulted in some minor amendments being made to phraseology in order to word the questions as similarly as possible to how the person might think about the information (Endsley & Garland, 2000).

Insert Table 5 close to this point

Data Processing and Analysis

The freeze probe technique provided an objective measure of situational awareness based on queries during pauses in the simulation. The participants' answers were then compared with the 'ground truth' and categorised based on Endsley's (2000) three aspects high lighted earlier

Results

Ground Truth

The expert level guides' responses are summarised and categorised in Table 6 using the three levels described by Endsley (2000).

Insert Table 6 close to this point

Participant Responses

The participants' responses are summarised and categorised in Table 7 using the three levels described by Endsley (2000).

Insert Table 7 close to this point

Discussion

The results demonstrated a difference between the SA levels of the expert-level guides and moderate water sea kayaking guides. The results echo the findings of Druckman and Bjork (1991) and Endsley (2005), who both identified a link between SA and expertise. In particular, the findings in the current study support the notion that the recognition of cues and detection of important features occurs more rapidly and accurately for experts. The experts' experience in the domain enables them to access, obtain and comprehend the significance of information in an efficient and effective way. Consequently, these experts are able to anticipate the future outcomes of a situation by picking up in advance on pertinent cues and understanding their potential implications (Ericsson & Lehmann, 1996). However, as with Endsley's (2000) findings, the results of the current study suggest that experts find it difficult to separate the three aspects of their SA because they are integrated. For example, comprehension of a ground swell[2] is dependent on its perception. Specifically, the projection of the ground swell's impact is dependent on understanding how it is created (comprehension), while the projection of its effect is only possible because its rate of change from one moment to the next has been perceived. Endsley's (2000) three stages suggests that the synergy could be cyclical in nature, as proposed by Adams, Tenney and Pew (1995), or possibly that a meta cognitive level might also be at play that acts as a cohesive link. This certainly warrants further investigation.

The moderate water sea kayak guides displayed level 1 SA (perception) for all of the queries posed during the virtual experience. We suggest this reflects the fact that the participants were active sea kayakers before training as guides – a unique aspect of adventure sports leader (guide) practice. This contrasts with Endsley's (2005) description of novices (in

[2] a broad deep undulation of the ocean caused by an often distant depression or wind.

the context of SA) as not knowing which information is important or being unable to access the information required in a timely manner. However, these are novice guides *rather than* sea kayakers, which appears to align with Collins and Collins' (2012; 2016) proposal of an underlying ability in the activity, namely, an actively participating development pathway. The challenge facing the moderate water sea kayak guides and guide trainers is therefore the development of level 2 and 3 SA rather than the fundamental aspects of sea kayaking and mere attention to the situation. In other words, a focus on comprehension of the impact of the group and a projection of future impacts are warranted. This would suggest that training may be better aimed at developing level 2 and 3 comprehension and projection, perhaps by focusing on the cognitive and metacognitive aspects of guiding based on a cognitive model of guiding practice in moderate water. Such findings distance the professional roles in the adventure domain from that of the participant and build on the professionals need to be able to be an active participant but still view their professional practice as discrete although synergetic with personal ability.

The moderate water sea kayak guides struggled with their perception and identification of specific situations, suggesting that the perception and action relationship may also offer further clues as to *why* they are misunderstanding specific situations. Adams, Tenney and Pew's (1995) notion of a 'perception–action cycle' may fit with these findings and offer one way of developing the guides' comprehension and projection, again highlighting the need to focus on comprehension and projection in the training of guides.

