

SEGMENTATION OF BACKCOUNTRY SKIERS AND SNOWBOARDERS IN JAPAN BASED ON RECREATION SPECIALIZATION: A CLUSTER ANALYSIS

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ABSTRACT: Backcountry skiing and snowboarding (BCSS) involve serious mountain hazards such as avalanches and falls, requiring participants to manage risks appropriately. In recent years, participation in BCSS in Japan has increased due to abundant snow conditions and growing inbound tourism demand, making safety an important issue. Previous studies have primarily focused on safety measures at the regional or community level, while perspectives that examine participants as heterogeneous groups and consider differences in their characteristics remain insufficient. Therefore, it is necessary to segment participants appropriately and to consider approaches to safety management and education based on their characteristics. Although recreation specialization has been widely used in recreation research as a framework for explaining involvement in activities, studies that systematically segment BCSS participants based on its multidimensional components remain limited.

This study aimed to segment BCSS participants in Japan using the multidimensional components of recreation specialization and to describe the structural characteristics of the resulting groups. An online survey was conducted with 1,309 participants in Japan. Three dimensions were measured: behavioral (experience and participation frequency), cognitive (skiing and climbing skills, avalanche knowledge, and equipment specialization), and affective (attraction, self-expression, and centrality in daily life). Scores were calculated for each component, and cluster analysis was performed to segment participants into distinct groups.

The analysis identified six clusters. The behavioral and cognitive dimensions showed broadly corresponding patterns across clusters, reflecting the accumulation of experience and the development of skills and equipment specialization. In contrast, the affective dimension did not necessarily co-vary with these dimensions and showed a relatively independent pattern. Multiple clusters had similar levels of behavioral and cognitive specialization but differed in affective involvement, and one cluster was characterized by particularly high affective involvement despite relatively lower experience and equipment scores.

These results indicate that BCSS participants in Japan cannot be adequately explained by experience and skill alone. Instead, they are differentiated by multidimensional profiles that also include affective involvement. This heterogeneity may also inform targeted safety communication. These findings provide a basis for developing more targeted avalanche education and information provision that account for differences in participant characteristics across clusters.

KEYWORDS: Backcountry skiing; Recreation specialization; Cluster analysis; Participant segmentation; Japan

1. INTRODUCTION

1.1 Background

Backcountry skiing and snowboarding (BCSS), conducted in snow-covered mountain terrain outside managed ski areas, have become increasingly popular outdoor recreation activities. Unlike skiing and snowboarding within managed ski areas, BCSS involves hazards such as avalanches,

route-finding errors, and falls, and therefore requires participants to manage risks independently.

Japan has abundant snowfall and is internationally recognized for high-quality powder snow. Demand for BCSS has increased in recent years among both international visitors and Japanese participants. At the same time, mountain accidents involving BCSS participants and the social costs associated with rescue operations have raised concerns, and regulations and local rules have been discussed in some regions. Thus, BCSS represents an important resource for outdoor recreation and snow tourism in Japan while also presenting significant safety-management challenges.

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Research on BCSS in Japan remains limited. Previous studies have examined community-level safety measures, serious skiing and snowboarding accidents, and route evaluation. Uchida and Kato (2016), for example, emphasized the importance of developing accident-prevention measures based on appropriate segmentation of participants. Yoshizawa et al. (2024) also argued that, because terrain selection is particularly important in unmanaged snow-covered mountain environments, route-rating systems and related information infrastructure should be developed so that participants can select terrain appropriate to their skills and preferences.

These findings suggest that improving BCSS safety requires more than treating all participants as a homogeneous population. Participants should instead be segmented using a framework appropriate to the characteristics of the activity, and safety-management and information strategies should be considered in relation to the characteristics of different participant groups.

1.2 Recreation specialization and study objective

Recreation specialization, originally proposed by Bryan (1977), is a concept used to explain differences in participants' involvement in recreational activities. It describes a continuum through which participants become increasingly specialized in their equipment, skills, knowledge, activity preferences, and involvement as they accumulate experience.

The concept is particularly relevant to BCSS. Participation requires not only skiing or snowboarding ability but also a range of competencies related to travel in winter mountain environments, including uphill travel, navigation, recognition of avalanche terrain, use of avalanche rescue equipment, and interpretation of weather and avalanche information.

McIntyre and Pigram (1992) emphasized the multidimensional nature of recreation specialization and incorporated behavioral, cognitive, and affective components into their framework (Figure 1). In their framework, the affective dimension includes enduring involvement expressed through importance, enjoyment, self-expression, and centrality. In the present study, the behavioral, cognitive, and affective dimensions were operationalized using experience; equipment and skill; and attraction, self-expression, and centrality, respectively.

