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"To use or not to use" understanding mountaineers' smartphone use in high-alpine environments

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ABSTRACT

As smartphone use continues to become more embedded within daily life, identifying the factors driving their use in extreme environments may have numerous meaningful implications. Little is currently known about mountaineers' intentions to use smartphones in high-alpine environments. Therefore, the purpose of this study was to examine the extent to which attitude, subjective norm, and perceived behavioral control predicted mountaineers' intentions to use smartphones in high-alpine environments. A sample of 167 mountaineers from 37 countries completed a brief questionnaire about their intentions to use smartphones during their next high-alpine expedition. A series of multiple regression analyses were used to determine the salient beliefs influencing mountaineers' smartphone use in high-alpine environments. The study findings provide a better understanding of the potential factors driving mountaineers' use of smartphones. More broadly, these findings add to the growing body of literature regarding smartphone use in extreme environments.

KEYWORDS

Mountaineering; outdoor recreation; smartphones; technology; theory of planned behavior

Introduction

Smartphone use has become a pervasive component of everyday living. For many people, the use of these devices plays an integral role not only as a resource for communication, but also as a means of entertainment, socialization, productivity, and information acquisition. The myriad functions for which a smartphone can serve has resulted in a type of "digital elasticity", whereby the use of such technology has stretched far beyond the boundaries of traditional activities and environments (Pearce, 2011).

Communication technology continues to advance at rapid rates, leading to an increased desire for innovation that has subsequently paved the way for new and improved devices, such as smartphones. The advancement of smartphone technology has grown exponentially in the last decade as it has become a device that is instrumental in many people's lives (Tossell, Kortum, Shepard, Rahmati, & Zhong, 2015). Indeed, these devices have gained popularity because of their increasing affordability and accessibility, among many other reasons (Kearney, Schuck, Burden, & Aubusson, 2012). Rather than providing basic operations, such as calls and text messages, as cellular

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phones once did, smartphones have evolved into handheld computers capable of providing GPS coordinates, predicting weather forecasts, playing music, and keeping appointments and contacts up to date.

Advancement in smartphone technology may have numerous implications for outdoor recreation experiences; however, given their relatively new presence in outdoor recreation pursuits, little research has examined the role that smartphones play in these experiences. For example, data collected by Martin and Blackwell (2016) suggested that smartphones have become the most commonly carried handheld communication and information device by backcountry travelers (29%), followed by GPS (26%), iPod, iTouch, Kindle (20%). Similarly, Whitacre (2018) found that 97% of backcountry snow sport participants in their study said they brought smartphones with them when they recreated in outdoor settings. In another recent study, Amerson, Rose, Lepp, and Dustin (2019) found that 96.7% of their 514 participants used a smartphone during their thru-hike of the Pacific Crest Trail. These studies help demonstrate the pervasiveness of smartphone use in outdoor recreation settings, further substantiating the need to understand the factors influencing the use of these devices by outdoor recreation users.

In addition to their ubiquity, smartphone use may have implications for outdoor recreation users' decision making. For example, Martin and Pope (2012) suggest that the use of technology, such as smartphones, may lead outdoor recreationalists to pursue activities beyond their skill level as a result of a reassessment of the risk involved in the activity. Others have also found that technology (e.g. smartphones) has increased participants' decisions to engage in risky behavior during outdoor recreation pursuits (Whitacre, 2018). For example, Sumann Hochholzer, Faulhaber, & Burtscher (2015) concluded that technology has allowed climbers to take a higher risk in approaching routes even when they lack the necessary physical and mental skills. Aside from influencing decision-making, smartphone use in outdoor settings has already lead to fatal outcomes. For example, Lamba et al. (2016) reported 127 known deaths while taking selfie photos from 2014 to 2016. The implications of smartphone use outdoor settings are expansive and deserve further exploration.

Undoubtedly, the growing use of smartphones may drastically change the way people interact with their environments (Pohl, 2006; Worley, 2011) and while smartphone use in natural settings may afford users numerous benefits, negative consequences may also exist especially for activities in extreme environments, such as high-alpine mountain environments (Ewert & Shultis, 1999; Martin, 2017; Martin & Blackwell, 2016; Pohl, 2006). High-alpine environment activities often consist of glacier travel, cold temperatures, increased exposure to risk, technical climbing abilities, and extended expedition lengths (Linxweiler & Maude, 2017). Despite smartphones' growing prevalence in outdoor recreation, little is currently known about why outdoor recreationalists use these devices in extreme environments. Therefore, there is a need to better understand the factors influencing their use in high-alpine environments.

A useful starting point for examining the factors influencing people's use of smartphones in outdoor settings could be through their intentions to use these devices. A person's intention to perform a behavior directly precedes their performance of the behavior; therefore, understanding mountaineers' intentions to use smartphones in

high-alpine environments may provide insight into the factors influencing their actual use of these devices in this setting (Ajzen, 1991; Miller, 2017).

Through a more robust understanding of the factors influencing behavioral intention, smartphone use in high-alpine environments may be more thoughtfully considered and discussed. This, in turn, may lead to more intentional strategies that land managers, mountaineering guides, educators, and the mountaineering community at large can use to enhance the safety of mountaineers while also integrating this evolving technology into outdoor recreation to enhance users' experiences. However, little is currently known about the factors driving mountaineers' use of smartphones in high-alpine environments. Therefore, the purpose of this study was to examine the factors that predicted mountaineers' intentions to use smartphones in high-alpine environments.

