AVALANCHE BEACON PARKS: FOCUS ON SKILL DEVELOPMENT AND TEAM COORDINATION

Audrey Desjardins[1]*, Saul Greenberg[2], Ron Wakkary[1,3], and Jeff Hambelton[4]

[1]School of Interactive Arts + Technology, Simon Fraser University, Surrey, British Columbia, Canada
[2]Department of Computer Science, University of Calgary, Calgary, Alberta, Canada
[3]Eindhoven University of Technology, Eindhoven, The Netherlands
[4]Mountain Education Center at Mt. Baker, Bellingham, Washington, United States

ABSTRACT: We observe and describe the ways backcountry recreationists use a wireless avalanche beacon training park located on a ski hill. From those observations, we suggest best practices on how to set up and maintain a wireless beacon park that supports companion rescue skill development by backcountry recreationists. Our goal is to understand how avalanche beacon training park can best support companion rescue training. We conducted an observational study combined with interviews of 22 participants using a wireless beacon park located at Mount Baker Ski Area in Washington, U.S.A. We were particularly interested in how users of avalanche beacon training pursue both skill development and team coordination training as suggested by the companion rescue protocol. Our observations reveal that beacon parks are mostly used in quite narrow ways that develop only certain aspects of the companion rescue protocol. Consequently, we suggest that beacon park design should: provide recreationists with successive challenges in companion rescue having progressive scales of difficulty; manage different levels of fidelity, balance skill development with team coordination training; and emphasize strategies that support the community of practice.

KEYWORDS: Avalanche beacon training park, team coordination, avalanche companion rescue, beacon, transceiver.

1. INTRODUCTION

Backcountry travel, including skiing, splitboarding, snowmobiling, and other methods, continues to grow in popularity. This activity is accompanied with varying levels of avalanche risk. In the last few decades, risk has been mitigated somewhat by: (1) recreationists making better terrain choices via avalanche bulletins and via training on how to read and travel through avalanche terrain; and (2) recreationists rescuing those caught in an avalanche if one does occur.

Our interest is in rescue, and in particular how recreationists learn the rescue protocol. Use of avalanche transceivers and other rescue equipment has been shown to reduce avalanche fatalities by reducing the search time required for locating and recovering a buried recreationist. In an avalanche involvement, partners in a backcountry travel group become the de facto rescue team, and must perform an efficient rescue with the tools immediately available in a practice called *avalanche companion rescue.*

* *Corresponding author address:*
Audrey Desjardins, School of Interactive Arts + Technology, Simon Fraser University, Surrey, British Columbia, Canada.
email: adesjard@sfu.ca

Avalanche companion rescue is often learned via classes, but recreationists need to continue practicing in order to remember the rescue protocol and to be able to use the equipment appropriately in the case of an emergency. While recreationists can practice on their own with their own equipment, wireless avalanche beacon training parks (or *beacon park* for short) are specifically designed to support avalanche companion rescue practice and training[1].

An avalanche beacon training park is a practice field containing pre-installed avalanche beacons (Christie 2004). They are usually located in advertised and signed areas at ski hills or at trailheads in backcountry locales (Fig 1c). A beacon park typically comprises 8 to 16 *practice beacons* that emit the same radio signal (457 Hz) as normal avalanche beacons. Beacons are usually protected in a waterproof case, and screwed to a 50 cm^2 plywood sheet (Fig 1a) that simulates the victim's surface area when probing. Beacons can be buried under the snow at the beginning of the season, with their depth varying over time with the snowpack. A beacon park can also be installed temporarily, such as for an event.

[1] We assume readers are familiar with the companion rescue protocol as offered in avalanche literature and safety courses.

Figure 1. a) Practice beacon in waterproof case on plywood. b) Beacon park control box. c) Beacon park area.

Beacon parks include a *control box* (Fig 1b) controlling the operation of the practice beacons.

To use the beacon park, recreationists arrive on site with their own beacons. They turn on one or more practice beacons through the control box. Following portions of the companion rescue protocol, they typically use their personal beacons to do the coarse and fine search towards one signal at a time, and then use their probes to detect the plywood holding the practice beacon through the snow.