The moderate water sea kayak guides were able to obtain the information from their SA but showed that the use of an appropriate schema or the ability to explore and modify that schema was not always present. Conversely, the expert guides demonstrated an adaptive capacity that was lacking in the neophyte guides. The moderate water guides did not appear to have a mental model of guiding behaviours, which resulted in wide variety in their responses

to the queries. Some did not have a clear notion of what guiding in moderate conditions entails, or if they did, their mental model was incorrect. This led to a misunderstanding or incorrect diagnosis of the situation, which restricted the neophyte guides to a predominantly level 1 SA. The implication for guide training and development is that it is necessary to recognise whether a clear mental model is being presented regarding what sea kayak guiding entails in this context. These findings highlight a fundamental need for training programmes to have an underpinning encapsulation of guiding in this context, which may need to be demonstrated by the trainer and the certifying body. Reflecting this, the participants did not demonstrate awareness of tactical decision-making within the group. The experts, however, did raise points relating to the group's tactical choices and potential for development. This suggests that the experts' mental model of guiding behaviours supports the notion of also having a coaching role, at least in part.

Implications for Guide Training

The findings of the current study demonstrate a need to develop SA during the training and development of sea kayak guides. These SA factors have implications for timely and effective decision-making while guiding (Endsley, 2015). There is a need to ensure that trainees and neophyte guides understand the environment they operate in, with an emphasis on the comprehension and projection of future events, as opposed to a simple description of what it is that they see before them. Moon's (2004) stages of reflective writing may serve as an analogy here.

One practical way this could be achieved is through the development and use of integrated contextual questions with the practical activity that stimulate the cognitive and metacognitive aspects of the guides' role in a clear mental model. For example, simple queries could be posed while on the water, such as the following: What is happening? Why is

this happening? So, what does this mean now or for later? What will you do now? What are you going to do if this happens? What might happen next? These questions could be used to elicit a deeper level of thought and develop metacognitive skills in sea kayak guides. It is this metacognition that will form the foundations for effective reflection in-action, on-action and on-action/in-context (Collins, Carson, & Collins, 2016). Such approaches may also enable and encourage guide learning post-training, independent of the explicit training programme and during the experience-gathering period between training and assessments. The use of experience consolidation between training and assessment also needs to be considered. The range and variety of situations encountered should improve the SA of the sea kayak guides and pay dividends, as will the greater number of novel situations experienced. Indeed, Endsley (2015) claims that even experts can be hampered by the same factors that affect novices when presented with a very novel situation. As such, it is incumbent on the trainer to broaden the experiences of the guides to encompass a wide range of situations, although the exact nature of those experiences warrants further research. The development of SA is most definitely an active cognitive process and not just a case of waiting for information to be presented (Endsley, 2015).

Limitations and Further Research

There are limitations to the use of freeze probe techniques as a method of data collection. It is an explicit method of data collection, where the participants are required to answer queries mid-task. One potential criticism is that it relies on working memory, a concern that Fracker (1988) shares when highlighting that the time taken to ask questions after the footage is frozen is limited to two seconds before recollections are inhibited. Another potential limitation is the unnatural environment of VR. This reduction in realism may also account for false recollections. In order to reduce these limitations, the questions were asked immediately after the freeze, and the questions remained simple. Future research is required in three areas.

Firstly, to further examining the value of VR freeze probe techniques in adventure sports setting. Secondly, to compare findings utilising Freeze probe techniques in VR against those in the real world. Thirdly to focus on the development of tools and techniques to advance the metacognitive skills of sea kayak guides in relation to improving their ability to project future outcomes in a more efficient and effective manner.

Conclusion

The stated aims of the current study were to (1) examine the level of SA in a small group of sea kayaking guides operating in moderate conditions by comparing their responses to those of expert sea kayaking guides, (2) identify and highlight the differences and (3) consider how SA might be better developed in those guides.

The expert sea kayak guides demonstrated nuanced and detailed comprehension of the situations presented to them. This supports the growing evidence about the nature of expertise in adventure professionals. The experts' attention on 'why' the situations occur differs from the 'what' account of the moderate water guides and highlights a gap in the participants' comprehension and ability to project and anticipate changes in the situation. The questioning used by sea kayak trainers should stimulate metacognitive activity associated with the comprehension and projection aspects of SA beyond a simple description of events. A greater contextualising of the knowledge gained through formal and informal reflection opportunities would enhance the experience obtained between training and assessment (Collins et al., 2016). The use of questions to develop SA must focus on future projections rather than descriptive accounts of the situations, as facilitated reflection in-action. It is this synergetic combination of situational awareness, metacognition and decision-making that is required for highly effective guiding.