Theoretical framework

The theory of planned behavior may be a useful theoretical framework for examining the factors driving mountaineers' intentions to use smartphones during their next high-alpine expedition. TPB has been applied to a variety of different disciplines, including marketing, technology, recreation, healthcare, and so forth (e.g. Armitage & Conner, 2001; Miller, 2017; Walker, Courneya, & Deng, 2006). TPB is an extension of the theory of reasoned action (TRA), which postulates that individuals' behaviors can be directly predicted and explained by their intention to perform the behavior (Ajzen, 1991). That is, as a person's intention to perform a behavior increases, the likelihood of behavioral performance also increases. TRA and TPB literature consistently demonstrate intentions' ability to predict actual behavior (e.g. Armitage & Conner, 2001; Miller, 2017).

According to the TRA, a person's intentions can be predicted by their attitude and subjective norm regarding the behavior (Ajzen & Fishbein, 1980). A person's attitude focuses on their evaluation of performing the behavior and the resulting outcomes. Subjective norm is a person's perception of others' attitudes toward their performance of the behavior, as well as their motivation to comply to the wishes of these referent others. TRA and TPB literature commonly cites the importance of a person's attitudes and subjective norm in predicting a person's behavior (e.g. Armitage & Conner, 2001).

TPB extends TRA through the addition of perceived behavioral control. A person's perceived behavioral control is made up of their perceived efficacy to perform the behavior, as well as the extent to which they believe performing the behavior is within their control (Ajzen, 1991). A person's efficacy to perform the behavior is heavily influenced by their perception of having adequate skills (Ajzen, 1991). Their control beliefs are heavily dependent on their perception of the behavior being able to be performed by them (Ajzen, 1991).

Each TPB construct can be measured directly; however, certain salient beliefs may provide greater explanation of the beliefs influencing each TPB construct. The composite of these salient beliefs represents the indirect measure of each TPB constructs and should be related to each global TPB construct (direct measures) (Ajzen & Driver, 1991; Ajzen & Fishbein, 1980). The connection between these underlying beliefs and their respective global TPB constructs is a function of the expectancy-value model, which suggests that as the influence of the belief on attitude is dependent on the strength of

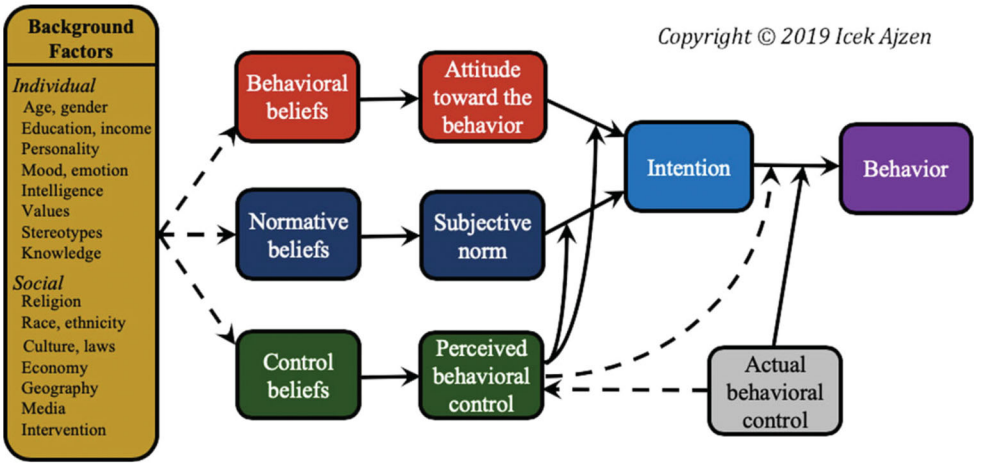

Figure 1. Theory of planned behavior. Used with permission.

the belief (Ajzen, 1991). This relationship between directly and indirectly measured TPB variables allows for a series of analyses with the potential to provide a more robust understanding of the underlying beliefs that influence a person's intention to perform a specific behavior (Ajzen & Driver, 1991). Figure 1 visually demonstrates the relationship between global (direct) and beliefs (indirect) measures of TPB.

Understanding mountaineers' salient beliefs may be a useful approach to better explaining their intentions to use smartphones. For example, a mountaineer's attitude toward using smartphones may be generally positive and attributable to certain *behavioral beliefs* about the outcomes of smartphone use and the likelihood that their use may lead to these outcomes (Ajzen, 1991). These beliefs may be about the different use of these devices, such as communication, photography, or the internet. The influence of this belief about smartphones as a communication device is then dependent on the extent to which the person believes using a smartphone will allow them to communicate with others.

A person's subjective norm is influenced by the set of *normative beliefs* from others and the person's motivation to comply with the beliefs of those important referent others (Ajzen, 1991). For example, mountaineers may look to their close friends and accomplished mountaineers for guidance about when and how to use smartphones in high-alpine environments; however, they may be more likely to comply with the beliefs of one referent more than the other. For example, mountaineers may be more likely to comply with their close friends than accomplished mountaineers, making the overall influence of close friends more critical to their subjective norm of smartphone use than the influence of accomplished mountaineers.

Perceived behavioral control is influenced by certain *control beliefs*. These beliefs are concerned with the extent to which people feel they are capable of performing the behavior and the extent to which people feel performing the behavior is within their control (Ajzen, 1991). For example, mountaineers may hold the belief that smartphone's battery life or network access may prevent them from being able to use these devices in high-alpine environments; however, the influence of each of these beliefs may not be equal, such that mountaineers may be more concerned with battery life than network

access. In this case, mountaineers' perceptions of battery life may more likely be the driver of their perceived behavior control of using these devices.

