



Research Article

‘Having a grand view of what the day entails’: A qualitative investigation of the non-technical skills utilised by Mountain Guides

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ABSTRACT

Mountaineering is a potentially risky activity, encompassing uncertain and dynamic terrains alongside adverse weather conditions. Within this context mountain guides work with client groups to plan activities and enhance safety. Despite the integral nature of mountain guides, and their responsibility for other individuals, to date there has been no research examining the range of non-technical skills (cognitive and social skills such as situation awareness and teamwork) necessary for safe and effective performance within this role. The aim of the current study was to explore perceptions of non-technical skills by mountain guides to better understand the skills that are considered important for maintaining safety during mountaineering activities, as well as explore perception of factors that might impact performance. Semi-structured interviews were conducted with 18 British Mountain Guides. Content analysis led to the development of six non-technical skill categories (situation awareness, decision-making, leadership, teamwork & communication, cognitive readiness, task management) with associated elements. Some of the elements, including managing client expectations and adaptive communication have not been previously reported in non-technical skills research and may be unique to mountain guides. Guides perceived there to be a range of factors that might impact safety and performance in this context including client behaviour, factors influencing cognition, environmental conditions and actions of other groups. The results highlight the range of skills that are encapsulated within the mountain guide’s role, skills that guides considered vital for both safety and client management. This suggests a need for non-technical skills training going forward for mountain guides.

Management implications: Mountain guide activities are a core aspect of adventure tourism across multiple countries. One of the most important elements of the mountain guide role is the protection and enhancement of client safety. Within the current context of commercial growth and regulatory development for adventure activities, the current results highlight the range of skills, both social and cognitive, reported by mountain guides as vital to maintain the safety and performance of themselves and their groups. The current lack of defined training and assessment in these skills for mountain guides is therefore potentially problematic. Moving forward training in these skills, comprising leadership, teamwork and communication, decision-making, situation awareness, task management and cognitive readiness, should be incorporated into mountain guide development to ensure client safety.

1. Introduction

Guided mountaineering is considered an aspect of adventure tourism and encompasses participants engaging in any strenuous activity within a natural mountain landscape, including hiking, skiing, rock and ice climbing (Rebelo et al., 2018). Unlike individual adventuring, adventure tourism places a significant burden of responsibility on the operator, or guide, to manage risk and ensure client safety (Cater, 2006). Research

with clients and operators suggests that the perception of risk can vary, with clients focused on the thrill aspect whilst perceiving low risk of injury, particularly where they trusted their adventure provider. In contrast, operators had a much more detailed perception of potential risks, and how those should be mitigated (Cater, 2006). Thus, the operator must balance client enjoyment through a sense of adventure, with an emphasis on safety to reduce the risk of accident or injury. Expedition safety has become ever more important in the context of

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climate change, with researchers highlighting the growing challenge of managing expeditions within increasingly limited glacial terrain, alongside frequent hazards such as rockfall (Rushton & Ruddy, 2023). So much so that Bordeau (2014) suggests mountain guides now need 'climatic intelligence' to enable swift adaptations of routes and activities to maintain client safety.

The ability of a guide to fulfil their role, and ensure the safety of their clients, has been reported as dependent on a range of skills such as situation awareness (Collins et al., 2021) and decision-making (Walker & Latosuo, 2016). Human factors research within high risk, safety critical industries, highlights the importance of skills such as these, usually referred to as non-technical skills, for work performance and safety. Indeed, previous research has developed behavioural taxonomies for multiple occupations, including scrub nurses (SPLINTS; Mitchell et al., 2012), farmers (FLINTS; Irwin et al., 2023) and pilots (NOTECHS; Flin et al., 2003), for the purpose of facilitating skill development and assessment to ultimately enhance safety. However, there is a lack of research identifying the full range of non-technical skills used by mountain guides, thereby preventing the development of a behavioural taxonomy and associated training and support. The aim of the current study was to address this gap in the literature through qualitative exploration of mountain guide perceptions regarding non-technical skills and performance influencing factors. This will increase our understanding of these skills for maintaining personal and client safety and provide a baseline for future behavioural taxonomy and training development.

1.1. Mountain Guides

The role of mountain guide is considered multi-faceted encompassing aspects such as physical ability (ability to engage in activities such as hiking, skiing, scrambling etc.), technical knowledge, social interactions with clients, commercial (e.g. securing clients) and safety management (Beedie, 2003). Guides can be self-employed or employees attached to a guiding organisation (Clivaz & Langenbach, 2020). Mountain tourism activities can take place during both summer and winter seasons. A prerequisite for winter activities is the presence of snow and ice, with the winter season under threat from climate change via increasing snow scarcity (Steiger et al., 2022). In comparison, the summer season for mountain tourism is associated with warmer temperatures and a broader range of activities including hiking and horse riding (Bourdeau et al., 2002). It is important to note that these season definitions can be ambiguous given variation across regions, it may be more useful therefore to consider the activities undertaken rather than the time of year, with summer activities often comprising rock climbing and hiking, whereas winter activities are more likely to include skiing and ice climbing (Apollo, 2017).

Accredited mountain guides are experienced mountaineers who adhere to rules and regulations developed by organisations such as the British Association of Mountain Guides (BMG) and the International Federation of Mountain Guide Associations (IFMGA) (Beedie, 2003; Clivaz & Langenbach, 2020). The precise route to qualification or accreditation can vary across regions, for example in France mountain guides can work towards a state diploma in mountaineering and high mountain guide (Clivaz & Langenbach, 2020), whereas British Mountain Guides gain a diploma and become accredited via years of experience and a stringent training program specifically produced by the BMG.

Rokenes et al. (2015) argue that a guide must create value if they are to run a successful commercial venture within a defined economic system (Clivaz & Langenbach, 2020). They define this value as encompassing client perceptions of utility, gain, cost reduction and emotional contribution in the context of guide contributions (Rokenes et al., 2015). Moreover, clients can be co-creators of this value via their experience, abilities and resources (Prebenson et al., 2014). Rokenes et al. (2015) further outline five dimensions of guiding considered important for creating value: instrumental, educational, choreographic, relational and

environmental. These dimensions highlight the complexity of guiding, and suggest guides need to utilise a range of skills to ensure the safety, wellbeing and satisfaction of their clients.

