THE DEVELOPMENT OF SKI GUIDE DECISION EXPERTISE

Iain Stewart-Patterson
Thompson Rivers University, Kamloops, BC, Canada

ABSTRACT: The development of ski guide decision expertise is situated within an environmental context influenced by massive consequence and feedback ambiguity. Typically, the quality of the decision process is described as being contingent on the evolved expertise of the decision maker. The central problem is that decision feedback often lacks clarity when nothing goes wrong. Notable events have been regularly studied for the possible lessons to be learned. However, days when everything has appeared to go well are rarely analysed. The implicit feedback from a day when nothing bad happened is that good decisions were made. This then becomes the basis for future pattern recognition. This is particularly significant when the consequences are high and the quality and quantity of feedback is low. Termed a wicked learning environment, it can help to form questionable patterns that may produce heuristic biases in the future.

KEYWORDS: decision-making, expertise, situational awareness, pattern recognition.

1. INTRODUCTION

Termed dual-process (Evans, 2010), the combined strength of intuition and analysis forms the basis of how expert ski guides make decisions in avalanche terrain. High quality decision-making can be produced through a sophisticated analytical process in addition to an intuitive process. A high quality intuitive process is dependent on an extensive repertoire of previous patterns generated by decision outcomes. Intuition is frequently poorly understood and often dismissed as unreliable and irrelevant. Deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993) aimed at the development of context specific expertise provides the foundation for a high quality decision process.

2. METHODOLOGY

Data were contributed over two seasons (2008/09 and 2009/10) by a self-selected group of 35 heli-ski and snowcat-ski guides working in British Columbia. Mixed methods were used to analyse three sources of data. An initial quantitative analysis of the participants' background experience and 96 event reports (62 good day reports and 34 near-miss reports) was used to provoke qualitative questions of interview data.

* *Corresponding author address:*
Iain Stewart-Patterson, Thompson Rivers University, Kamloops, BC V2C 0C8;
tel: 250 828-5184; fax: 250 371-5845;
email: spatterson@tru.ca

3. RECOGNITION PRIMED DECISION-MAKING

The RPD Model is based on the assumption that recognition is the initial step in the decision process (Klein, 1998). There are two components to recognition. The need for a decision must be recognized first. This primes the second component, which is recognition of the decision environment. This central theme of recognition in RPD is based on the concept of situational awareness (SA), which has been described as the ability to maintain the big picture (Endsley, Farley, Jones, Midkiff, & Hansman, 1998; Endsley & Robertson, 2000; Endsley, 1997, 2006; Matthews, Strater, & Endsley, 2004). SA is a state of being and is considered important for all levels of mastery from novice to expert (Endsley, 2006). The correct identification of the situational context and decision clues can lead to effective decision-making. This is different from a decision error that results from a poorly understood decision context. Experts can typically make rapid decisions based on situational awareness and pattern recognition (Klein, 2011).

According to Endsley (2006) experienced decision makers will develop mental models that represent previous patterns and corresponding levels of all three levels of SA. Well-developed models are able to account for dynamic situations and adapt previous schemata to new situations. Pattern matching is dependent on the ability to identify critical cues. Not all features will be represented

in similar patterns, so it is essential to identify the key elements of the pattern.

As the decision maker experiences increased saturation in a particular environment through repeated exposure, there may be an expectation of more rapid recognition of patterns. Although Klein (1998) suggests that the expert has actions that are triggered in a single step for rapid 'automatic' decision responses, the speed of the response may compromise accuracy. Automaticity may result in things being missed through a lowering of situational awareness. When expectations of events do not match up with reality, it indicates the need to adapt goal selection to the decision environment. For example, avalanches on low angle terrain might indicate the need to re-evaluate the hazard forecast.

There are also a number of human factors that effect the development and use of situational awareness including: attention span, working memory, goal orientation, expectations and pattern matching (Endsley, 2006). Of these, pattern matching is perhaps the most significant for the ski guide. SA is not considered transferable, as knowing what to look for and the meaning of what is perceived is context specific and dependent upon tacit knowledge and expertise. Experts are normally able to develop sophisticated mental models that incorporate an interconnected, systems-based interpretation of the environment.