Before proceeding further, it is important to acknowledge critiques of TPB and the potential limitations of its use in this particular study. A primary critique of TPB is that it presumes that humans make their decisions rationally and linearly (Sniehotta, Presseau, & Araújo-Soares, 2014). While it seems reasonable that this assumption might pose significant issues when applied to more spontaneous behaviors, or behaviors otherwise typically made without much forethought, Ajzen (2015) reassures readers that such a critique misconstrues TPB. Recognizing this critique of TPB, we posit that the decision to bring a piece of gear (i.e. smartphone) on a mountaineering expedition is likely much more intentional, as each piece of gear is often carefully selected for its particular purpose and utility on the expedition (Linxweiler & Maude, 2017). This sort of planning resembles a more rational thought process that might warrant use of TPB.

Another critique of many studies that utilize TPB as a guiding theoretical framework is their reliance on intentions rather than actual behavior (Miller, 2017; Sniehotta, Presseau, & Araújo-Soares, 2014). The use of intention without also measuring behavior may lead to a need to make an inferential leap based on theory. Indeed, taking such an approach means a cross-sectional design that limits the data in ways that prevent certain causal claims to be made about the factors that drive behaviors. While this is certainly a limitation worthy of noting, the study of intentions without behavior can still be instructive. Closely related to a primary assumption of TPB, the use of intentions calls upon a rational decision-making process, that as previously mentioned, likely resembles the well-thought through planning that occurs before a mountaineering expedition. Following this logic, knowing mountaineers' intentions regarding smartphone use may likely be informative of their actual behaviors, and therefore, use of smartphones.

Critics of TPB also cite that most studies using this framework fail to adhere to its theoretical roots and do not connect global measures of TPB constructs to the underlying salient beliefs (Miller, 2017; Symons Downs & Hausenblas, 2001). Ajzen (1991) suggests that without an understanding of these beliefs, TPB may lack significant explanatory power. Further, without knowing these underlying beliefs, efforts to construct useful behavioral change interventions lack the sophistication and complexity that might otherwise be offered by including these measures in data collection. The aforementioned critiques and limitations of TPB provide a handrail from which we considered the design of this study.

Hypotheses

Using TPB as a theoretical framework to guide this investigation, the research team developed a set of hypotheses aimed at testing the theory's global constructs as predictors of a mountaineer's behavioral intention to use a smartphone during his or her next high-alpine expedition. Follow-up analyses involved investigating the influence that specific belief statements had on mountaineers' attitudes, subjective norm perceptions, and perceived behavioral control for the target behavior. Operating with these goals in mind, the study proceeded with the following hypotheses to test each variable's effect on behavioral intention.

Hypothesis 1: Mountaineers' attitudes toward the use of smartphones during a high-alpine expedition will predict their intention to use a smartphone during their next high-alpine expedition.

Hypothesis 2: Mountaineers' evaluation of the subjective norm around the use of smartphones during a high-alpine expedition will predict their intention to use a smartphone during their next high-alpine expedition.

Hypothesis 3: Mountaineers' perceived behavioral control for smartphone use will predict their intention to use a smartphone during their next high-alpine expedition.

Methods

Research design

To address and test each of the stated research hypotheses, the following study was comprised of two study phases. Phase 1 of the study focused on identifying the specific salient beliefs that readily come to mind when a mountaineer thinks about smartphone use on an alpine expedition. The identification of these modal salient beliefs among the population of interest is a necessary and critical first step to the development of a valid TPB questionnaire (Ajzen, 2013; Ajzen & Fishbein, 1980). The research team then used the information garnered in Phase 1 to develop a series of items aimed at measuring both the direct and indirect determinants of a mountaineer's behavioral intention to use or not use a smartphone as part of their next high-alpine expedition (Ajzen, 2013). Direct measurements of each TPB construct were used to assess the effects of each factor at a more general level (Ajzen, 2013). Indirect measurements of each TPB construct allowed for a more nuanced understanding of the salient beliefs driving each TPB construct (Ajzen, 2013). Utilizing a cross-sectional approach, data collected in phase 2 of the study provided the opportunity to examine the predictive capability of both sets of determinants and identify the most salient beliefs underlying a mountaineer's intentions for using a smartphone. Earlier research has shown that belief-based analyses of this type can offer more explanatory value in understanding the intention behind a given behavior (Leeuw, Valois, Ajzen, & Schmidt, 2015).

Phase 1

Prior to creating a TPB questionnaire that could be widely administered, the research team conducted an elicitation study in order to garner insight into the salient beliefs that mountaineers hold about smartphone use on high-alpine expeditions. Although not always employed in TPB research (Symons Downs & Hausenblas, 2001), elicitation studies play an important role in helping to ensure that belief statements are not subjectively or intuitively selected but rather derived from the targeted research population (Ajzen, 1991). Participants of the elicitation study comprised 31 mountaineers (64.5% male) from 12 countries. Participants reflected a broad demographic both in terms of age ($M = 38$, 26–62 years) and experience ($M = 16$, 4–45 years). The recruitment of participants for this study phase occurred through targeted social media posts on

multiple sites to invite mountaineers to provide answers to a series of open-ended questions about their use or nonuse of smartphones during high-alpine expeditions.