Research suggests that a key purpose for engaging a mountain guide is to enable the client to experience complex activities, and enter otherwise inaccessible terrain, in safety (Clivaz & Langenbach, 2020). Despite this goal it is acknowledged that engaging in adventure tourism activities poses a potential risk to personal safety, with operators reporting a range of client injuries from minor (e.g. cut, scrape, twisted ankle) to major (requiring hospitalisation) each year (Bentley et al., 2004). A study examining injury and fatality rates linked to adventure tourism in New Zealand ranked mountaineering highest for client injury risk alongside snow sports, horse riding and mountain biking (Bentley & Page, 2008), with a sizeable proportion of injuries within mountaineering linked to falls. It is perhaps unsurprising therefore that researchers indicate that safety should be a mountain guide's number one priority, certainly adventure tourists report safety as one of their main motivations for hiring a guide (Rebelo et al., 2018).

1.2. Non-technical skills

Non-technical skills (NTS) are defined as the social (e.g. teamwork, leadership, communication) and cognitive (e.g. situation awareness, decision-making, cognitive readiness, task management) skills that, in addition to technical knowledge, enable safe and effective performance (Flin et al., 2017). These skills have been studied across a range of contexts, including aviation (Flin et al., 2003), offshore drilling (Sneddon et al., 2006) and agriculture (Irwin et al., 2022). Work in these industries has identified that lapses in NTS can be a key cause of accidents and injuries, for example, failures in teamwork have been linked to adverse events during surgery (Catchpole et al., 2008).

The primary focus of previous skill-based research relevant to safety with mountain guides has been on decision-making due to the potentially serious, or life-threatening consequences, of poor decisions (Stewart-Patterson, 2004; Walker & Latosuo, 2016). Research suggests that guides frequently need to make decisions under time pressured and uncertain conditions, sometimes within a complex social dynamic where they may need to challenge incorrect assessments made by less experienced group members (Ivaldi & Whitehead, 2021). More broadly, within the context of adventure tourism, research indicates that situation awareness is a vital, but under-developed, skill for sea kayaking guides (Collins et al., 2021), and that planning is important for informing and developing effective decisions within outdoor adventure excursions (Boyes et al., 2019). These studies highlight the potential importance of NTS within adventure tourism, but no study, to our knowledge, has examined the full range of NTS utilised by mountain guides. Given the indication that situation awareness is not developed effectively through current training for sea kayaking guides (Collins et al., 2021), with associated consequences for safety, this gap in the literature has important connotations for mountain guide development and training.

By expanding NTS research into a new domain, one where the activity has a recreational focus (e.g. engaging in mountain tourism) rather than the work-based focus of previous research (e.g. farming, Irwin et al., 2023), we can enhance our understanding of the application of these skills in different contexts and potentially develop new categories and elements tailored to this domain. In addition, it is important to consider NTS with a systems lens, evaluating how individuals' function within a complex system (in this case the dynamic mountain landscape, which encompasses changeable weather, the presence of multiple individuals, variable terrain and a range of hazards, Rushton & Ruddy, 2023) including exploration of perceived factors that might impact skill performance in practice. Understanding the inter-relationship between skills and performance limiting factors enables greater understanding of both adverse incidents, and the elements that support work, in this case guiding, proceeding as expected (Naweed & Murphy, 2022). Previous research highlights that within mountain guiding, the client themselves

can present a risk, via pressure to achieve a goal, risk-taking behaviours, lack of experience or failure to abide by the guides' decisions (Girard et al., 2020). This presents a new and unique consideration for the utilisation of NTS, whereby the 'team' consists primarily of fee-paying clients, as opposed to co-workers. In summary, the current study addresses a key gap in the adventure tourism literature regarding the skills used by mountain guides to maintain safety and has both practical (enhancement of mountain guide training and safety) and theoretical (application of NTS within a new context with unique pressures) connotations.

1.3. Study aim

Although mountain guides, including those featured in this study, operate across both winter and summer seasons, or activities, the current study has a predominant focus on activities undertaken in cold, wet and snow conditions. The critical incidents discussed within the interviews primarily took place across activities such as skiing and ice-climbing or featured more general mountaineering activities (such as rock climbing) that took place during cold weather conditions. Within this context the aim of the current study was the identification, and description, of key NTS categories, elements and associated behaviours necessary for safety in mountain guiding. In addition, to understand the utilisation of these skills within the mountain guide context, including barriers and facilitators, we also aimed to understand mountain guide perception of factors that they considered might influence NTS performance and safety:

- RA1: Explore mountain guide perception of the key NTS categories, elements and associated behaviours, considered necessary for safe mountain guiding.
- RA2: Investigate mountain guide perception of potential factors which could limit NTS performance and safety in the mountain context.

The key contributions of this study to the literature are, firstly the exploration of the full range of NTS utilised by mountain guides to manage safety, thus providing a baseline for the development of training and assessment of these skills for this crucial role. Second, by considering perception of context specific factors that could impact safety and skill performance, this study adds to the growing literature exploring NTS from a systems perspective helping us begin to understand the application of these skills in practice.

2. Method

2.1. Participants

A total of 18 British Mountain Guides (all male, M^{age} : 49.58, sd : 12.72) were recruited using three methods: via an advert shared through the internal British Mountain Guide (BMG) email newsletter (sent to all BMG guides), through an internal social enterprise network, and via direct email, with email addresses sourced via the BMG website. BMG is a member of the International Federation of Mountain Guide Associations (IFMGA), which is the body that coordinates the standards and mutual recognition of the twenty-six national mountain guide associations. As such all BMGs hold the IFMGA carnet, which is the highest qualification possible for mountain guides (BMG, 2023). In addition, all BMGs are qualified to lead expeditions internationally, meaning participants had a wealth of experience to draw on. Each participant had a minimum of two years experience (M^{exp} :18.26, sd : 13.82) operating as a mountain guide post-qualification.