Previous studies have demonstrated the usefulness of these multidimensional components for distinguishing groups of participants within the same recreational activity (Ninomiya et al., 2006; Matsumoto, 2015). However, few studies have

systematically segmented BCSS participants using a multidimensional recreation-specialization framework.

The purpose of this study was therefore to segment BCSS participants in Japan based on the components of recreation specialization and to identify the structural characteristics of the resulting participant groups.

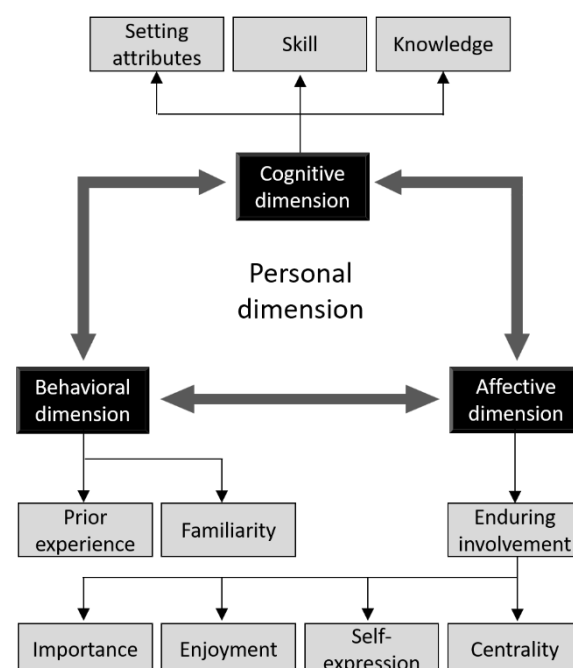


Figure 1: Components of recreation specialization, adapted from McIntyre and Pigram (1992), following Ninomiya et al. (2006).

2. METHODS

2.1 Participants and survey procedure

An online questionnaire survey was conducted among BCSS participants in Japan from December 7, 2022 to March 17, 2023. Information about the study and research ethics was provided on a dedicated website, and participation was promoted through avalanche-education organizations, web media, and social-media groups related to BCSS.

To reduce duplicate responses, participants were asked to confirm before completing the questionnaire that they had not previously responded to the survey. A total of 1,309 valid responses were obtained.

The study was approved by the Research Ethics Committee of Tokyo Women's College of Physical Education (approval no. 2022-58).

2.2 Measures

Personal characteristics included sex, age, occupation, income, educational background, place of residence, primary activity region, and the type of skiing or snowboarding equipment used for BCSS.

Recreation specialization was measured using items adapted from previous studies (Ninomiya et al., 2006; Matsumoto, 2015) to reflect the characteristics of BCSS. A total of 28 items represented three dimensions and six components:

Behavioral dimension

- Experience: 5 items

Cognitive dimension

- Equipment: 2 items
- Skill: 11 items

Affective dimension

- Attraction: 3 items
- Self-expression: 3 items
- Centrality: 4 items

The experience component included years of BCSS experience, frequency of participation during different periods of the winter season, and frequency of overnight BCSS trips.

The equipment component included the number of skis or boards used for BCSS and the total financial investment in BCSS equipment.

The skill component included uphill-travel capability, skiing or snowboarding on different slope angles and snow conditions, navigation, recognition of avalanche terrain, carrying and using avalanche transceivers, probes, and shovels, gathering weather and avalanche information, and perceived BCSS skills and knowledge.

The affective dimension assessed psychological involvement in BCSS. Attraction represented the importance and enjoyment of BCSS; self-expression represented the extent to which BCSS was related to participants' identity and self-expression; and centrality represented the extent to which BCSS occupied a central position in participants' daily lives and social relationships.

Responses were converted to scores ranging from 1 to 5, with higher scores indicating a higher level of recreation specialization. Items with four- or six-category response scales were proportionally converted to the same 1–5 range.

2.3 Analysis

Cronbach's alpha coefficients were first calculated to assess the internal consistency of each recreation-specialization component.

Component scores used for cluster analysis were calculated by summing the item scores within each component. For descriptive presentation of the resulting clusters, mean item scores on a 1–5 scale were calculated for each component. Cluster analysis was then conducted using the summed scores for experience, equipment, skill, attraction, self-expression, and centrality to segment BCSS participants according to their multi-dimensional specialization profiles. Solutions ranging from three to eight clusters were examined, and a six-cluster solution was selected based on the within-cluster distances.