Open-ended questions specifically sought to understand the behavioral, normative, and control beliefs of the targeted behavior. With that aim in mind, the research team asked respondents to identify what they perceived as the advantages and disadvantages of using a smartphone as part of their next high-alpine expedition. To determine the salient normative beliefs, participating mountaineers responded to questions that asked them to distinguish between what groups of people might approve or disapprove of the use of a smartphone during a high-alpine expedition. The final component of the elicitation study examined control beliefs. The research team asked participants to identify factors that they believed facilitated the use or nonuse of smartphones during a high-alpine expedition. In accordance with previous research practices (e.g. Ajzen & Fishbein, 1980; Cheung, Chan, & Wong, 1999; Francis et al., 2004), the research team content analyzed, coded, and categorized submitted responses into themes aligning with the theoretical constructs of TPB. Those beliefs mentioned more frequently and ranking in the upper 75% of all beliefs elicited were selected and developed into belief items for phase two of the study.

Elicitation study results indicated that a majority of the mountaineers surveyed in this phase used smartphones during high-alpine expeditions and highlighted the overall multipurpose aspect of these devices as important to their use. More specifically, participants said they used smartphones to take photographs, to communicate with others, as a basic GPS device, and for safety. Study participants perceived most other mountaineers as having favorable attitudes toward smartphone use in high-alpine environments, with the exception of more traditional climbers who were described as being resistant to the use of this type of technology. The results revealed that bad weather, battery life, and network access were barriers to smartphone use in high-alpine environments. These results were used to guide item development of the instrument used in the second phase of the study.

Phase 2

The recruitment of participants for phase two of the study occurred through purposive sampling. Utilizing social media websites and international online mountaineering forums frequented by mountaineers, prospective study participants received an invitation to complete an online questionnaire about their use or nonuse of smartphones during a high-alpine expedition. To obtain a sample of mountaineers who frequently participated in the sport, criteria for inclusion in the study involved using only data from those participants who self-identified as high-alpine mountaineers and who planned to go on another expedition in the next year. A total of 167 mountaineers fully completed the questionnaire after accounting for questionnaires that contained missing data and removal of outliers. Those mountaineers who completed the questionnaire in its entirety represented 37 countries, were predominantly male ($n = 128$), varied in age ($M = 38$, 18–70 years old), and represented a range of mountaineering experience ($M = 12.6$, 1–50 years).

As highlighted previously, the research team developed a close-ended questionnaire representing each of the theoretical constructs based on responses from the elicitation

study in phase 1. Items included in the TPB questionnaire revolved around a specific behavior: the use of smartphones during a high-alpine expedition. A description of each measure included in the TPB questionnaire appears below.

1. User intention (UI). Evaluations of participants' intention to use a smartphone on their next high alpine expedition occurred using three items. Each item aimed to measure a participant's expectation to perform the target behavior (i.e. I want to use a smartphone during my next high-alpine expedition). Participants provided response ratings ranging from 1 to 7 (Strongly Disagree – Strongly Agree). The composite score for the three items served as the direct measure for UI. Cronbach's reliability estimates indicated acceptable internal consistency ($\alpha = 0.90$).
2. Attitude toward smartphone use (ATT). The evaluation of participants' attitude toward the target behavior involved asking participants to rate the behavior on four 7-point semantic differential scales (i.e. For me, using a smartphone during my next high-alpine expedition would be …). Polar adjectives used for the scale included: Bad-Good, Right thing to do-Wrong thing to do, Useful-Worthless, and Unsafe-Safe. The composite score for the four items served as the direct measure for ATT. Cronbach's reliability estimates indicated acceptable internal consistency ($\alpha = 0.89$).
3. Subjective norm (SN). The research team used a single-item measure to evaluate the normative pressures mountaineers perceived for the target behavior. Although not without limitations, the use of a single item measure to assess the global pressures around a given behavior is evident within much of the TPB literature (Ajzen & Fishbein, 1980; Armitage & Conner, 2001). Response ratings ranged from 1 to 7 (Strongly Disagree to Strongly Agree). Participant ratings served as a reflective indicator of the injunctive norm of the target behavior (i.e. Most people important to me think I "should/should not" use a smartphone during my next high-alpine expedition).
4. Perceived Behavioral Control (PBC). To evaluate PBC, participants provided response ratings to four statements aimed at understanding the extent to which a mountaineer perceived the ease or difficulty of using a smartphone while on a high alpine expedition (i.e. Using a smartphone during my next alpine expedition is possible). Response ratings ranged from 1 to 7 (Strongly Disagree to Strongly Agree). The composite score for the four items served as the direct measure for PBC. Cronbach's reliability estimates indicated acceptable internal consistency ($\alpha = 0.73$).
5. Indirect Measure of Attitude (IA) – Assessing the indirect measure of a mountaineer's attitude toward the target behavior involved multiplying responses from 5 behavioral belief items with corresponding responses from 5 evaluations of outcome items. For each set of paired items, responses ranged from 1 to 7 with the product of the two serving as a single datum. For example, the research team multiplied a participant's response to "using a smartphone during my next high alpine expedition will help me navigate" (Extremely Unlikely to Extremely Likely) with "for me to have assistance navigating during my next high-alpine

expedition is" (Extremely Unimportant to Extremely Important). The sum of the products represented the overall indirect measure of a participants' attitude toward using a smartphone during their next high-alpine expedition.