2.2. Interviews

Qualitative semi-structured interviews can be utilised as a form of

task analysis (Mitchell et al., 2011) to gather information on the social and cognitive processes used when working with others to achieve a goal. This method of task analysis, incorporating discussion of a recent critical incident or adverse event (Butterfield et al., 2005), and conducted with subject matter experts, is frequently utilised as the first step to explore perception of non-technical skills within a new domain (see Irwin et al., 2023; Mitchell et al., 2011). The critical incident technique was originally formulated by Flanagan (1954) as a methodology for exploring pilot behaviour. It has since been applied across multiple disciplines (see Viergever, 2019 for a review) for the purpose of collecting participant perspectives on factors, behaviours and skills that are advantageous, or a barrier, to achieving a specific task goal (Viergever, 2019). As such this is an ideal approach for examining expert perceptions of NTS and any performance limiting or enhancing factors, and has been applied across multiple studies for that purpose (see Mitchell et al., 2011; Yule et al., 2006; Irwin et al., 2023 for examples).

Prior to the main interview, participants were asked a series of demographic questions regarding their gender, role, and years of experience as a mountain guide. Participants were then asked nine questions across four sections of the semi-structured interview (Table 1), including the critical incident section. These questions mirror those applied in other studies exploring NTS (e.g. Irwin et al., 2023) adapted to suit mountain guides.

All interviews were conducted over the phone, lasting between 30 and 120 min. Interviews were recorded and then transcribed verbatim. The transcriptions were anonymised and the recordings deleted.

2.3. Ethics

The research project was approved in September 2021 by the Psychology Ethics Committee, University of Aberdeen (Ident: PEC/4834/2021/10). All participants were asked to sign a consent form prior to participation and received a debrief form after completion.

2.4. Analysis

The epistemological stance of the authors was primarily

Table 1
Interview questions and sections for mountain guide NTS interviews.

Interview questions
Section 1
1 Please describe, in as much detail as you can, your usual actions as a mountain guide before, during, and after, a typical outing with clients. This can include summer and winter activities.
Section 2
2 What do you think are the main hazards that could lead to accidents or errors during a typical outing in the mountains?
3 What do you do to mitigate or respond to these hazards?
Section 3
4 Please describe a recent example of an adverse event that you had to deal with, or an error that occurred, or adverse conditions that you had to manage. This can be anything from a relatively minor event such as a misplaced equipment to a more major events such as a client injury or dealing with mountain conditions. It is important that we get as much detail as possible from you so please begin your description just prior to the event occurring, including what led up to events, and finish by describing what happened right after. Please include your own thoughts and actions within the event, as well as the actions of others around you.
Section 4
5 What type of activities or actions does the leader of a mountaineering party engage in during a group expedition?
6 How do members of a mountaineering group communicate with one another during an activity or expedition?
7 Is there anything that you have to anticipate during a typical outing – any cues that you look out for?
8 As a mountain guide what sorts of decisions do you typically have to make during an outing or activity?
9 What are the main issues that might compromise performance and safety during an activity or expedition?

constructivist, with meaning derived from interactions with the world (Chamberlain, 2015). The approach used to analyse the data was theory-driven directed content analysis (Hsieh & Shannon, 2005). Typically, this approach includes both deductive and inductive aspects to coding and category development. The deductive aspect involves the formulation of categories based on previous theory (Elo & Kyngäs, 2008), in the current paper this involved the application of a framework of over-arching generic NTS categories to the data, based on those skills most commonly found within NTS research (Irwin et al., 2022, 2023). The core skill categories were situation awareness, decision-making, cognitive readiness, task management, leadership, teamwork and communication. We applied an unstructured coding matrix, whereby inductive coding enables the researcher to develop detailed codes to inform and tailor the theory-based categories and sub-categories (named elements to correspond with the NTS literature) to the specific context of study (Elo & Kyngäs, 2008). In the current paper that entailed the development of behaviour specific codes based on the semantic content of the text. As described below these behaviour codes then enabled a bottom-up approach to the development of skill elements to ensure these were relevant to the mountain guide context. Inductive coding was also applied to reported perceptions of factors that might influence skill performance and safety.

Analysis in the current study consisted of five key stages (Hsieh & Shannon, 2005):

- Within stage 1, the first author undertook familiarisation by reading the transcripts several times.
- Stage 2 involved the first author coding the transcripts, first through application of the NTS framework, then latterly via coding to identify perceptions of performance limiting factors. Codes for NTS were developed to describe the behaviour outlined in the text and were attached to the relevant skill category from the applied framework. Codes relevant to perception of influencing factors described the relevant issue or hazard detailed by participants as limiting performance or safety.
- Within stage 3, the first author developed a NTS category table which grouped codes according to alignment with a skill category and element. Elements were developed using a bottom-up approach to ensure each encompassed the mountain guide specific codes. A table of perceived influencing factors was also developed, with codes grouped into categories.
- Stage 4 encompassed a test of inter-rater reliability (Stemler, 2000), conducted using 40 excerpts taken at random from the interview transcripts and entered into an excel datasheet. The datasheet was then coded by author 4 and compared with the codes applied to those excerpts by author 1. The result indicated a substantial level of agreement ($k: 0.68$).
- Stage 5 entailed academic review to facilitate content validation (Elo & Kyngäs, 2008) whereby each co-author checked and edited the NTS framework and the table of influencing factors until all authors were in full agreement regarding the content and presentation.

2.5. Data saturation

Data saturation was evaluated for the current study based on guidance provided by Guest et al. (2006). Guest et al. (2006) found that data saturation was usually achieved within 12 interviews, and as such that was our minimum sample size for the current study. Saturation is then evaluated dependent on code and category generation, with saturation determined to have been reached once no new codes or categories are developed with the addition of new transcripts (Guest et al., 2006). Within the current study saturation was determined to have been reached during the data analysis process by the 16th interview, with no new codes or elements arising from the 17th or 18th transcripts.

3. Results

3.1. Critical incidents

The critical incidents described by participants encompassed the following activities: ascent to mountain summit ($n = 7$), skiing ($n = 6$), rock climbing in snow/wet conditions ($n = 4$), descent from mountain summit ($n = 1$).

3.2. Non-technical skills

Within the NTS literature a skill category represents an overarching description of the skill, encompassing multiple applications. Elements are in essence sub-categories, dividing the skill into different forms or applications of that skill. The final code aspect describes specific behaviours representative of the element (Flin et al., 2003), the associated behavioural descriptions reported in the tables below can be considered units of meaning within a content analysis (Kleinheksel et al., 2020).