For the ski guide, this would typically include an interpretation of the impact of a group of skiers on the snowpack and their location in the terrain. It would also include the implications of multiple groups in the same terrain, the logistics of the helicopter or snowcat and the transitions from one geographic feature to the next as the day progressed. Mental models facilitate the integration of individual elements of critical information into the decision process that may be filled with many pieces of apparently important information. This is important in the development of forecasts and the possible ramifications of a decision. A high quality mental model becomes the bridge that allows an expert to match the current situation with a previously experienced pattern. Recognition of the critical cues allows for more rapid pattern matching.

3.1 Automaticity

Automaticity often develops with increased learning and practice (Endsley, 2006). The reduction in effort directed at simple tasks allows the decision maker to focus on more demanding tasks. For example a new heli-ski guide may become absorbed by the demands of terrain hazard assessment and not be able to direct attention at the challenge of managing the group. With increased skills and automaticity in terrain selection, the guide can focus more attention on group management. However there is a downside to automaticity. An expert may be able to adequately manage 'normal' situations with a diminished level of SA, but may not be prepared when an abnormal situation arises. The drift into complacency and automaticity is dangerous ground (Klein, 2011). Checklists have been used successfully as a way to avoid automaticity. It is important even for experts, to recognize when a situation is completely novel, as previous patterns will likely be inadequate. In trying to make a pattern fit a current situation, the decision maker may be guilty of stretching a pattern beyond recognition in the search for a possible solution.

3.2 Pattern recognition

When placed within the context of Naturalistic Decision-making (NDM) the question arises as to whether wilderness ski guiding is any different from other environments that pose risk-based challenges. The key element that stands out is the questionable reliability, or even existence of a feedback loop (Isaac & Goth, 1991). Feedback provides an opportunity to react and modify the decision strategy. Feedback may be entirely absent for the ski guide. There is certainly the potential for a poor decision to result in a fatality, but it is perhaps equally likely that nothing bad will happen at all. Poor decisions occasionally result in feedback in the form of near-misses or accidents, yet there will also be times when poor decisions do not result in any overt feedback.

At the other end of the ski-guiding decision spectrum, a good outcome is not necessarily attributable to a good decision. Explicit feedback often does not occur on good guiding decisions. It may be challenging to evaluate decision quality, as the most common direct feedback is that nothing bad happened. Although this could be considered a good outcome, if the decision process were flawed, it might create a template for

future flawed decisions, perhaps with outcomes not as favourable. Inferences can be made as to the quality of the decision based on this non-result by those involved, such as other guides. The question as to whether this was a good or bad decision hinges on the perception of whether the actual outcome (nothing bad happened) was representative of existing conditions. If other guides within the operation considered the decision quality low, there is considerable opportunity for feedback and reflection.

Pattern recognition is not necessarily the panacea for all decision problems. Bad patterns can also be formed. Hogarth et al. (1991) suggested that this could occur when decision feedback was absent or misleading. Ewert, Shellman and Glenn (2006) equated pattern matching with a possible decision trap, the heuristic bias of familiarity. They suggested that a seemingly familiar pattern might provide an easy solution to a slightly different decision problem. A failure to recognize the subtleties of the differences could result in a poor decision.

4. DUAL PROCESS DEFINITION

Kahneman, Slovic and Tversky (1999) described the use of two systems within the decision-making process. System 1 used perception and intuition. It was driven by easily accessible thoughts that did not require much in the way of reflection. Operations conducted under System 1 were: fast, effortless, implicit, could be emotionally charged, governed by habit and were difficult to control. System 2 used reasoning. Operations conducted under System 2 were: slower, serial, effortful, potentially rule-based, and were consciously controlled.

There is consensus that as expertise develops, intuition becomes a more refined tool and is used more extensively; the challenge being to not become overly reliant on it (Kahneman & Klein, 2009). An intuitive response will likely generate a feeling or emotion that is identifiable at a conscious level. However the origin of the feeling cannot be identified (Evans, 2011). The conscious analysis of an intuitive response does not change its sub-conscious origins. The Default-interventionist theory would suggest that we would act on these rapid intuitions unless the intuitive solution does not saticfice the decision challenge (Alter, Oppenheimer, Epley, & Eyre, 2007).