6. Indirect Measure of Subjective Norm (ISN). For the indirect measure of subjective norm, the research team multiplied corresponding responses from the 3 normative belief items with responses from the 3 motivation to comply items. For each set of paired items, responses ranged from 1 to 7 with the product of the two serving as a single datum. For example, the research team multiplied a participant's response to "other mountaineers like me (Do not use/Use) smartphones during their expedition" with "doing what other mountaineers like me do is important for me" (Strongly Disagree/Strongly Agree). The sum of the products represented the overall indirect measure for the subjective norm perceived by participants for the use of a smartphone during their next high-alpine expedition.
7. Indirect Measure of Perceived Behavior Control (IPBC). To estimate the indirect measure of perceived behavioral control, the research team multiplied responses from 3 control belief items with corresponding responses from 3 perceived power belief items. For each set of paired items, responses ranged from 1 to 7 with the product of the two serving as a single datum. For example, the research team multiplied a participant's response to "my smartphone's battery life will keep me from using it during my next high-alpine expedition" (Unlikely/Likely) with "when my smartphone's battery runs low I am (Less Likely/More Likely) to use my smartphone during my next high-alpine expedition." The sum of the products represented the overall indirect measure of participants' perceived behavioral control for their use of a smartphone during their next high-alpine expedition.

The initial analysis focused on examining the means and correlations for each of the major constructs in the TPB model. This approach to data analysis accomplished two goals. First, the examination of means provided an opportunity to evaluate the shape and distribution for each of the TPB constructs. Second, by understanding the relationship between each of the direct measures and user intention, the research team was able to determine which TPB factors influenced intention (Ajzen, 1991; Ajzen & Fishbein, 1980). Hypothesis testing and subsequent follow-up analyses occurred systematically. That is, the research team first focused on understanding the predictive capability that the global constructs of TPB (ATT, SN, and PBC) had on mountaineers' composite intention score for the target behavior. As a statistical technique, multiple regression has served as both a common and valuable way to model and test the TPB (Hankins, French, & Horne, 2000). Based on previous research practices, the research team then carried out a series of regression analyses among only those direct measures found to significantly predict mountaineers' intention (Ajzen & Fishbein, 1980). These analyses were intended to examine the extent to which behavioral, normative, and control beliefs (indirect measures) predicted scores on the direct measures and constructs of TPB. Belief-based analyses of this sort have positioned researchers to gain insight into the specific psychosocial and cognitive determinants underlying a given behavior (Ajzen & Fishbein, 1980; Symons Downs & Hausenblas, 2001).

Results

Descriptive statistics

Prior to hypothesis testing, descriptive statistics were examined to understand the shape of the data and the means for all variables of interest. Examination of sample means for TPB variables revealed that mountaineers had strong intentions to use smartphones on their next high-alpine expedition. Directly measured TPB variable mean scores can be found in Table 1.

Hypothesis testing

To test the study hypotheses, assumptions for multiple regression analyses were tested. Several univariate and multivariate outliers were discovered using box plots and Mahalanobis distance values. These outliers were determined to be inappropriate cases for the sample or resulted from incorrect data entry and were removed from the data before further analyses were conducted. Inspection of histograms revealed normality of regression residuals. Homoscedasticity was determined through inspection of residual scatter plots. Pearson's product moment correlation analysis was conducted to determine if significant relationships existed between the directly measured TPB variables and the behavioral intention variable. Results revealed statistically significant relationships ($r = 0.455–0.824$, $p < .001$) between intention and the directly measured TPB variables. Significant relationships also existed between all TPB variables (see Table 2). VIF statistics did not indicate multicollinearity between relevant variables (see Table 3).

Once significant relationships between TPB variables were established, a multiple regression analysis was used to determine the extent to which directly measured attitudes, subjective norm, and perceived behavioral control variables predicted mountaineers' intentions to use smartphones during their next high-alpine expeditions. Overall, directly measured TPB variables explained 71% of the variance in intentions ($R^2 = 0.711$, F (3,163)=133.490, $p < .001$) to use smartphones during their next high-alpine expeditions. Interpretation of variable beta weights suggested that attitudes and perceived behavioral control were statistically significant contributors to the effect. See Table 3 for the complete regression model.

Next, Pearson's product moment correlation analysis was conducted to determine if a statistically significant relationship existed between belief variables and their corresponding directly measured TPB factors. There were statistically significant relationships between the direct measures and indirect measures (belief variables): attitude ($r = 0.511$, $p < .001$) and perceived behavioral control ($r = 0.382$, $p < .001$). Once statistically significant relationships were established, additional multiple regressions were conducted to determine if the indirect measures predicted the direct measures. The indirect attitude

Table 1. Descriptive statistics for directly measured TPB factors.

Variable	Mean	Standard deviation
User intention	5.53	1.75
Attitude	5.61	1.41
Subjective norms	5.53	1.52
Perceived behavioral control	5.57	1.27

Table 2. Pearson product moment correlations for TPB factors.

Variable	UI	ATT	SN
User intention (UI)			
Attitude (ATT)	0.824*		
Subjective norm (SN)	0.455*	0.525*	
Perceived behavioral control (PBC)	0.715*	0.718*	0.426*

Note. *Indicates statistical significance at $p < .01$.

Table 3. Multiple linear regression predicting user intention using direct measures.

Variable	*B*	*SE B*	β	*t*	VIF
Attitude	0.789	0.080	0.636	9.85**	2.352
Subjective norm	0.015	0.057	0.013	0.272	1.390
Perceived behavioral control	0.346	0.083	0.252	4.143**	2.081

Note. **Indicates statistical significance at $p < .001$.