3.2.1. Cognitive skills

This section will outline the cognitive non-technical skills reported by mountain guides (Table 2).

3.2.2. Situation awareness

The perceptual level of situation awareness appeared split between initial gathering of information that occurred in advance of any activity and ongoing awareness maintenance that occurred during the activity (Table 2). Finding out more about new clients was judged as particularly important when putting together the initial itinerary, spanning physiological condition, experience and cognition:

'It's about the people that we are heading out onto the mountains with. And that will be research about the people. So that can come from, it can come from medical forms, it can come from client experience, questionnaires'. P7

Once the activity was underway participants emphasised the need for ongoing active monitoring of the environment, usually through visual and auditory sweeps:

'So it's about monitoring temperature, monitoring pace, snow underfoot, approach, steepness, the way I'm going to do it, where other people are, where is my route?'. P10

This was combined with active monitoring of client performance and wellbeing through visual checks and haptic feedback from ropes:

'Every opportunity I have to look at them I look at them, just to see how they're moving, how they were moving before. If they're going slower, how they're breathing, how they're looking'. P1

In both cases, this continuous checking was required due to the capacity for both environment and client wellbeing to change, sometimes very quickly. Perception of these changes then fed directly into the elements of understanding and anticipation, enabling guides to recognise when changes had occurred as well as anticipate the likely impact of that change on their current activity and level of safety:

'If there's low certainty on the forecast, or the forecast is just poor, then I'll choose a route that I know quite well. It's quite escapable, it's maybe quite sort of safe in nature that I can get back to the valley or I can get returned to a cable car'. P6

3.2.3. Decision-making

Managing risk via deciding to stop an activity was an important, and often difficult, aspect of decision-making, and was contingent on assessment of multiple factors including client fatigue and wellbeing, weather conditions and the perceived risk level. Interviewees highlighted that this was an awkward decision to communicate when it was

Table 2

Four categories of cognitive non-technical skills relevant for mountain guides, presented with associated elements and codes with descriptions of meaning.

Skill categories	Elements	Code (meaning)
Situation awareness: <i>Building and maintaining an awareness of the environment, conditions and self. Recognising and understanding information and cues in the environment, then using that information effectively to anticipate future states.</i>	Gathering information: <i>Seeking information relevant to the proposed activity/route/itinerary prior to activity.</i> Maintaining/updating awareness: <i>Ongoing information gathering and collation during activity to consistently update mental model.</i> Understanding the situation: <i>Recognising and interpreting information present in the environment to enable appropriate action/reaction.</i> Anticipating future events: <i>Predicting what might happen next, and where issues might develop, based on environment and action/in-action.</i>	Initial gathering (checks multiple sources of information about the terrain and conditions). Client evaluation (evaluates client experience level/ability/physiological condition/cognitive status). Checking (engages in regular visual/auditory checks of immediate environment). Monitoring (regularly monitors/checks on client movement/performance/hydration/food levels). Feedback (tactile/haptic feedback on client position/movement via rope). Recognising (recognises specific terrain types, signs of potential problems and associated risks). Action taking (takes action to ensure self and clients are adequately hydrated/fed/rested). Environment (actively trying to anticipate environmental changes). Descent (anticipates mountain descent requirements e.g. effort and difficulty). Contingency (Generates contingency/escape route for if weather/conditions change). Stopping (Stops activity/action if conditions have increased risk or client judged unable to continue). Avoiding (avoid specific points of terrain known to be hazardous/when conditions are hazardous). Altering (reschedule/delay activity if self or clients fatigued). Cascading decisions (route choice impacts equipment choice, impacts preparation requirements). Staging decisions (decision to carry on with activity dependent on time taken at specified point). Check points (identifies check/decision points on route e.g. where decision to continue could be made). Client-route matching (selecting routes/activity according to client
Decision-making: <i>Reaching an appropriate judgement about a situation, selecting the most appropriate actions, solving problems, and managing risk.</i>	Managing risk: <i>Evaluating a situation to identify potential risks and hazards, then acting to mitigate or remove those hazards to enhance safety.</i> Identification and utilisation of decision-points: <i>Recognition of necessity of certain types of decision at specific points on a route/during an activity. Link between some decisions also acknowledged (if a then b).</i>	
Task management: <i>Planning the activity/itinerary, and ensuring </i>	Planning: <i>Producing route and accommodation or shelter requirements and </i>	

Table 2 (continued)

Skill categories	Elements	Code (meaning)
necessary preparations are carried out to maximise safety and performance	<i>locations prior to actual activity. Consideration of scheduling requirements and commitments.</i> Physical and kit preparation: <i>Activities to ready self and clients for activities.</i>	competence/training/tiredness). Oversight (maintain oversight of entire activity/route in order to pre-plan descent). Timing (manages timing of activities to achieve objectives/avoid long waits/avoid fatigue). Gear (check/prepare/test client kit/gear for fit/utility/comfort). Client ability (test of client climbing ability/performance and speed). Familiarisation (familiarise clients with kit/techniques prior to full activity). Quick response (responds quickly to dynamic changes in the environment e.g. change in weather). Updating (continuously update plan to accommodate conditions/terrain/position and other groups). Adjustment (Adjusts plan to suit client ability/experience level). Mental preparation (guides client mental preparation/readiness for potential hardships/effort). Understanding (ensure client has good understanding of upcoming activity via repetition/reiteration). Flexibility (encourage/train clients to be flexible about plan and route).
Cognitive readiness: <i>Employing mental preparation and adaptability to cope with dynamic mountain conditions and ensure client safety.</i>	Adaptation to conditions: <i>Altering actions to suit changes in the environment, ability to switch focus and activity both in response to environment and in order to achieve goal.</i> Mental preparedness: <i>Ensuring self and client mentally prepared for climb/route/hardship.</i>	

based on client limitations:

‘You have to turn around and tell them, I’m really sorry, you’re not going well enough. You’re not fit enough, you’re not strong enough, you’re not experienced enough, and actually managing that is, is much harder than managing weather conditions’. P9