In this paper[2] we present a study that observes beacon park use. Based on those observations, we offer suggestions on how beacon parks can better support multiple aspects of companion rescue training for backcountry travelers—including individual skill development and team coordination. In the next sections we present the methods for our study, our findings regarding how participants currently use the beacon park, and our reflections on how to best set up and maintain a beacon park in order to improve training.

2. OUR STUDY

Our study took place in a dedicated area at Mount Baker Ski Area in Washington, U.S.A. Our study comprised 2 parts: 1) an observational study with interviews of participants using the beacon park; and 2) a reflection on our own practice of installing and modifying the beacon park in response to what we observed. As the two parts of the study happened simultaneously and influenced each other, we continuously evolved and refined our research questions. Two of the authors, an interaction design researcher (also newly a backcountry skier) and a professional avalanche education specialist were on site to install and maintain the wireless beacon park. They conducted the study one day per weekend over four weeks. The education specialist served a dual role, where he acted as both as an observer and as a facilitator for those asking for help.

With this study, we ask:

- How do recreationists use beacon parks for both skill development and team coordination?
- What are the best practices to set up and maintain a wireless beacon park to support backcountry recreationists?

2.1 *Part I: Observational study and interviews*

Part I of the study focused on our first research question. Observational data was gathered with the goal of constructing a detailed portrait of how recreationists used the Mount Baker beacon park somewhat 'in the wild': they were allowed to pursue their own activities, but had the option of using an on-site expert as a resource.

Participants. We recruited participants by advertising the opportunity to practice avalanche companion rescue in a beacon park, with the option of participating in a study. We advertised on online sports-related forums, through sports equipment shops' social media, with print ads in the local community, and on the Mount Baker ski area's website. We had 22 participants (5 female, 17 male). 12 were related to the Mount Baker ski area and 10 from the general public. We had 10 participants that came individually, 3 teams of 2, and 2 teams of 3. 10 had never used a beacon park, while the rest had used them at other ski resorts. There was a broad range of backcountry ski experience, from no experience to 16 years of experience. All had at least several years of resort skiing experience. We note that downhill skiing expertise did not necessarily correlate with backcountry experience or companion rescue expertise. For example, several volunteer ski patrollers participating in the study did not

[2] A longer version of this study was presented to a human-computer interaction community in (Desjardins et al. 2016).

routinely go backcountry skiing, and had limited companion rescue training (if at all).

Tasks. Participants came to the tent (Fig 1c), where we introduced a particular avalanche rescue scenario. They would then do a scenario, usually returning to the tent afterwards for the next scenario. The facilitator would offer his expertise to participants (perhaps after observing participants or on participants' request), where he would offer tips, comments and even help them through particular scenarios. Otherwise, we let the participants use the beacon park in the way they wanted to keep the ecological validity of the study. We invited participants to perform as many rescues as they wanted. If participants had come alone, we let them use it by themselves. If they had come as a group, we suggested that they perform practices as a team.

Data Collection. We conducted a pre-activity questionnaire to gather information about each participant's motivation for using the beacon park, and their level of expertise in skiing, companion rescue, and beacon parks.

As the participants used the beacon park, we shadowed them and observed their actions. We also asked them to describe what they were thinking as they were doing their practice rescues (a technique called 'think-aloud'). One researcher followed them and took hand written notes. We also filmed the participants for the length of the search with a GoPro camera. We wrote a report for each participant summarizing our observations on how they performed the rescues, how they used the beacon, how they collaborated with others, and how they modified their strategies of search from one scenario to another.

Finally, we conducted post-activity semi-structured interviews with those participants who were willing (9 in total). The interview questions focused on participants' experience of the beacon park, (including positive and challenging aspects of practice, the development of skills, and the practice of coordination) and on how beacons and beacon parks could be designed in the future.