5. FEEDBACK

Hogarth et al. (2008) argued that the critical element in the development of intuition was the quality and quantity of feedback. They described feedback as being relevant or irrelevant, in relation to the seriousness of the consequences, which could be described as lenient or exacting. Intuition does not need to be very precise when consequences are lenient. A general direction can be sufficient. However, when consequences are exacting, there are significant consequences for minor errors. This produces an environment that can be described at its extremes as either ‘kind’ or ‘wicked’ (Hogarth et al., 1991). A ‘kind’ environment has relevant feedback and lenient consequences, compared to a ‘wicked’ environment, which has irrelevant feedback and exacting consequences.

This has particular significance to the decision-maker in avalanche terrain. The experience gained by expert ski guides might have been acquired in range of wicked and kind environments. Many decisions could be made when there is the potential for catastrophic consequences and minimal, or irrelevant feedback is generated. The “cultural capital or the inventory of intuitions that guide behaviour” (Hogarth et al., 2008, p. 91) has the potential to be tainted by this lack of relevant feedback, necessitating regular calibration.

The ski guide faces the challenge of interpreting numerous, possibly conflicting environmental feedback clues, such as a lack of recent skier-triggered avalanche activity despite a known weakness within the snowpack. High quality feedback on the decision maker’s interpretation of the environmental feedback could come from other experts. Teams of guides such as those used by most mechanized ski operations could likely benefit from some form of decision analysis during the traditional evening guides meeting. As intuitive responses based in pattern matching possibly play a critical role in the interpretation of environmental feedback, knowing if and how intuition is developed would be of great benefit to the guiding community and the greater community that hires guides to conduct them safely through hazardous terrain.

6. EXPERTISE

A number of conditions have been cited as being characteristic of events that foster the development of expertise and the subsequent impact on intuition. These included: a desire and motivation to improve, a well designed task that accommodated the learner's starting point, and timely access to high quality feedback (Ericsson, Krampe, & Tesch-Romer, 1993). The greatest potential for development occurred when tasks that met these criteria were repeated often. Of these characteristics, feedback whether generated externally or internally through a reflective process, was generally considered the most important (Balzer, Doherty, & O'Connor, 1989; Brown, 2006; Hogarth et al., 1991). A well-designed task performed by a highly motivated person can meet with limited success in the absence of high quality feedback (Balzer et al., 1989). For the ski guide, this can be the case all too often. Low-probability – high-consequence scenarios do not provide consistent high-quality feedback (Klassen, 2010). Ski guides cannot be dependent solely on environmental feedback as it can lack qualities that are truly representative of the decision complexity. Feedback that addresses not only what the correct answer was, but also includes elements of why the answer was correct can be much more effective in the development of decision-making skills (Hammond & Summers, 1972).

7. FINDINGS

Faced with an environment over the winters of 2008-2010 that hindered both analytical and intuitive processes, how were guiding teams able to produce high quality and safe experiences for their guests? An exploration of how and when intuition was used has provided a possible explanation. The quantitative data suggested that participants used positive or good feelings as the basis for many decisions. However the interview data suggested that participants defaulted to the conservative option when intuition and analysis clashed, with generally the intuitive response indicating the need for additional caution.

7.1 The acceleration of expertise

Endsley (1997, 2006) concludes that experts generally have more refined situational awareness. Fadde (2007) adds the suggestion that situational awareness could be trained through dedicated practice with an increase in repetitions. These repetitions could be attained directly, or by watching others. A less experienced ski guide could build situational awareness by anticipating the lead guide's decisions. Personal reflection in conjunction with a feedback session facilitated by the lead guide would complete the process. Whether through direct or indirect repetitions, timely feedback is likely best when focussed on the decision process rather than the outcome.

The standard method of developing expertise consists of performance preparation, performance and debriefing (Fadde, 2007). The preparation and debriefing phases are the key to the eventual development of expertise. However to accelerate the development of expertise, targeted instructional settings can be constructed that focus on the development of the recognition component of the decision process.