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Situation Awareness Rating Questionnaire

For your journey today, please circle your responses.

Thank you for your time, this will take no longer than 5 minutes

Date: **Location:**

How changeable is the situation?

Is the situation highly unstable and likely to change suddenly (high, 7) or is it very stable and straight forwards (Low, 1).

1 2 3 4 5 6 7

1. How complicated is the situation?

Is the situation highly unstable and likely to change suddenly (high, 7) or is it very stable and straight forwards (Low, 1).

1 2 3 4 5 6 7

How variable is the situation?

Is it complex with many interrelated components (high, 7) or is it simple and straight forwards? (Low, 1).

1 2 3 4 5 6 7

2. How aroused are you in this situation?

Are you alert and ready for activity (high, 7) or do you have a low degree of alertness (Low, 1).

1 2 3 4 5 6 7

How much are you concentrating on the situation?

Are you concentrating on many aspects of the situation (high, 7) or focussed on only 1 (Low, 1).

1 2 3 4 5 6 7

How much is your attention divided in this situation?

Are you concentrating on many different aspects of the situation (high, 7) or focussed on only 1 (Low, 1).

1 2 3 4 5 6 7

How much spare mental capacity do you have in this situation?

Do you have sufficient capacity to attend to many variables (high, 7) or nothing to spare at all (Low, 1).

1 2 3 4 5 6 7

How much information have you gained about the situation?

Have you received and understood a great deal of information (high, 7) or is it very stable and straight forwards (Low, 1).

1 2 3 4 5 6 7

How familiar are you with the situation?

Do you have a great deal of relevant experience (High, 7) or is this a new situation (Low, 1).

1 2 3 4 5 6 7

Table 1. Situation Awareness Rating Questionnaire

Participant		*Demands*	*Supply*	*Understanding*
1	Mean	11.4	5.4	10
	SD	5.22494019	1.34164079	2.91547595
2	Mean	13.8	6.2	10.6
	SD	4.20713679	0.83666003	1.94935887
3	Mean	10.8	5.4	6.8
	SD	2.48997992	1.14017543	2.48997992
4	Mean	13.6	3.8	7.4
	SD	4.09878031	1.30384048	1.94935887
5	Mean	8.4	4	11
	SD	5.27257053	2.34520788	3.16227766
6	Mean	13.6	6	12.6
	SD	2.60768096	0.70710678	0.89442719
7	Mean	12.2	5	9.6
	SD	5.21536192	1.58113883	2.07364414
8	Mean	8.8	4.2	8.4
	SD	2.48997992	1.64316767	0.89442719
9	Mean	13.4	3.8	8.2
	SD	2.60768096	1.09544512	2.04939015
10	Mean	12.4	4.6	10.2
	SD	3.78153408	0.89442719	0.83666003
11	Mean	11.6	3.8	6.4
	SD	3.91152144	1.30384048	2.70185122
12	Mean	13.2	6.4	10.4
	SD	1.78885438	0.54772256	1.94935887
13	Mean	14.4	5.2	10.2
	SD	6.30872412	1.92353841	3.1144823
14	Mean	12.6	4.2	7.8
	SD	6.76756973	1.09544512	3.19374388
15	Mean	14.4	5.4	9.8
	SD	1.51657509	1.81659021	2.68328157
16	Mean	13.2	6.4	10.8
	SD	3.42052628	0.89442719	2.28035085
17	Mean	17.6	3.2	10
	SD	2.96647939	1.30384048	2.91547595
18	Mean	13	4.6	8.8
	SD	3.87298335	0.54772256	1.78885438
19	Mean	12.6	4.2	8.2
	SD	3.78153408	1.78885438	1.4832397
20	Mean	12	5.6	12.8
	SD	4.24264069	1.51657509	1.09544512
21	Mean	12.8	4.6	8.8
	SD	4.96990946	1.67332005	3.56370594
22	Mean	9.8	6.2	12.6