2.2 *Part II: Reflections on maintaining a beacon park*

Part II of the study focused on our second research question where we reflected on the design strategies we used to install and maintain the beacon park, and the changes we made to our installation over the course of the study based on our observations in Part I.

Installing and Maintaining the Beacon Park. For each day on site, we created a series of scenarios. For each, we positioned and buried each practice beacon to create a variety of scenarios for participants. Each scenario used bamboo poles to indicate the start and end of the simulated avalanche path. Scenarios ranged in expected difficulty. The simplest were those simulating a single burial. More difficult scenarios simulated two victims located at various distances from one another. Multiple burials make it more difficult to locate a signal (due to multiple beacon signals), added coordination complexity, and increased stress due to the greater number of victims for the same survivable amount of time. For each day, we used insights gathered from the previous study day to modify the beacon park setup.

Data Collection. The two on-site authors debriefed each other at the end of each study day. Through a written report, they recorded what they had observed in relation to the organization of the beacon park, the way the scenes were installed, the way information was communicated to participants, and impressions for what worked well and what needed adjustment. We took photos of the training scenes and our installation.

3. RESULTS: USAGES OF THE BEACON PARK

We first present our findings about the different ways participants used the beacon park to practice avalanche companion rescue.

3.1 *Individual skill development in context*

The beacon park was commonly used by participants to practice individual skills with their beacons. We observed a necessary progression starting with an individual's familiarization with the technological aspects of the beacon and its functions, learning how to use that beacon in the context of the simulated search, and then to a mastery of particular rescue skills.

For some participants (e.g. P1, P13, P15b)[3], the beacon park was their first experience with a beacon and with the avalanche companion rescue protocol. Their learning largely revolved around transceiver basics: how to turn the beacon on, how to switch between transmit and receive modes, and how to read the signals as one moved

[3] Participants who came alone are referred to as P#. Participants who came as a group are referred to as P#a, P#b and P#c, with same #.

over the terrain. Even experienced people practiced with their beacon. For example, the beacon park was seen as a good place to get to know new equipment, as functions and modes often differ between beacons. The beacon park also served as a catalyst for participants to become aware of technical or logistical issues with their equipment such as the lack of recharged batteries for example (P4).

Beyond familiarization with the beacon, participants used the beacon park to master certain skills. For example, couple P11a and P11b pushed each other to get the fastest times on the single burial scenarios. While one was performing the rescue, the other timed the rescue. This provided an additional stress simulating a more realist rescue scene.

In addition to focusing on the technology (at least initially), participants were also interested in acquiring skills about using that technology within the context of an actual search. As P3c said: "*It's not just about turning the beacon on, but about the way to do the rescue too*". For instance, participants P3b, P5 and P10c all mentioned that they wanted to use the beacon park specifically as a way to become more proficient in the context of multiple burial scenarios. In their case, they used the simpler scenarios (single burials) as a warm up exercise before engaging with the scenarios they wanted to gain more experience with.

It was interesting to note that almost half of our participants came alone to the beacon park. Participants came on their own for a multitude of reasons: they are new to backcountry skiing and are looking for a group to go with (e.g. P1), they had some free time between ski runs by themselves (e.g. P8), or they wanted to focus practice on their device (e.g. P13). Some of them were aware of the potential to practice as a group, while others were not. But in any case, all found great value in using the beacon park and in practicing individual skill development with beacons in the built in scenarios.

3.2 Team coordination training

Coordination is one of the hardest aspects of avalanche companion rescue, and thus one of the areas with the most opportunities for improvement. In our discussions with participants, they were enthusiastic at the idea of practicing as a team:

"*I think that a group setting is more effective, and more fun than training alone. It is rare, or at least unwise, to travel in the backcountry alone, so training with other people seems to make sense. Also, communication is often overlooked, so working it with other forms of practice, or training is a good idea*." (P13)

Yet this enthusiasm was not reflected in reality. Although most participants agreed that coordination and communication were highly important for the success of companion rescue, only 6 out of 22 reported to have practiced team coordination in the last year. In addition, as we will show below, practicing coordination did not come intuitively to various participants.