Table 4. Indirect measure beta-weights*.

Variable	β
Attitude	
Communication	0.322
Safety	0.235
Navigation	0.300
Record	0.330
Weather	0.268
Perceived behavioral control	
Battery	0.493
Weather	0.414
Network Access	0.463

Note. *Separate regressions were conducted for attitude and perceived behavioral control. The beta-weights represent contributions to the TPB variable under which they are listed.

measure was a statistically significant predictor of the attitude direct measure score ($R^2 = 0.261$, $B = 0.025$, SE $B = 0.003$, $\beta = 0.511$, $t = 7.632$, $p < .001$). The indirect perceived behavioral control measure was a statistically significant predictor of the perceived behavior control direct measure ($R^2 = 0.146$, $B = 0.032$, SE $B = 0.006$, $\beta = 0.382$, $t = 5.307$, $p < .001$).

Since each indirect measure was a statistically significant predictor of the direct measure, another set of multiple regressions was conducted regressing the belief measures onto their corresponding summed product score variables (indirect measures). This regression helped explain the salient beliefs driving each of the TPB variables. Results from the model regressing beliefs onto the summed product score attitude variable indicated that the recording belief ($\beta = 0.330$) was the most influential predictor of attitude. Results from the model regressing beliefs onto the summed product score perceived behavioral control variable indicated that the beliefs about batteries ($\beta = 0.493$) was the best predictor of perceived behavioral control. See Table 4 for other results.

Discussion

The purpose of this study was to examine the factors that predicted mountaineers' intentions to use smartphones during their next high-alpine expeditions. Study results

suggested that mountaineers' intentions to use smartphones were explained by their attitudes and perceived behavioral control. The results of this study have numerous implications for both theory and practice. More specifically, this study provides evidence which continues to support TPB's ability to predict and explain user intention. The results may also be a useful resource for the consideration of technology's use in outdoor recreation environments and the underlying beliefs influencing the use of smartphones in outdoor settings. This section elaborates on both the potential theoretical and the practical utility of the study results.

Theoretical implications

There are two fundamental assumptions of TPB. One primary assumption is that there is consistency between a person's attitudes and behaviors. While this study does not explicitly measure behavior, the attitude–intention relationship should logically hold (Ajzen, 1991). The results of this study provide evidence of attitude–intention consistency by demonstrating that mountaineers' intentions can be predicted by attitudes and perceived behavioral control and does so with a large effect size. The results of this study do not support subjective norm's influence on behavioral intention, which is a common finding mentioned in the literature, as subjective norms may vary greatly across numerous variables, including the specific aspects of the behavior and personal characteristics (e.g. Ajzen, 1991; Trafimow & Finlay, 1996; Walker et al., 2006).

Another fundamental assumption of TPB is that certain underlying salient beliefs drive people's attitudes toward certain behaviors. The results of this study provided evidence supporting this assumption by demonstrating that the salient beliefs (those first identified in phase 1) are adequate predictors of TPB factors. The results of this study contribute to the large body of literature which supports the TPB as a useful theoretical framework for examining the factors that drive behavioral intention.

Practical implications

The study results also have numerous practical implications and may be useful when considering technology use in outdoor recreation. Given the rapid technological advancements being made, especially advancements related to smartphones, there is reason to believe that these changes may not only affect people's lives every day, but they may also impact their outdoor recreation experiences. Although the use of technology in natural environments during outdoor recreation is not a new phenomenon, smartphones' use in these environments is a relatively contemporary matter. As such, very little literature explores smartphones' use in outdoor settings, especially the factors that influence their use; however, some literature has begun to explore the effects of smartphones in other recreational experiences, such as tourism (e.g. Pearce & Gretzl, 2012). Therefore, the results of this study add to the emerging understanding of this new phenomenon.

The results of this study suggested that mountaineers' intentions to use smartphones were driven by both their attitudes toward smartphones in these environments, as well as their beliefs about their ability and control to use these devices in this environment.

The systematic analysis of behavioral and normative beliefs (indirect measures) provided a useful starting point for considering the salient beliefs' effects on each TPB construct. Each of the TPB constructs, and their corresponding beliefs, are discussed in greater detail below.

Mountaineers' attitudes toward smartphone use in high-alpine environments were the most important predictors of their intentions to use these devices on their next expedition. Attitudes were influenced by several underlying beliefs about the outcomes of smartphone use during high-alpine expeditions. The results suggested that mountaineers' beliefs about smartphones as devices for recording their experiences and communicating with others were the two primary drivers of their attitudes. These findings may have especially important implications for outdoor recreation experiences, considering the continued improvements of smartphones' capabilities as multimedia recording devices (Sanyal, 2018). More specifically, the use of smartphones as recording devices may influence the behaviors of mountaineers. For example, in an effort to take the perfect picture or record a video of an ascent, will mountaineers take more risks than they might otherwise take because of these devices? While the results of this study cannot answer these questions, nor can we assume that other forms of recording devices of the past or other factors did not also influence mountaineers' behaviors, we suspect that the social pressures associated with social media posts from remote places likely affects behaviors to some degree, which may, in turn, result in questions about these device's effect on safety via the misinterpretation of risk or flawed decision-making.