	SD	7.04982269	1.30384048	1.94935887
23	Mean	9	6.8	9.2
	SD	3.39116499	0.4472136	1.30384048
24	Mean	13.8	6	9.2
	SD	3.19374388	0.70710678	0.83666003
25	Mean	9.8	6	10.6
	SD	5.26307895	0.70710678	4.5607017
26	Mean	11	4.2	7.8
	SD	2.34520788	1.30384048	1.30384048

Table 2. Descriptive analysis of responses to Questionnaire

Subject matter experts	*Age*	*Sex*	*Experience*	*Qualification*
1	53	M	25 years	BCU Level 5 Sea kayak coach. Moderate water leader provider.
2	38	M	18 Years	BCU Level 5 Sea kayak coach Moderate water leader provider.

Table 2. Subject matter experts.

Participant	*Age*	*Sex*	*Experience*	*Qualification*
1	55	M	5 years	Moderate water leader
2	39	M	4 years	Moderate water leader
3	43	F	8 years	Moderate water leader
4	40	M	6 Years	Moderate water leader

Table 4. Neophyte Guide details

Table 5. Freeze probe questions.

How many people are in your group? (Perception)
What are the current environmental conditions? (Perception)
Is the group behaving in a cohesive way and can you justify why you think this? (comprehension)
Is this environment within the moderate water classification can you justify why? (comprehension)
Is the group operating in a safe manner and can you justify why? (Perception and comprehension)
Are any of the group members more or less willing to take part in the tasks and can you justify you answer?
What observations have you made during that section of coastline?
What if any consequence was there if there had been a swimmer at that point? (Projection)
Do the group members have appropriate skills to be in this environment and can you justify why you have decided this?
In that last sequence what specific hazards have presented themselves?
What were your thought processes for that last sequence?

Table 5. Ground Truth response

Question	*Expert level guides responses*	*SA Level*
How many people are in your group?	• They were able to recall the number of participants in their groups immediately.	1
What are the current environmental conditions?	• They were very aware of the sea state, wave height, shape and frequency. • They were able to recognise changing conditions and the reasons for those changes, such as impact with the land/rocks. • They were also able to identify other aspects at play such as water depth and the influence this would have.	2
Is the group behaving in a cohesive way and can you justify why you think this?	• They identified that the group behaved in a cohesive, way only some of the time. They were able to link the decisions they made with the group's actions and interactions. • They were also able to recognise that even though the group stayed together that this may not have been the appropriate decision and therefore were able to make judgements about their tactical awareness and judgement and decision making.	2
Is this environment within the moderate water classification can you justify why?	• They were quickly able to recognise that the environment fell clearly within the moderate water classification. • They were able to gives reasons for this relating to wind strength, sea state, perception of tidal movement and access to landing spots. • They were able to identify isolated moments when, for example the focused wave shape, size and direction made for a more dynamic experience for the group but still remained within the moderate water remit.	2
Is the group operating in a safe manner and can you justify why?	• They were able to recognise that although the group displayed a desire to 'play' near the rocks, on the whole they were doing this in a relatively safe way.	3

- The guides were able to observe the group dynamics and also the changing nature of the environment which aided them in answering the question.
- The guides again highlighted the group's decision making and tactical awareness within their answers, they were also concerned with aspects of leadership such as maintaining line of sight, peer to peer observation and communication.
- The lack of the groups observation of the environmental conditions was concerning for the experts as they identified this as a key indicator of the group's ability to generally be safe paddlers.
- The experts commented on the fact that although during the video the group operated safely they were able to predict that this may not always be the case given what they had observed, there was a clear lack of understanding of key aspects such as timing, positioning and route choice.