Coordination: beyond the beacon

One of the main challenges we observed in the beacon park was to move beyond understanding the beacon technology, i.e., to gain a larger perspective of the situation. When teams arrived on scene, we seldom saw overt discussions about roles or strategies for the rescue they were about to perform. Instead, we saw participants focusing on the beacon technology rather than team coordination, and on the details of their search rather than the big picture of what was going on. This lack of communication often continued as the search progressed.

For example, the team of P3a, P3b and P3c began their search by finding the first signal and focusing on it. As the three participants started to do a fine search on the first signal, they were too close together. P3a and P3b were in the way of P3c who was trying to narrow the probing area. Not only was this sub-optimal, but it also meant that no one was searching for the second victim. This could have easily been prevented by simple and short communication between the participants, e.g. 'I'll finish this search, P3b get your probe out, and P3c start the coarse search for the second victim'. Similarly, had a leader been selected, their role would have included identifying and remedying issues such as these.

After observing the above situation, the facilitator debriefed these points with the participants. The participants then moved to the second multiple burial scenario and were encouraged to work more closely as a team and specifically to communicate better. They agreed that communication was important and that they should plan differently for the next scenario. However, in practice and even with the proper intentions of the participants, communication was lacking. Participants still showed signs of working individually instead of as a team. In fact, it seemed that the participants were still very much focused

on understanding their own beacons and that most of their attention remained on the technology rather than the teamwork. This finding reveals that coordination and communication may not come easily, and that considerable practice is required to achieve a level of team coordination proficiency.

As a contrasting example to the previous case, the team of P10a, P10b, and P10c (who had never performed a rescue together) had much better communication and were able to coordinate on the scene. At the entrance of the scenario, P10c proposed to his teammates to split the avalanche path into search paths for each of them. As they walked down the hill, P10c reached the first victim. P10a and P10b got closer to him as well, as their beacons also indicated that direction. While P10b got ready to help P10c by probing, P10a recognized that he was not needed there and walked past them to search and find the second victim. In this case, the team was able to monitor each other's actions and fluidly take the roles that were the best for the team's success.

3.3 Breaking the false sense of confidence

In previous research, it was pointed out that practice that is too simple or too easy can lead to a false sense of confidence for backcountry recreationists (Desjardins et al. 2014). In this study, we found that the way the scenarios were organized in the beacon park and the variety of their expected difficulty could help break that false sense of confidence for participants. This allowed them to realize the complexity and challenges that are part of some avalanche accidents and served as a confirmation that practicing is important for avalanche preparedness.

We often observed the following pattern. Participants who began with a sequence of single burial scenarios became faster and more efficient at finding the single victim. This boosted their sense of confidence about their ability to perform successful rescues. When participants moved to more challenging scenarios, such as a coarse search on a multiple burial scene, difficulty increased significantly, for example because they encountered confusing indications on beacon signals, and because more team coordination was required. In these cases, we saw some participants able to find a first victim but not the second one. In other cases, participants could find both victims but took a much longer time relative to the single burial scenarios. In most cases, the harder scenarios shook the participants' confidence and trust in their beacon.

One issue appears to be that participants – particularly those with less experience – had an incorrect view of the accuracy, precision and robustness of their beacon technology. Beacons have significant problems with the multiple signals received in a multiple burial scenario. They do not always display competing signals in an understandable manner. For example, some beacons alternate distance numbers between the two victims, which some found confusing (e.g. P1), while others fix onto one signal while hiding the other. Beacons sometimes lose the signal due to the rapid movements of a searcher. In other beacons, the screen can even go black. Some beacons try to simplify searching by allowing the search to hide a particular signal (called 'marking'), yet this is considered an advanced feature and introduces further problems. A beacon may even have to be turned off and on again to reacquire a lost signal (e.g. P5). These events are, of course, stressful (as reported by various participants) as this is often the first time they have seen their beacon act like this. Their confidence is shaken, and their mental model of the technology is broken. It is only through practice, repetition and mentoring that participants were able to make sense of the nuances of their beacon and of those signals, where they could eventually perform rescues more successfully.