Surprisingly, mountaineers' in this study also had favorable beliefs about smartphone's utility as a communication device. This is surprising considering the relatively limited network access found in many high-alpine environments; however, as network access continues to improve in remote areas, mountaineers' use of smartphones as communication devices may increase and subsequently have numerous safety implications (Pope & Martin, 2011). While beyond the scope of this study, it is important to consider that use of smartphones as communications devices does not inherently lead to imminent safety concerns. Indeed, many mountaineers who identified smartphones as communication devices may also plan to carry other more reliable safety communication devices such as satellite phones or other satellite-based communication devices. The results of this study do, however, suggest that the mountaineers in this study do view smartphones as potential communication devices, wherein the problem does not necessarily lie in their potential use, but rather the sole dependency of these devices for communication purposes. As smartphone use in remote settings continues to become more common, land managers and guiding companies should consider the ways in which sole use of these devices as communication devices, especially for use as an intended safety device, may complicate search and rescue efforts and potentially put others at risk.

Perceived behavioral control beliefs were also an important factor influencing mountaineers' intentions to use smartphones during their next high-alpine expedition. More specifically, the study results suggested that mountaineers were more confident in their ability to use smartphones when they had favorable beliefs about the device's battery life and network access. These findings may be especially important considerations given the continued improvement of smartphones' battery life and growing network

access. Similar to the discussion of mountaineers' use of smartphones as communication devices, improved battery life, and network access may influence mountaineers' use of smartphones in ways that result in numerous safety implications, such as sole reliance on these devices as communication devices intended for use in emergency situations. Further, if mountaineers start to perceive smartphones' battery life and network access to be markedly improved, there is reason to believe based on the findings of this study that mountaineers' intentions to bring smartphones on their expeditions may increase. An increase in intention, although not deterministic nor answerable through the data we collected, has the potential to result in less reliance on other communication devices that do not offer the promise of multiple functions.

Again, it is important to stress that the use of smartphones in high-alpine environments is not inherently problematic or dangerous; rather, the results of this study suggest that the reasons why mountaineers intend to use these devices may indirectly affect their behaviors, both volitionally and by omission. More specifically, by understanding the reasons why mountaineers intend to use smartphones during their expeditions, land managers may be better positioned to implement policies and procedures that help address their varied uses. In addition, knowing more about the reasons why mountaineers plan to bring smartphones on their experiences may serve as a useful talking point for educators training future guides, as well as more novice outdoor recreationists. Such conversations might stress the potential influence that smartphones could have on risk assessment and decision-making, thus, educating mountaineers and other outdoor recreation users of the potential downsides of relying on technology instead of or above and beyond sound risk management and decision-making.

Limitations and future research

Although the results of this study may provide useful insight into the factors driving smartphone use in high-alpine environments, several limitations should be considered when interpreting these findings. A primary limitation pertains to the sample elicited in this study. More specifically, the sample is relatively small and drawn from potentially biased sources. A larger sample size would have increased the power of the analyses resulting in a more robust explanation. In addition, sampling that included nonsocial media or online forum sources would have potentially broadened the experiences and perspectives of the study participants. In doing so, an alternative sampling approach may have allowed for a greater diversity of perspectives about smartphone use during mountaineering expeditions, which in turn, may have changed the results of this study. Furthermore, given our sampling approach, the results of this study may be most easily generalized to the population of mountaineers who use social media and online mountaineering forums. Similarly, the sample was comprised of mountaineers from 37 countries with varying levels of mountaineering experience, which could present limitations in the generalizability of the study findings to more focused populations of mountaineers with different characteristics. While the results provide an overview applicable to a broad conceptualization of mountaineers, future research should utilize more clearly defined samples in order to enhance the generalizability and utility of the study findings. Relatedly, data collection through self-report instruments may also limit the

generalizability and utility of the study findings. This data collection method may be susceptible to social desirability, in addition to providing subjective accounts.

Another limitation was the decision to not collect data regarding actual use of smartphones by mountaineers during their next high-alpine expedition. Instead, the study utilized self-report data examining user intention. While extant literature (e.g. Armitage & Conner, 2001) demonstrates user intention's moderate to strong predictive power of actual behavior, the results of this study do not account for actual behavior, and subsequently, a causal explanation of the factors driving behavior cannot be provided. Future research should collect actual behavior data in addition to user intention. This approach to data collection could be accomplished by trailhead surveys or other types of post-trip mail-in or participant matched online surveys. This additional data point would enhance the utility of study results. Finally, future research may also consider using the Technology Acceptance Model (TAM), proposed by Davis (1989). TAM explores the effects of attitude of using technology on behavioral influence. Additionally, the effects of direct and indirect perceived usefulness and usability are also examined within TAM (Davis, 1989; Nikou & Economides, 2016).

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References

Ajzen, I. (1991). Theories of cognitive self-regulation: The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. doi:10.1016/0749-5978(91)90020-T

Ajzen, I. (2013). *Theory of planned behaviour questionnaire. Measurement instrument database for the social science*. Retrieved from www.midss.ie.

Ajzen, I. (2015). The theory of planned behaviour is alive and well, and not ready to retire: A commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review*, *9*(2), 131–137. doi:10.1080/17437199.2014.883474

Ajzen, I., & Driver, B. L. (1991). Prediction of leisure participation from behavioral, normative, and control beliefs: An application of the theory of planned behavior. *Leisure Sciences*, *13*(3), 185–204.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Amerson, K., Rose, J., Lepp, A., & Dustin, D. (2019). Time on the trail, smartphone use, and place attachment among Pacific Crest Trail thru-hikers. *Journal of Leisure Research*. Advance online publication. doi:10.1080/00222216.2019.1680264

Armitage, C.J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499.