Are any of the group members more or less willing to take part in the tasks and can you justify you answer? What observations have you made during that section of coastline?

- They were able to identify individual paddlers who were more or less keen to be involved. 1
- They were also able to identify individual kayakers' placements within the group such as who was leading the group and who remained at the back.
- They were very aware of the variety of route choice options here, one which was more difficult than the other. 2
- The experts observed that the group decided to take different route options but could only speculate why this was decided upon.
- They identified that the group re-joined and were quick to point out that as they did one kayaker had already committed to the next rock hop. This was described by one of the experts as "being the least cohesive moment of the journey so far" as it was clear there was no communication or planning between the group members.
- The experts again highlighted the lack of environmental awareness as the group just simply followed on behind the first paddler with one particular paddler having a more 'dynamic' experience than the rest. One

	expert commented “if they had watched the wave sets come in this could have been identified as a possibility and been avoided”. • The experts recognised that the group re-joined on the seaward side of the rock which was seen as a positive point. It was felt that the breakdown in the group and the actions that followed stemmed from one rogue paddler which the others followed.	
What, if any consequence was there if there had been a swimmer at that point?	• They were able to identify that the consequences depended upon where the capsize took place. There were two possible options one which at first glance appeared tricky and the other which brought the rocks and waves into play. The experts did however identify that the first of these possibilities was given protection from the swell by the rocks thus allowing more time to initiate the rescue and manage the incident. • They identified the second option of the gap in the rocks as being potentially more serious. They raised the possibly of boats and bodies being dragged along the shallower rocks and therefore making the rescue more challenging for the rescuer and more dangerous for the swimmer. • They also commented that as a result of the observations made up to now the group would find it challenging to play an active role in the rescue unless the boat and body washed out into the deeper water where a more flat-water recovery could be implemented.	3
Do the group members have appropriate skills to be in this environment and can you justify why you have decided this?	• The experts made a clear distinction here between technical and tactical skills. • From a technical point of view, it was deemed that even though they looked a little clumsy they were appropriate for both the tasks and the environment. There reasons for this decision came from their ability to maneuver their boats in a given direction and move with reasonable control along the coastline. • The tactical skills however were identified as sorely lacking across the entire group. It was speculated that this may be because it is a new experience for them. The decision to describe their tactical skills as not appropriate came from elements such as the groups positioning prior to going through gaps, their timing choices or lack thereof and their awkwardness when reacting to waves moving their boats unexpectedly.	3

In that last sequence what specific hazards have presented themselves?	• They were aware that the aspect of the coastline and the specific inlet in question allowed for what sea state was present to be clearly felt. • The presence of underlying rocks was noticed and the fact that some of the group members disappeared around the back of the inlet was mentioned. • The general proximity to the rocks was raised as an issue for the experts as the waves could cause one of the boats to be surged onto some rocky outcrops. • The confined space the group was operating in may also lead to the group getting in each other's way.	3
What were your thought processes for that last sequence?	• The experts were focused not only on the individuals in the group but also the environmental conditions. They observed the way the waves were interacting with the rocks and the effect this was having on the kayaks. • The judgement was made that the task was relatively safe since the kayaks were being lifted rather than surfed in and onto the rocks. • It was also identified that even though the rest of the group were away from the rocks in deeper water and therefore in a relative safe zone they were all focused on the task with no one looking out to sea for any incoming waves which could cause an issue in the impact zone.	3

Table 7. Participant responses.