One-way analysis of variance was used to compare recreation-specialization scores across clusters. Personal characteristics were compared using one-way analysis of variance or the Kruskal-Wallis test, depending on the type of variable. Post-hoc multiple comparisons were conducted when significant differences were identified.

All analyses were performed using IBM SPSS Statistics version 28.0.0.

3. RESULTS

3.1 Participant characteristics

Of the 1,309 participants, 84.4% were men and 15.0% were women. Participants in their 40s represented the largest age group (32.0%), followed by those in their 50s (20.9%) and 30s (13.8%). Approximately half of the respondents were company employees (51.0%).

The most frequently used sliding equipment was alpine skis (70.4%), followed by snowboards (23.9%), splitboards (18.9%), and telemark skis (11.3%). Multiple responses were permitted for equipment type.

3.2 Reliability of recreation-specialization measures

Cronbach's alpha coefficients were 0.66 for experience, 0.69 for equipment, 0.79 for skill, 0.94 for attraction, 0.83 for self-expression, and 0.60 for centrality. These values were considered sufficient for proceeding with the subsequent analyses.

Table 1: Mean scores for recreation specialization components by cluster

Dimension	Component	Cluster 1 (n=241)	Cluster 2 (n=134)	Cluster 3 (n=260)	Cluster 4 (n=321)	Cluster 5 (n=107)	Cluster 6 (n=246)	Overall
Behavioral	Experience	3.15 ^a	2.98 ^a	2.70 ^b	2.25 ^c	2.12 ^c	1.81 ^d	2.49
Cognitive	Equipment	3.57 ^b	4.23 ^a	2.48 ^c	1.88 ^d	1.97 ^d	1.45 ^e	2.47
	Skill	4.31 ^a	4.25 ^a	4.10 ^b	4.01 ^b	3.84 ^c	3.73 ^c	4.04
	Attraction	4.89 ^a	4.34 ^b	4.31 ^b	4.85 ^a	2.69 ^d	4.13 ^c	4.39
Affective	Self-expression	4.65 ^a	3.35 ^c	3.35 ^c	4.64 ^a	2.08 ^d	3.52 ^b	3.84
	Centrality	4.13 ^a	3.38 ^c	3.30 ^c	3.73 ^b	2.60 ^e	2.92 ^d	3.44

Note: Values are mean item scores on a 1–5 scale. Within each row, means with different superscript letters differ significantly at $p < 0.05$. Post-hoc comparisons were conducted using Tukey's HSD test, except for Centrality, for which the Games–Howell test was used.

3.3 Segmentation based on recreation specialization

The cluster analysis identified six distinct groups of BCSS participants. Mean scores for the recreation specialization components in each cluster are shown in Table 1.

Cluster 1

Cluster 1 had the highest mean scores of all clusters for every component except equipment, for which it had the second-highest score after Cluster 2. Participants in this group therefore showed high levels of behavioral, cognitive, and affective specialization.

The proportion of professional BCSS guides was also relatively high in this cluster, as was the use of specialized equipment such as telemark skis and splitboards.

Cluster 1 can therefore be characterized as a highly specialized group across all three dimensions.

Cluster 2

Cluster 2 had the highest equipment score of all clusters and the second-highest experience and skill scores after Cluster 1. In contrast, scores for the affective components were lower than those of Cluster 1, particularly for self-expression and centrality.

Cluster 2 can therefore be characterized as a group with high behavioral and cognitive specialization but comparatively lower affective involvement.

Cluster 3

Cluster 3 showed moderate scores across the behavioral, cognitive, and affective dimensions. Participants in this group also had the highest mean age among the six clusters.

Cluster 3 can therefore be characterized as a group with moderate specialization across all dimensions.

Cluster 4

Cluster 4 had relatively low experience and equipment scores, while its skill score was lower than those of Clusters 1 and 2 but comparable to that of Cluster 3. In contrast, the affective scores were particularly high. Attraction (4.85) and self-expression (4.64) were comparable to those of Cluster 1, and centrality was also relatively high (3.73).

Cluster 4 can therefore be characterized as a group with particularly high affective involvement relative to its behavioral and cognitive specialization.

Cluster 5

Cluster 5 had relatively low scores across all components. Its affective scores were particularly low: attraction was 2.69, self-expression was 2.08, and centrality was 2.60; all three were the lowest among the six clusters.

Cluster 5 can therefore be characterized as a group with generally low specialization across all three dimensions.

Cluster 6

Cluster 6 had the lowest experience (1.81) and equipment (1.45) scores, while its skill score (3.73) was comparable to that of Cluster 5 and lower than those of Clusters 1–4.