The guides’ knowledge of the mountains, including typical difficulty levels and timings for various routes, was important for identifying and utilising decision points. Once a specific route was selected this led to a series of related decisions – with the chosen terrain dictating what kit might be needed, particular approaches etc. There were also various checkpoints, or key places, along routes which guides used to facilitate their decisions on whether to continue with a certain activity and how long it might take:

‘So there’s a really classic sort of cut-off time move, 2–2.5 hours to this emergency hut [Solvay] on the Matterhorn. If that is really hard, if it takes you 2 hours 29 minutes, but you’ve been working really hard, it’s going to be a very long day. If you get there in 2 hours 10 minutes it’s all fine’. P2

3.2.4. Task management

Within the element of planning, interviewees discussed the

importance of matching the activity or route to their assessment of the client’s ability and fitness level:

‘Their technical skills are something that will help give them an enjoyable run down the hill, but it also keeps them and yourself safe. So, making sure the route is appropriate to the client, I find this really important’. P4

This indicated the need for balance between ensuring a client felt challenged, but also preventing clients from attempting something that would increase their risk of accident due to a lack of ability or knowledge.

Guides reported the value of maintaining oversight of the entire activity until finished. This was important from a planning perspective to avoid problems on the descent from a mountain, which might be as effortful, or even more difficult, than the initial ascent:

‘Having a kind of, a grand view of what the day entails, and saying that ‘we’re going from point A to point B, and back to A.’ P12

This was closely linked to consideration of activity timing, encompassing the proposed start time, how long each section of the route might take, and the possibility of there being the presence of multiple groups on the mountain that may induce waits on certain sections:

‘The start of the climbing is two minutes’ walk from the hut. But the start of the climbing is a real bottleneck. So if you are slow out the hut, you don’t get your place in that queue’.P2

3.2.5. Cognitive readiness

Given the dynamic nature of the mountain environment, combined with the potential for changes to client performance and physiological condition enroute, it is perhaps no surprise that our interviewees highlighted the need for flexibility and adaptability. The ability to adapt to conditions was linked back to ongoing monitoring as part of situation awareness, where cues indicating an upcoming change could be spotted. Adaptation then required quick reactions, the swift implementation of alternative actions/activities, or a change in the planned itinerary to maintain client safety:

‘We might suggest ideas and opportunities, but it remains flexible until we’re actually on the route. And even on the route, if conditions deteriorated significantly whilst climbing then the plan would change’. P6

Interviewees also discussed the importance of mental preparedness, including the need to ensure clients were prepared mentally for both the changeable conditions, and inherent flexibility in plans, as well as the potential for hardship whilst on the mountain:

‘Mental preparation for clients is really important, I try to explain everything really carefully to them. So, they have a good understanding in the leader, what the climbing entails’. P4

3.2.6. Social skills

This section will outline the social skills reported by mountain guides (Table 3).

3.2.7. Teamwork and communication

An important aspect of communication, which tended to begin in advance of any activity – usually during the planning stage, was managing client expectations (Table 3). This involved a combination of ensuring clients had realistic goals in the context of their abilities and experience, as well as emphasising that activities were not guaranteed:

‘It’s very long, very difficult, it’s fully engaging, and involves preparation. It’s not your average mountaineer that does that. And yes, many people do it, but you meet the ones that are successful. There’s just as many teams - 5 or 6 who are not successful’. P10

Table 3

Two categories of social non-technical skills relevant for mountain guides, presented with associated elements and codes with descriptions of meaning.

Skill categories	Elements	Behavioural examples
Teamwork & communication: <i>Sharing information, goals and understanding to facilitate working well with others. Combining activities and effort to reach a shared goal safely and effectively.</i>	Managing client expectations: <i>Ensuring clients have a realistic idea of what will be achievable in the context of their goals, and are aware of why options/routes are selected.</i>	No guarantees (ensure clients are aware that making a summit/ascent is not guaranteed). Client goals (determine client goals/needs via initial communication). Explanations (explain reasoning for/discuss route/actions/decisions prior to activity). Pre-activity briefing (sharing weather, terrain, options, emergency protocols with team). Hazard descriptions (describe and then discuss potential risks/hazards associated with activity). Debrief (review experience at the end of the activity). Allocation (gives tasks to members of team/clients to support achievement of goal). Support (Helps teammate when that person is struggling). Peer monitoring (encourages clients to monitor/check on each other/maintain chatter). Insights (share ongoing insights/holds/ approaches/ observations during climb/activity). Assertiveness (Speaks up if an issue or problem is noticed). Tone (alter communication tone/ emphasis to get attention/highlight issue). Information level (alter level of information to suit client ability/stage of activity/urgency). Exertion (manages activity exertion level to avoid over/under exertion during activity). Instruction (guide client actions directly via specific instruction to achieve activity goal). Visualisation (co-ordinate client actions via visualisation e.g. aim for that boulder, and/or hand signals). Listening (Listen to concerns/worries/points raised by others). Shared decision-making (gathering opinions and discussing options to reach shared decision).
	Exchanging information: <i>Ensuring everyone is aware of the planned activity/ route, is aware of the associated hazards/risks and knows the approach.</i>	
	Sharing tasks/ supporting teammates: <i>Interacting with others to ensure tasks are shared appropriately, including asking for help when needed and providing support to others.</i>	
	Sharing insights/ approaches/concerns: <i>Verbalisation of internal thoughts and observations to inform/instruct others and guide attention and highlight issues.</i>	
Leadership: <i>Building a holistic picture of the environment and team actions, overseeing and guiding task activities, ensuring client wellbeing and safety.</i>	Adaptive communication: <i>Alter flow of information and/or emphasis to suit circumstances and client needs.</i>	
	Directing/guiding task activity: <i>Guide client actions to complete the activity safely and effectively, while also engaging in training and education of clients where possible.</i>	
	Developing psychological safety: <i>Ensure clients feel comfortable raising concerns/questions and communicating freely with guide.</i>	

(continued on next page)

Table 3 (continued)

Skill categories	Elements	Behavioural examples
	Client management: <i>Ensuring clients are supported, appropriately motivated and wellbeing is maintained.</i>	Speaking up (encourage clients to ask questions/speak up). Conflict management (manage client conflicts, both client-client and client-guide). Adaptive support (adapts support level to match client knowledge/abilities/confidence). Goals (supports client motivation via goal setting).