Question	*Expert level guides responses*	*SA Level*
How many people are in your group?	• Two of the participants correctly identified the number in the group. • Two corrected their answers after one or two minutes to the correct number.	Level 1 SA by 2 2 exhibiting sub Level 1 SA
What are the current environmental conditions?	• The participants observed the swell, the impact of the waves on the rocks and the lack of wind present. • There were differing interpretations of the swell with one describing it as "a little amount" and another as being "moderate". • It was identified that the waves tended to surge at times. Later on (6 minutes into the video) one of the participants commented that there was actually more swell than they initially thought.	All Level 1 SA
Is the group behaving in a cohesive way and can you justify why you think this?	• The participants observed that the group was at times a little spread out but behaving cohesively. • Three of them thought that on the whole they were waiting for each other as they moved through the gaps, however one participant through there was "no obvious regrouping and they are just wondering off after going through the gaps". • In addition to this one participant commented that it was "hard to ascertain how cohesive they are".	All PARTICIPANTS displayed level 1 SA.
Is this environment within the moderate water classification can you justify why?	• All participants agreed that it was within the moderate water classification, the reasons being included wind strength, sea state and perceived lack of tide.	3 at Level 1 1 at Level 2
Is the group operating in a safe manner and can you justify why?	• Three of the participants decided that they were, and one decided they were not. The justifications for why they were was simply that they remained together with the counter being that not everyone is paying attention, they have not spent time	3 at level 1 1 at level 2.

	observing the environmental conditions and they don't appear to be looking after each other.	
Are any of the group members more or less willing to take part in the tasks and can you justify you answer?	• The participants all agreed that the everyone one was willing to get involved, they were all aware that one boat is hanging back however only one of them was able to identify the colour or type of boat in question. • One of the participants commented that "one boat rushes off" but did not offer a way to identify this boat by either colour or type.	All level 1.
What observations have you made during that section of coastline?	• The participants were aware of the kayakers engaging in rock hopping activities in a self-led manner. This provided varying level of task anxiety with one participant describing the activities as stressful due to the perceived risk. • They did identify that not everyone was taking part with two participants describing this as sensible. No reason why it was sensible was offered. • only one participant ventured into level 3 SA as they were able to predict that due to the multiple activities taking place it may result in multiple capsizes with the possibility that they (the guide) may not see the incident occur. • Only one participant commented on the groups lack of environmental awareness.	3 at level 2 1 at level 3
What, if any consequence was there if there had been a swimmer at that point?	(This query generated the most variety in answers and as such has been separated into participant statements.) • Most of the participants described the possible damage to both boats and people as a consequence of a swimmer during this section of the video. • Participant 1 was aware of the potential of having two swimmers at once and the resulting possibility of the group splitting up. They went on to describe the hazards associated with cold water emersion and the possible psychological impact of getting injured during the incident.	Participants 1 and 4 displayed level 3. Participants 2 and 3 level 1.

	• Participant 2 could not identify any possible negative consequences and described the potential outcome as “not really a difficult situation”. • Participant 3 thought the consequences were acceptable and manageable but did not offer a justification for this. • Participant 4 asked the researcher if there was tidal movement around the rocks, they were not given the answer to this as it may have influenced their judgement of the situation. They went on to discuss how people and boats may end up on rocks and that other members of the group who attempted a rescue may also get into trouble.	
Do the group members have appropriate skills to be in this environment and can you justify why you have decided this?	• All the participants agreed that the group had the appropriate skills to be in the environment, some were able to identify differences in skill level via boat color or type. Common themes included their confidence near the rocks, the ability to maneuver their boats and their body language during the activity.	Level 2 by all.
In that last sequence what specific hazards have presented themselves?	• The presence of rocks and swell became a major focus for all the participants, particularly the potential of one or more of the kayakers being washed into the rocks. • Three of the four noticed a loss of line of sight with group members as they headed around the corner of the inlet. • Only one participant identified the semi and submerged rocks in the inlet a hazard.	Level 2 by all.
What were your thought processes for that last sequence?	• All the participants were concerned with a potential capsize. • Two were not happy with the activity taking place. There was concern that the task was not appropriate and there was also concern for the rest of the groups safety if an incident did occur. • The other two were happy with the situation but knew they needed to be poised to deal with an issue. One of these participants observed that the	Level 2 by all.

group members engaging in the activity were choosing to do so based on conscious decision of the risks involved.