A sequence of progressively more difficult scenarios helps mitigate this loss of confidence. Although harder scenarios were more challenging, participants appreciated the opportunity to sharpen their skills. As P15a suggested: "*Keep the progression of difficulty going. Maybe also add a 3 person burial scenario, something even more complex*". Our decision to seed the beacon park with multiple scenarios representing different levels of difficulty thus proved important. Scenarios of similar difficulty allowed people to return and practice their skills. Advancing to the next level gave them opportunity to tackle more complex situations, which forced them to acquire a higher skill level (which they appreciated) and increased confidence.

4. RESULTS: SETTING A BEACON PARK

An important component of how a beacon park is experienced relies on its set up on the terrain and how it is presented to recreationists. In this work, we evolved the beacon park set up over our study period. Based on our observations and self-reflections about our practices, we now share the varied decisions we made about this technological training ground, and how it influenced participants'

ability to practice and develop their skills and team coordination practices.

4.1 Physical constraints in the beacon park

The beacon park is a technology-augmented context for training, where it should be designed to mimic real-life threat situations. This implies a combination of two things: real life elements as reflected in the terrain; and the technology itself.

Ideally, we wanted terrain that was on a steep slope resembling an avalanche slope. However, this desire had to be balanced against how accessible the beacon park would be for participants, and the constraints imposed by the terrain the ski resort management provided for us to use. The somewhat flat terrain we used (which is true of most beacon parks) did not match a typical avalanche slope. As well, the snow quality differed from the varied snow that could result from an avalanche. In addition, the trampled ground of a beacon park does not visually resemble a real avalanche, which rescuers would normally scan for visual cues to determine the avalanche path and the debris zone. Finally, the beacon burial depth was constrained by the shallow snow depth during the study.

4.2 Scenarios require explicit communication of their details

Because there is no real avalanche, details of scenarios have to be explicitly communicated to the participants. This includes where the scenarios are located and the number of victims. In our study, the facilitator verbally explained each scenario to the participants, and bamboo poles marking the top and bottom of the imagined avalanche zone served as visual cues. Although participants were generally able to imagine the avalanche path and the debris zone, others found that more challenging. For example, P10a mentioned: "*The run out zone (or where the debris would be) requires a lot of imagination on my part, maybe this could be improved.*" (P10a). We see opportunities for imagining alternative ways of communicating these scenarios to participants.

Beacon park flexibility

While we had to adjust to the physical constraints of the terrain, the beacon park system is very simple—a set of buried beacons that can individually be turned on or off—which makes it highly configurable in terms of constructing scenarios for different learning situations, e.g., how people navigated through the park, how they configured it for single or multiple burials, how different skills could be practiced, and how more structured teaching can be layered atop of it.

Through our observations, we saw how the beacon park was sometimes seen as this flexible platform supporting a variety of learning activities. We observed various teaching strategies both between the facilitator and participants, and between participants. More experienced participants in a group would teach the less experienced participant basic skills. For example, P16a (who had companion rescue experience) used the beacon park as a place to show his girlfriend (P16b) the basic search movements during the coarse and fine search, including how one should respond to the signal seen in the beacon. In the example of P11a and P11b timing each other, we see how certain exercises could be created ad hoc in the technological setting of the beacon park without the need of external facilitation or suggestion. In addition, in 2016, the same beacon park was used to create side by side races to encourage healthy competition between participants during the Baker Beacon Rally event.