This was often followed by further explanation, often at the start of an activity, outlining potential issues – particularly when assessment of the conditions meant the guide was considering cancelling, or cutting short, the itinerary:

‘By the time we’ve travelled 100 m, I would probably be starting to inform them again, that the likelihood of us achieving that plan for today is probably less than 50%’. P6

Interviewees highlighted the importance of information exchange, ensuring clients had all the relevant information, often through a pre-activity briefing either the night before or immediately prior to engaging in the activity:

I explain to people what is going to happen, what I’d like them to do, and then we’ll probably get to some kind of transition zone where we might like gear up and I might get the rope out, that sort of thing, always pretty clear on the safety briefings’. P15

This was followed by ongoing communication throughout - sharing insights into aspects such as the environment, approach to various obstacles, and highlighting a change in technique. The level of detail provided within these communications was tailored to the needs of the client and the specific situation via adaptive communication. Predominantly the guides discussed utilising an informal tone and encouraging demeanour, however, this would change within a problematic or emergency situation, where depth of information was reduced, and tone altered:

‘I’ve warned all my clients pre anything that I go into, where I feel that can be a serious element, that my voice will turn will change, when I feel that we have to concentrate on something in particular’. P10

Finally, although the majority of each group consisted of paying clients, they could be experienced. As such, guides discussed sharing tasks with select members of a group, either to help share or manage workload across the group or to manage the actions of the particular group member:

‘You can give sort of jobs to people in the group so you can get the strong skier and ask him to hang back and ski last, which is quite a good one. So, it does two things. A- He is then able to go and help anyone who falls over. B - You’ve slowed him down. You’ve made him ski at the back’. P2

3.2.8. Leadership

Leadership was a core skill for mountain guides, with client groups reliant on guides for route finding and guidance on task activities alongside training and support when required. Guides highlighted that directing/guiding client activity could vary from the need for specific, technical direction, to overall monitoring of task and exertion levels to prevent client fatigue or discomfort:

‘We try and slow people down generally. Like people will be over-enthusiastic. And people even who’ve done – so if you do a four-hour hut walk and you try and do it in three and a half hours, you’ll be tired, whereas four and a half might feel easy’. P2

Despite the responsibility of mountain guides for decisions throughout activities, interviewees emphasised building an environment of psychological safety. This encompassed providing clients with insights into the factors influencing decisions, encouraging clients to share their opinions and engaging in shared decision-making where possible:

‘Create those pauses in your day, to have the discussions, and I suppose set a tone, where everybody’s got a voice’. P9

Guides also discussed client management via supporting clients in various ways, including managing and resolving conflicts and motivating clients to continue when they were feeling tired or cold:

‘You’re going to get in there, and you’re going to be warm, you’re going to make your food, you’re going to get a hot drink, you’re going to have a warm meal, and it can feel good’. P7

3.3. Perception of potential performance limiting factors

Key factors perceived by guides as having the potential to influence safety and performance of NTS were organised into four key categories: client behaviour, cognition, environmental conditions, and actions of other groups (Table 4).

Table 4

Four categories of context relevant factors that mountain guides perceived may influence performance of NTS, presented with code and description of meaning.

Category	Code (meaning)
Client behaviour	Issues with client behaviour (client injured, under influence, loses kit/disregards instruction/lack of experience). Ambition (if guide/client over ambitious they may lead group/push group over too difficult route). Task pressure (meeting client expectations/ambitions/achieve goal/give value for money). New/unknown client (do not yet know extent of client abilities/abilities may be exaggerated).
Cognition	Tunnel vision (effort or strong focus on specific aspect of task). Autopilot (repetitive actions can lead to loss of sustained attention). Focus lost (loss of focus/attention distributed too widely - self or client). Making assumptions (assuming knowledge or actions on behalf of others). Rushing (linked to getting past other groups, making specified time in specific time) Fatigue (tiredness, lack of sleep, physical or mental fatigue). Lack of confidence (swayed by actions of others/pressure to perform).
Environmental conditions	Tough working conditions (temperature variation, terrain, early start times, adverse weather) Adaptation difficulties (difficulty adapting to/recognising sudden dynamic environmental changes). Dynamic change (sudden environmental changes – rock fall, avalanche). Growing problems (incremental/small changes in environment/situation can go unnoticed leading to sudden issues).
Actions of other groups	Actions of other teams (can encompass competitiveness, risky behaviour by other group, rockfall caused by other group). Interruptions (task interrupted by person/other group, breaking concentration).

3.3.1. Client behaviour

Participants emphasised that clients could set goals and have their own recreational ambitions for a task, as well as providing the financial incentive for the activity. The interviewees felt that this dynamic could have an adverse impact on the guide if not managed appropriately, particularly where clients had strong ambitions (which they did not always have the experience or ability to achieve), that they tried to pressure the guide into accomplishing:

‘A people hazard. It’s people whose aspirations dominate maybe their thinking and their actions, where sometimes their aspirations are not properly aligned with their capability’. P7

Even when client ambitions appeared reasonable, interviewees felt that there was a danger that guides could progress a task beyond the point they should have stopped due to an inherent desire to ensure the clients have a positive outing:

‘You tell yourself that you’re making okay decisions about the snow and you’re aware that you might not be because of other things like these clients are paying a lot of money’. P8

3.3.2. Cognition

Fatigue was commonly discussed by interviewees with reference to over-exertion, discomfort (physical fatigue), and their perception, based on experience, that fatigue could adversely impact their decision-making and attention levels (cognitive fatigue). Interviewees discussed the heightened risk associated with un-managed fatigue, with a perceived association with a rise in error rate:

‘When I’m working if I’m tired, I’m careful with my decisions because I know I’m more prone or potentially prone to making weaker decisions’. P5

Guides also highlighted their experience of the potential consequences of rushing, where cues or changes in the environment could be missed, and making assumptions, where the environment was not scanned or evaluated adequately:

‘Maybe I didn’t look quite closely enough at the terrain I was going to travel through, I just made an assumption that probably it was going to be okay because everyone says it is safe’. P1

3.3.3. Environmental conditions

Guides felt that being out in difficult or adverse mountain conditions for extended periods could have an adverse impact on physiology, resulting in fatigue as discussed above:

‘You’ve got the effects of the sort of diurnal changing the temperature, particularly in the Alps. Really hot during the day, like, quite cold at night, can be pretty debilitating’. P3

Guides further highlighted the changeable nature of these conditions, particularly where a change might be very sudden, or so incremental as to go unnoticed:

‘Where there are subtle changes, very kind of incremental, small changes in the environment, kind of creep up on you’. P7

3.3.4. Actions of other groups

Guides also discussed their perception of the behaviour of other groups on the mountain, with a focus on the potential for the actions of others to have an adverse impact on the safety or actions of their own group. This was usually featured other groups being above the guide’s group on an ascent, or being in a location that then increased the risk of the guide’s chosen route or activity:

‘Other people will kill you, whether they’re above or below. So don’t climb below others. Full stop. When you don’t climb below others, they can never drop, or create a hazard for you’. P10

4. Discussion

The results from this paper contribute to our theoretical understanding of NTS by providing important insight into the range of skills (situation awareness, decision-making, task management, leadership, teamwork & communication, cognitive readiness) used in a recreational setting by mountain guides. This context differs from the bulk of the NTS literature, where the focus is NTS used within an industrial work setting, with the team or group composed of workers (e.g. Mitchell et al., 2012), as opposed to a group composed primarily of clients, as in the current study. Despite this the skill categories reported here align with NTS frameworks from other contexts such as FLINTS (Irwin et al., 2022) within agriculture, and HeliNOTS within aviation (Hamlet et al., 2023, pp. 1–15). The main areas of differentiation appear within the skill elements and behaviours, with a number of elements developed that have not been previously reported elsewhere (e.g. client management, managing client expectations, adaptive communication). Many of these unique elements are reflective of the client and recreational focus of the mountain guiding context.

The current study also identified factors influencing NTS, providing insight into the application of NTS within the dynamic mountain environment, spanning factors internal to the guide, environmental and created through the behaviour of others. Taking this system-based approach supports the consideration of NTS lapses within a complex system, moving away from individual blame and towards development of multilevel interventions (Naweed & Murphy, 2022). Combined these findings provide the groundwork for development of a specific NTS mountain guide behavioural marker system - a framework to support observation and training of these skills (Yule et al., 2006). The remainder of the discussion will consider each of the skills identified within this study in turn, in the context of the human factors and adventure tourism literature, followed by indications of future research directions and practical implications.

4.1. Cognitive skills

The current findings highlight the importance of situation awareness for mountain guides and align with Endsley’s model of situation awareness, comprising three main processes of perception, comprehension and projection (Endsley & Garland, 2000). Similar to recent work with sea kayaking guides (Collins et al., 2021), each element of situation awareness appeared integrated with the next; for example, regular monitoring of the environment enabled indicators of potential problems to be seen and understood. The emphasis on the importance of maintaining situation awareness through regular checks, enabling consistent updating of the held mental model, is also indicative of the highly temporal nature of situation awareness in a dynamic environment (Endsley & Garland, 2000; Irwin et al., 2023). For guides this encompassed both the environment and the actions and perceived wellbeing of their clients, meaning their attention had to be distributed across multiple points (Endsley & Garland, 2000). Research suggests that distributed attention can constitute a high cognitive workload, with lapses in situation awareness and subsequent errors more likely under such conditions (Endsley & Rodgers, 1998). Certainly, this was recognised by guides as a factor that could impact situation awareness performance and may explain the emphasis on gathering information on clients prior to an activity. An accurate picture of client abilities and fitness may make these regular checks of the environment less effortful, particularly where the client is familiar.

Situation awareness has been linked to decision-making in a range of recreational environments, including sea kayaking (Aadland et al.,

2017) and recreational avalanche incidents (Hallandvik et al., 2015). The current study supports this link with situation awareness appearing to facilitate effective decision-making, as guides reported making decisions regarding risk management based on their understanding of the situation, and anticipation of what could happen next. Interestingly, given the recreational context and guide responsibility for client safety and well-being, a key aspect of decision-making was consideration of client abilities and physical state (Clinch & Filimonau, 2017). Previous research suggests this may be a factor in creating a high decision-making load for guides, where the clients pass all decision-making responsibilities to their guide yet are themselves a factor in the complexity of each decision (Collins et al., 2018).

Interviewees emphasised the importance of being able to make the decision to stop or cancel an activity when required. This kind of decision has the potential to upset clients (Clinch & Filimonau, 2017), particularly where a specific goal or challenge will not then be achieved (e.g. the three peaks challenge, Ivaldi & Whitehead, 2021). Within the current study, it was apparent that guides removed some of the barriers to a stop decision through managing client expectations; ensuring clients were prepared for the cancellation or cessation of an activity.

A mechanism for reducing the likelihood of having to make a stop decision was task management, where there was an emphasis on the importance of planning and preparation before an activity. This is perhaps unsurprising given planning is considered a vital aspect of safety management, enabling goal clarification, timeline setting and recognition of potential issues or problem areas (Boyes et al., 2019). Proactive planning has also been reported as a strategy for responding to dynamic mountain conditions linked to climate change (Mourey et al., 2020). The planning process discussed by current interviewees closely resembles that proposed by Boyes et al. (2019): consideration of the group (e.g. client abilities), evaluation of the location, and personal preparation, facilitated at each stage by the information-gathering aspect of situation awareness.

The final cognitive skill of cognitive readiness is becoming gradually more recognised as an important skill category within the general NTS framework, starting with helicopter pilots (Hamlet et al., 2020) and more recently with chainsaw operators (Irwin et al., 2023). Cognitive readiness has been a key focus within the military literature, where it is highlighted as a vital competency to enable individuals to manage uncertain, complex and dynamic environments (Cramer et al., 2021), all descriptors which also apply to the mountain environment. Critically for mountain guides, the mental preparation discussed was not only for themselves, but was viewed as a vital component for clients, particularly those lacking experience. The need for flexibility and swift adaptation was focused on reactivity within an activity, however it is likely that this sits within a larger narrative of increased flexibility required due to climate change (Mourey et al., 2020). Mourey et al. (2020) argue that climate change effects are altering mountain environments, requiring guides to adapt to maintain solvency, encompassing changes to work patterns, and techniques, as well as the need to be reactive to conditions.