The training of recognition skills has a potential benefit in the acceleration of decision expertise, as it is the first step in the RPD process. Quicker recognition provides a more rapid priming of the decision process. Fadde (2007) identifies three critical issues: why train recognition, how can recognition best be trained, and will improved recognition lead to better decision-making? Fadde (2007) suggests that it is possible to use instructional design to hasten the development of expertise through the improvement of training that targets pattern recognition. This combination of prescriptive instructional design with descriptive expertise research may offer a way to accelerate the transition from competent practitioner to expert and as such is not appropriate for teaching novices.

7.2 Deliberate Practice

As the ski guiding decision context varies considerably, multiple opportunities exist to explore new techniques. Developing experts can choose to make the task progressively more difficult. The recognition training approach is anchored in direct instruction, which has been largely remiss in addressing the developmental needs of RPD. The instructional elements are immediate feedback and incremental difficulty.

7.3 Recommendations

Over the two years of the study, the general theme expressed by participants was a lack of trust in their analytical process and a questioning of their

intuitive responses. They described a wicked decision environment that did not match previous patterns. Kahneman and Klein (2009) suggested that intuitive responses should be evaluated through effortful analysis, but that this regularly did not happen, either through inability, or lack of effort. Even though the participants described how they reflected upon their intuitive responses, it did not generate a sense of confidence as the results of their analytical decision processes were also suspect.

Although the consequences were exacting, often the feedback timing allowed participants the opportunity to make decisions that were subsequently proven wrong. Fortunately the catastrophic consequences occurred prior to participants exposing themselves and their groups to the suspect slopes. After experiencing events such as this, participants described how they began to trust their negative intuitive responses more than their positive ones. A tendency to rely more on negative intuitive responses developed. Participants turned to more conservative choices when they experienced general feelings of uncertainty and low levels of confidence.

There are two major implications for the ski guiding industry and the ski guide training and certification providers. Intuition and analysis form two sides of the decision process and both should be used. Analytical capacity has come under pressure, while intuition is under-valued and under-trained.

There needs to be complimentary development of an integrated decision matrix. This would be a two-stage process for improvement. A filtering process for analytical decision process and a training tool for intuition need to be designed. Heuristics, using only information that addresses the most important aspect of the decision environment should be considered, as this may straddle the two problems. Heuristics can be used as a filtering process for an excess of analytical data. This would simplify the search for a solution that works (Gigerenzer & Goldstein, 1996).

When intuitive responses degenerate into lazy heuristic shortcutting, the decision process can be derailed, become less accurate and suffer from biases. However, intuitive responses that are grounded in pattern recognition and learning generated through experiences, the decision process can be remarkably accurate (Kahneman & Klein, 2009). The ability to differentiate between skill-based intuition and heuristic-based intuition is key.

8. SUMMARY

Kahneman and Klein (2009) suggested that the best way to evaluate the quality of a decision was to look at the underlying conditions of the environment and the decision maker's level of mastery within that environment. Shanteau (1992) examined the development of expertise and related use of intuitive responses. He suggested that the predictability of the environment and the degree to which an individual had learned from that environment were key considerations in the development of decision expertise. He noted that some areas of expertise development produced higher reliability in decision outcomes.

Of particular significance to this discussion is the notion that expertise regularly becomes 'fractionated' (Kahneman & Klein, 2009). In this situation, an expert's decision process works well for some circumstances, but not all. Decision confidence generated under optimal conditions may spill over into non-optimal ones. The mark of true expert would be the ability to recognize when a situation poses novel challenges and is outside of the decision maker's pattern recognition. These anomalous conditions were an ever-present part of the decision environment for ski guides over the winters of 2008 to 2010.

There is a great opportunity for ski guides to learn how to develop their intuitive responses into a much more potent tool. The optimal conditions, under which intuition will be more accurate, include an environment that provides relatively consistent indicators as to its true nature. The second and perhaps more important aspect is whether the decision maker has had the opportunity to learn the meaning of these indicators. The absence of quality environmental cues, or a decision maker that has not learned the meaning of the cues may lead to confidence in an intuitive response that lacks underpinning. This confidence has been termed the 'illusion of validity' (Einhorn & Hogarth, 1978). A good outcome based on the illusion of validity can only be attributed to luck.