4.3 The role of the facilitator

In our study, many of our participants were novices and needed some orientation for how to use the beacon park. The first role of our facilitator was to introduce the park and how to best use it, including what scenarios to do, in what order, and where scenarios are physically located. As participants pursued scenarios, the facilitator answered many questions, ranging from specific questions about advanced functions on beacons to deeper understanding of rescue strategies. Finally, we found that participants appreciated debrief sessions or feedback from the facilitator. Once a scenario was completed, the facilitator summarized his observations and asked participants to describe what they saw, how they felt and how they think things could have been better. Through this discussion, the facilitator encouraged the participants to realize what they could do differently. Those conversations often led to improvement in the next scenario performed. For example, with the couple P11a and P11b, the facilitator explained a specific strategy for probing that is particularly efficient with two rescuers; a strategy they tried and found successful in the next scenario. Participants recognized the value of the facilitator: "*Having [the beacon park] staffed also really helped, because when you have someone teach you, this makes a large difference*." (P10c)

The presence of a facilitator was very significant for an effective use of the park. However, staffed beacon parks are not the norm. Yet without the facilitator, people could easily develop poor practices that limits how they perform companion rescue during a real avalanche.

5. DISCUSSION

Our results provide insights into particular changes that can make beacon parks more efficient, more inviting and more tailored to the training of backcountry recreationists. We know summarize insights on how to best use, set up and maintain a beacon park for backcountry recreationists.

5.1 The value of progressive scales of difficulty

We saw significant value in using progressive scales of difficulty in beacon park scenarios. The facilitator encouraged participants to follow a progression, where he suggested to do simple single burial scenarios first until they mastered their basic skills, and only then to make their way to the complex multiple burials. While solidifying basic skills increased self-assurance, the complexity progression of the scenarios also helped break the false sense of confidence. We saw how more complex scenarios provided a space to ask questions, reflect on more difficult situations, understand device and personal limitations, and overall provide a sense for how hard companion rescue could be. Learning is influenced by the progression of scenarios, by practicing in context even if simulated, and (sometimes) by team mentoring.

In general, beacon parks are offered as environments where people attempt to learn on their own and in an ad-hoc manner. We believe these training grounds can be improved dramatically by offering scenarios of increasing difficulty (as we did), by explicitly describing skills that should be mastered at that level, and by offering a way for learners to 'grade' themselves in terms of mastering a scenario level. We also suggest that this information should be communicated to recreationists in ways that are appropriate to the outdoor physical context. For example, we advise using weather resistant posters to describe scenarios, potentially augmented by digital material (accessible via a mobile device) to describe best practices and learning goals.

5.2 A variety of levels of fidelity

A beacon park includes a variety of levels of fidelity along the three aspects of environment, equipment and psychology (Beaubien and Baker 2004). Throughout our results we have articulated how certain aspects could reach a higher level of fidelity while others could not. For beacon parks, the level of environmental fidelity is difficult to manage, for it is heavily constrained by the terrain available. If varied terrain is available, areas should be chosen to match the scenario conditions (e.g. steepness of the slope, the presence of terrain traps, etc.). However, the level of fidelity for equipment is under our control. As we saw, signals from buried beacons are indistinguishable from real beacons, and we expect learners to bring in their own personal equipment including their personal beacons.

The low level of environmental fidelity can be partially remedied by manipulating the psychological level of fidelity, i.e., the ways participants construct believable stories for themselves about the rescue situation. This is especially important for practicing team collaboration (Beaubien and Baker 2004). In our study, this was done by constructing scenarios that included a story of how the avalanche happened, using buried beacons to represent victims, and by visually marking areas in the environment to simulate environmental conditions (e.g., bamboo poles indicating avalanche boundaries). We saw that participants were largely able to construct the story in their minds and reach a higher level of psychological fidelity. The novelty of each scenario added to their believability since others created the scenarios. In addition, we could manipulate people's stress (e.g., by observing, timing and critiquing people's rescue performance), which proved effective in increasing the level of psychological fidelity.

5.3 Balancing skill development & coordination training

We saw a large number of participants focus on learning individual skills at the cost of communication and coordination training. This likely occurs because, at the surface level, the beacon park emphasizes the technology itself (beacon search), whereas the need for communication and coordination learning is tacit and thus easily overlooked.

The solution is, in part, to make communication and coordination learning an explicit activity. Toups et al. (2011) argued for focusing solely on distributed cognition and team coordination training, both for economical and focus reasons.