4.2. Social skills

Research suggests that adventure tourism clients can have a range of expectations regarding their proposed activity, ranging from the romantic to more practical expectations regarding physiological effort (Ponte et al., 2021). Managing those expectations under conditions of uncertainty, where environmental conditions may lead to cancellation or adaptation of activities, is therefore considered a core element of the commercial side of adventure tourism (Ponte et al., 2021). Within the current study one of the novel skill elements within the leadership skill category focused on client management, with mountain guides discussing management of expectations from both the perspective of commercial considerations, such as monetary pressures, and safety concerns. In both cases interviewees emphasised the importance of ensuring clients had a realistic perception of the planned activities, including the

likelihood of those activities going ahead. This clarity of communication was part of a strategy to reduce differences in representation between clients and guides, where clients may oppose a guide's decision due to an alternative, or erroneous, viewpoint (Girard et al., 2020). As such this was also a mechanism for reducing problematic client behaviours linked to being overly ambitious.

Guides considered the pre-activity briefing an important aspect of communication, where clients would be provided with an overview of the activity, route and key hazards. Although the content of these communications was instructional in nature, guides indicated that they tried to keep their tone informal, engaging in social chat, likely as a mechanism for strengthening group cohesion (Buckley, 2010). Interestingly, guides highlighted that the tone and content of their communications would change if the conditions became high risk. This aligns with the emphasis on high-clarity health and safety communications as a vital component of safety within adventure tourism (Buckley, 2010).

The balance between instruction and social aspects was also seen within the skill of leadership, where guides discussed providing specific directions to clients to achieve goals, supporting client motivation, and developing psychological safety. The concept of psychological safety is considered to be the shared belief within groups or teams that they are able to engage in interactional risks, such as speaking up or completing 'voice' actions (O'Donovan & McAuliffe, 2020). This concept has been included in only one other NTS framework to date, as an element of leadership within forestry management (Irwin et al., 2023). Supportive leadership behaviours linked to this concept comprise inclusiveness, trustworthiness and integrity (Newman et al., 2017). The benefit of psychological safety within the mountain context primarily encompassed the utilisation of client perspectives to enhance task performance and safety.

Guides considered that both leadership and teamwork performance could potentially be constrained by client behaviour and task pressure. The pressure to achieve client satisfaction and a good experience can be linked to the concept of emotional labour, or 'service with a smile', where guides feel compelled to act in a way not necessarily reflective of their underlying emotions (Buckley, 2010; Mathisen, 2019). Previous research suggests guides felt there were three key guiding responsibilities: safety, fun and building community. All three areas required emotion management, such as not showing fear within a risky situation, modelling enthusiasm for various activities and engaging in social facilitation (Sharpe, 2005). This emphasises the multiple pressures and expectations that guides may feel obliged to manage, and which may adversely impact their NTS during times of heightened pressure.

4.3. Limitations and future directions

The current study was based on self-report and recall of past adverse incidents, as such the results are subject to potential bias and errors related to human cognition and memory. The sample consists of British Mountain Guides therefore the experiences and insights provided by the guides in our study may be reflective of the training undertaken by guides in the process of attaining accredited status. As such, the interview findings may not generalise fully to other groups of mountain guides where the process of training and accreditation can differ (Clivaz & Langenbach, 2020). Finally, the qualitative nature of the current study means that although we were able to discuss the experiences and insights provided by our interviewees, including factors they had experienced as impacting their performance, we cannot make any assessment of causal relationships between the various factors and skills.

The current study represents the first step towards the development of a NTS behavioural marker system for mountain guides. Typically, a behavioural marker system will encompass a skill taxonomy, with defined skill categories, elements and behaviours, together with user guidance and a rating scale for assessment purposes (Flin & Martin, 2001). Within the NTS literature the next steps are defined as

encompassing quantitative validation of the identified NTS via survey and/or observations (Irwin et al., 2022). This is typically followed by discussion groups comprised of subject matter experts tasked with assessing the identified skills and further developing positive and negative behaviours for each element (Hamlet et al., 2023, pp. 1–15). Once the system has been developed it should then be subjected to user testing whereby subject matter experts are provided with the framework and asked to assess video simulations of real-world events, enabling tests of inter-rater reliability to be conducted (Mitchell et al., 2012). In addition to developing a functional behavioural marker system, future research should also consider a comparison of NTS use across warm and cold weather activities to determine if there is a need for two systems, each tailored to different weather types or seasons.

4.4. Practical implications

The focus of the current study was on the critical NTS perceived as important for safe and effective mountain guiding. As such the key practical implications related to this study are primarily concerned with the assessment and training of mountain guides. At present there is no defined, or recognised, training for mountain guides linked to accreditation that focuses on NTS. Given the findings outlined above this represents a gap in current training, one which, based on both the current findings and the more general NTS literature (e.g. Flin et al., 2003), could have adverse consequences for the safety of mountain guides and their groups. We recommend this gap is filled through the development of a behavioural marker system for mountain guides, linked to associated specific training. Such training has been utilised within other contexts such as aviation (Flin et al., 2003), where such training is now mandatory, to enhance safety and reduce the likelihood of adverse incidents.

4.5. Conclusion

The current findings highlight the importance and utility of NTS within the context of mountain guiding and identify six core skill categories (situation awareness, decision-making, leadership, teamwork & communication, task management, cognitive readiness) with associated elements. The performance of these skills within the complex mountain environment could be adversely impacted by a range of factors such as fatigue, client behaviour and conditions. This suggests a need for the development of tailored NTS training for guides to support the development of these skills. Such training would have the capacity to enhance safety, ideally in conjunction with guidance regarding factors, such as fatigue and task pressure, that may influence the performance of these skills in practice.

CRediT authorship contribution statement

A. Irwin: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Visualization, Supervision. **J. Thacker:** Formal analysis, Resources, Writing – review & editing. **G. Brame:** Investigation, Methodology, Formal analysis, Writing – review & editing. **O.E.D. Hamlet:** Formal analysis, Writing – review & editing.

Declaration of competing interest

None.

Data availability

The data that has been used is confidential.

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