Cheung, S. F., Chan, D. K.-S., & Wong, Z. S.-Y. (1999). Reexamining the theory of planned behavior in understanding wastepaper recycling. *Environment and Behavior*, *31*(5), 587–612. doi:10.1177/00139169921972254

Davis, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Ewert, A., & Shultis, J. (1999). Technology and backcountry recreation: Boon to recreation or bust for management? *Journal of Physical Education, Recreation and Dance*, *70*(8), 23–28. doi:10.1080/07303084.1999.10605701

Francis, J., Eccles, M. P., Johnston, M., Walker, A. E., Grimshaw, J. M., Foy, R., … Bonetti, D. (2004). *Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers*. Newcastle upon Tyne, UK: Centre for Health Services Research, University of Newcastle upon Tyne.

Hankins, M., French, D., & Horne, R. (2000). Statistical guidelines for studies of the theory of reasoned action and the theory of planned behaviour. *Psychology and Health*, *15*(2), 151–161. doi:10.1080/08870440008400297

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology*, *20*(1), 14406. doi:10.3402/rlt.v20i0.14406

Lamba H., Bharadhwaj, V., Vachher, M., Agarwal, D., Arora, M., & Kumaraguru, P. (2016). Me, myself and my killfie: Characterizing and preventing selfie deaths. arXiv: 161101911 [cs]. Available from: http://www.arxiv.org/abs/1611.01911

Leeuw, A., Valois, P., Ajzen, I., & Schmidt, P. (2015). Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: Implications for educational interventions. *Journal of Environmental Psychology*, *42*, 128–138. doi:10.1016/j.jenvp.2015.03.005

Linxweiler, E., & Maude, M. (Eds.). (2017). *Mountaineering: Freedom of the hills* (9th ed.). Seattle, WA: Mountaineers Books.

Martin, S. (2017). Real and potential influences of information technology on outdoor recreation and wilderness experiences and management. *Journal of Park and Recreation Administration*, *35*(1), 98–101.

Martin, S., & Blackwell, J. (2016). Personal locator beacons influences on wilderness visitor behavior. *International Journal of Wilderness*, *22*, 25–31.

Martin, S., & Pope, K. (2012). The impact of hand-held information and communication technology on visitor perceptions of risk and risk-related behavior. In D. Cole (Ed.), *Wilderness visitor experiences: Progress in research and management, 2011 April 4-7, Missoula, MT*. (Proc. RMRS-P-66.). Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, Z. (2017). The enduring use of the theory of planned behavior. *Human Dimensions of Wildlife*, *22*(6), 583–590. doi:10.1080/10871209.2017.1347967

Nikou, S. A., & Economides, A. A. (2016). An outdoor mobile-based assessment activity: Measuring students' motivation and acceptance. *International Journal of Interactive Mobile Technologies (Ijim)*, *10*(4), 11–17. doi:10.3991/ijim.v10i4.5541

Pearce, P. L. (2011). *Tourist behaviour and the contemporary world*. Bristol: Channel View.

Pearce, P. L., & Gretzel, U. (2012). Tourism in technology dead zones: Documenting experiential dimensions. *International Journal of Tourism Sciences*, *12*(2), 1–20. doi:10.1080/15980634.2012.11434656

Pohl, S. (2006). Technology and the wilderness experience. *Environmental Ethics*, *28*(2), 147–163.

Pope, K., & Martin, S. (2011). Visitor perceptions of technology, risk, and rescue in wilderness. *International Journal of Wilderness*, *17*(2): 19–26, 48.

Sanyal, R. (2018). *Why smartphone cameras are blowing our minds*. Retrieved from https://www.dpreview.com/articles/8037960069/why-smartphone-cameras-are-blowing-our-minds.

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, *8*(1), 1–7. doi:10.1080/17437199.2013.869710

Sumann, G., Hochholzer, T., Faulhaber, M., & Burtscher, M. (2015). High-altitude mountaineering made safer. *Trauma*, *17*(1), 4–16. doi:10.1177/1460408614531878

Symons Downs, D., & Hausenblas, H.A. (2001). *Applying the theories of reasoned action and planned behavior to exercise: A meta-analytic update*. Paper presented at the Association for the Advancement of Applied Sport Psychology. Orlando, FL, USA.

Tossell, C., Kortum, P., Shepard, C., Rahmati, A., & Zhong, L. (2015). Exploring smartphone addiction: Insights from long-term telemetric behavioral measures. *International Journal of Interactive Mobile Technologies (IJIM)*, *9*(2), 37–43. doi:10.3991/ijim.v9i2.4300

Trafimow, D., & Finlay, K. A. (1996). The importance of subjective norms for a minority of people: Between subjects and within-subjects analyses. *Personality and Social Psychology Bulletin*, *22*(8), 820–828. doi:10.1177/0146167296228005

Walker, G. J., Courneya, K. S., & Deng, J. (2006). Ethnicity, gender, and the theory of planned behavior: The case of playing the lottery. *Journal of Leisure Research*, *38*(2), 224–248.

Whitacre, J. A. (2018). *Exploring the relationship between technology and decision making by investigating perceptions of safety in outdoor adventure activities* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (2036305710).

Worley, G. H. (2011). Wilderness communications. *Wilderness and Environmental Medicine*, *22*(3), 262–269. doi:10.1016/j.wem.2011.05.001