The scenarios and learning descriptions mentioned earlier should include these not only as goals to incrementally master, but should describe the steps on how to achieve them. If individuals (rather than teams) appear on site, the usage descriptions of the area should highly encourage them to find other like-minded people to do the exercises together. Perhaps meeting times can be advertised as a way for ad hoc groups to gather opportunistically. This solution, of course, will show better results if participants are familiar with the technology required before and can focus on the coordination training rather than mastering their own device.

5.4 Supporting the community of practice

In our study, we also observed that learning from others within beacon parks is not as common as it could be. As with communication and coordination, this is also likely due to the emphasis on the technology, which seemingly favors individual skill development over team learning.

A partial solution recasts the technological training ground in a way that encourages mentorship and facilitation within the community. Since scenarios can be structured and ready to use, members of the community can go straight to the heart of the topic without spending a whole day preparing the site, which was identified as a challenge in previous research on avalanche companion rescue (Christie 2004). Importantly, beacon parks can be designed as a common space where members of the community can group and build relationships between each other, which create opportunities for more knowledge exchanges.

For example, beacon parks could be presented and advertised as an area inviting people with more skills to teach novices particular skills. For instance, when a person has mastered a particular scenario difficulty and skill, they could be encouraged to mentor others going through simpler scenarios. The payback is that people often gain even more mastery by teaching. In addition, a beacon park can advertise particular times as a 'meet and greet' event for like-minded people to learn, socialize, and meet potential backcountry partners. Finally, many high-risk communities of practice encourage skill development through competition (e.g., mountain bike racing, competitive rock climbing). The beacon park can be offered as a place for holding competitions, where teams 'race' against each other, while practicing rescue skills.

6. CONCLUSION

In summary, we articulated how avalanche beacon training parks can be used both for individual skill development as well as team coordination practice. We also encourage the ISSW community to reflect on and apply our findings regarding the importance of progressive scales of difficulty; the management of different levels of fidelity; the balance between skill development and team coordination training; and strategies for supporting a community of practice.

CONFLICT OF INTEREST

The creation of this document was not supported financially or materially by the ISSW. None of the authors benefit financially from the production or sale of ISSW proceedings nor have they received any related grants or patents.

ACKNOWLEDGEMENTS

We thank BCA for providing the beacon park equipment, Mount Baker Ski Area, and all our participants. This research was funded in part by SSHRC, the NSERC Discovery Grant and by the AITF / Smart Industrial Chair in Interactive Technologies.

REFERENCES

Beaubien, J. M., and D. P. Baker, 2004: The use of simulation for training teamwork skills in health care: how low can you go? *Qual. Saf. Health Care*, **13**, i51–i56, doi:10.1136/qshc.2004.009845.

Christie, S., 2004: Transceiver Training Parks: Shortening the Beacon Learning Curve. *Proc. 2004 Int. Snow Sci. Workshop Jackson Hole Wyo.*, 351–354.

Desjardins, A., C. Neustaedter, S. Greenberg, and R. Wakkary, 2014: Collaboration Surrounding Beacon Use During Companion Avalanche Rescue. *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*, *CSCW '14*, New York, NY, USA, ACM, 877–887 http://doi.acm.org.proxy.lib.sfu.ca/10.1145/2531602.2531684 (Accessed January 19, 2015).

——, S. Greenberg, R. Wakkary, and J. Hambelton, 2016: Avalanche Beacon Parks: Skill Development and Group Coordination in a Technological Training Ground. *CSCW 2016*, 872–886 http://summit.sfu.ca/system/files/iritems1/16186/AvalancheBeaconPark-AUTHOR_PROOF-Oct7.pdf (Accessed October 26, 2015).

Toups, Z. O., A. Kerne, W. A. Hamilton, and N. Shahzad, 2011: Zero-fidelity Simulation of Fire Emergency Response: Improving Team Coordination Learning. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *CHI '11*, New York, NY, USA, ACM, 1959–1968 http://doi.acm.org.proxy.lib.sfu.ca/10.1145/1978942.1979226 (Accessed April 13, 2015).