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RESCUECELL: YOUR MOBILE IS ALREADY YOUR LIFE, LET IT SAVE YOU

Philippe Berthet-Rambaud[1]*, Fanny Bourjaillat[1], Joachim Metter[2], Istvan Feher[3] and Dan Micu[4]

[1]Engineerisk, Ste Hélène du Lac, France
[2]SMI GmbH, Heldburg / Thüringen, Germany
[3]Rubin Information Technology Inc., Budapest, Hungary
[3]Mira telecom, Bucharest, Romania

ABSTRACT: The RESCUECELL project aims at developing a new kit to search avalanche (and earthquake) victims by means of their mobile phones signal. This new system will complement Search and Rescue technics available for professional rescuers and ski patrollers teams to support operations in case of unequipped (transceivers, Recco®) buried victims and assuming that they probably carry a cell phone. The system is mainly composed of a Control Center and portable nodes that are installed around the affected zone, even if there is no GSM network available: roughly, the system generates an autonomous mobile phone network in the search zone and making possible the interaction with mobile phones in the area to allow a proper positioning (the expected accuracy is few meters). The emergency network starts sending messages to which connected phones respond with a series of bursts. The signals sent by a phone are caught by the nodes. Using the output of the nodes, the Control Center is capable of estimating a position for the mobile phone. A mobile node carried by a rescuer will display the position of the victims and it allows increasing the accuracy. In parallel to the software developments and tests, keypoints consist also in global ergonomics (weight of each component, autonomy…), deployment requirements and operation time: at this stage, first mobile phones would be located in less than 80 seconds after the system deployment.

KEYWORDS: SAR, mobile phone, location, GSM, emergency.

1. INTRODUCTION

In mountainous terrain, avalanches are among the most serious objective natural hazards to life and property, with their destructive capability resulting from their potential to carry enormous masses of snow at high speeds. Table 1 presents a list of some notable avalanches in Europe and confirms that largest catastrophes occurred in ‘’urban’’ or ‘’high mountain’’ contexts.

Assuming that nowadays a majority of citizens own a cell phone, the opportunity to use this way to find people trapped in an accident is a civil safety challenge. However, such services cannot be offered by cellular operators since they do not provide the location with enough precision to be useful. This situation led to the RESCUECELL project supported by EU within the Research for SMEs program. This project started at the beginning of 2013 and this paper presents the main principles of the development of this new tool, initially dedicated to earthquakes ruins and snow avalanches.

Tbl. 1: List of notable avalanches in Europe

Death toll (estimate)	Event	Location	Date
9	Mont Maudit avalanche	France	2012
9	Restelica	Kosovo	2012
6	2009 Schalfkogel avalanche	Austria	2009
3	2009 Buachaille Etive Mòr avalanche	United Kingdom	2009
31	Galtür Avalanche	Austria	1999
12	Montroc avalanche	France	1999
20	Flateyri	Iceland	1995
14	Súðavík	Iceland	1995
7	Sankt Anton am Arlberg (Wolfsgruben avalanche)	Austria	1988
16	Vassdall	Norway	1986
12	Neskaupstaður	Iceland	1974
39	Val-d'Isère	France	1970
21	Lofoten	Norway	1956
16	Low Tatras	Slovakia	1956
57	1954 Blons avalanches	Austria	1954
265	Winter of Terror; series of 649 avalanches	Austria-Switzerland	1951
37	Ortiporio (Corsica)	France	1934
18	Rybô Avalanche[citation needed]	Slovakia	1924
18	Siglufjörður	Iceland	1919
20	Hnífsdalur	Iceland	1910

2. GENERAL PRINCIPLES

Mobile phones have become a personal device and it is difficult to find somebody without a mobile phone. This fact allows a connected life, where anybody, if desired can be accessed and can be located with the only condition of having the mo-

* *Corresponding author address:*
Dr. Philippe Berthet-Rambaud,
Engineerisk CEO, 354 Voie Magellan,
73800 Ste Hélène du Lac, France;
tel: +33 6 2375 0444; web: www.rescuecell.eu;
email: contact@engineerisk.com