However, its affective scores—attraction 4.13, self-expression 3.52, and centrality 2.92—were clearly higher than those of Cluster 5. Participants in Cluster 6 were also relatively young.

Cluster 6 can therefore be characterized as a group with low behavioral and cognitive specialization but moderate affective involvement.

4. DISCUSSION

4.1 Multidimensional structure of recreation specialization among BCSS participants

This study identified six distinct groups of BCSS participants based on the multidimensional components of recreation specialization.

Overall, the behavioral and cognitive dimensions showed broadly similar patterns. Clusters 1 and 2, which had high experience scores, also had high skill scores, whereas Clusters 5 and 6 had relatively low scores for both experience and skill. Although equipment showed some variation, these results suggest that greater participation experience broadly corresponds with higher skill levels and greater equipment specialization.

In contrast, the affective dimension did not necessarily follow the same pattern as the behavioral and cognitive dimensions.

This distinction is clearly illustrated by the comparison between Clusters 1 and 2. Both groups had extensive experience and high skill levels, but Cluster 1 also showed very high attraction, self-expression, and centrality, whereas affective involvement in Cluster 2 was comparatively lower.

A similar contrast can be seen between Clusters 3 and 4. Cluster 3 had greater experience and higher equipment scores than Cluster 4, yet Cluster 4 showed exceptionally high attraction and self-expression, at levels comparable to Cluster 1.

Differences were also apparent between Clusters 5 and 6. Although both groups showed low behavioral and cognitive specialization, Cluster 5 also had very low affective involvement, whereas Cluster 6 showed moderate attraction and self-expression despite limited experience.

These findings suggest that recreation specialization in BCSS cannot be adequately described as a simple process in which increased experience leads uniformly to higher skills, more specialized equipment, and stronger emotional involvement. Rather, behavioral and cognitive specialization and affective involvement appear to vary partly independently, and different combinations of these dimensions produce distinct participant profiles.

4.2 Relationship with the characteristics of BCSS participation

The multidimensional patterns identified in this study may partly reflect the distinctive characteristics and historical development of BCSS in Japan.

Historically, backcountry skiing in Japan developed partly as a form of ski mountaineering practiced by mountaineers. More recently, however, it has increasingly been viewed as an extension of resort-based skiing and snowboarding (Sekine et al., 2016).

Thus, contemporary BCSS participants may enter the activity through at least two different pathways: from mountaineering and from resort-based skiing or snowboarding. Participants following these pathways may differ in their previous experience with mountain travel, skiing or snowboarding, equipment, and motivations for participating in BCSS.

Because BCSS combines mountaineering with skiing or snowboarding, differences in participants' backgrounds and entry pathways may contribute to the observed mismatch between behavioral/cognitive specialization and affective involvement.

However, this study used a cross-sectional survey and did not follow individuals over time. The six clusters should therefore not be interpreted as sequential developmental stages through which participants necessarily progress. Rather, they represent different structural profiles of recreation specialization at the time of the survey.

4.3 Implications for safety education and information provision

The differences among these clusters may also be relevant to safety management in BCSS.

Avoiding avalanche and other mountain hazards requires more than possessing technical knowledge and skills. Participants must also make decisions about how much risk they are willing to accept and whether to modify, continue, or abandon an intended activity as conditions change. Sakakibara (2015) argued that the target level of risk—the level of risk considered acceptable in relation to an expected benefit—may be strongly influenced by an individual's emotional attachment to mountaineering, climbing, or skiing and by the position of these activities within the individual's life. Consequently, acquiring correct knowledge does not necessarily result in an immediate reduction in the level of risk a participant is willing to accept.

The affective components measured in this study—attraction, self-expression, and centrality—represent the extent to which BCSS is enjoyable and important to participants, contributes to their identity, and occupies a central position in their lifestyle. It is therefore possible that strong affective involvement influences decisions concerning terrain selection, continuation or termination of a tour, and retreat.

This possibility may be particularly relevant to participants such as those in Clusters 4 and 6, whose affective involvement was relatively high compared with their behavioral and cognitive specialization. For such participants, strong involvement in BCSS may influence how activity objectives and acceptable levels of risk are evaluated, even when relevant hazard information is available.

In contrast, Clusters 1 and 2 had high levels of experience and skill but differed in their affective profiles. This suggests that even among highly experienced participants, the psychological context underlying decision making may not be uniform.

Accordingly, safety education and information provision for BCSS participants may benefit from considering not only years of experience and technical skill but also differences in affective involvement. Tailoring the way hazard information is communicated and providing information that supports appropriate terrain selection for different participant profiles may contribute to improved safety.

However, the present cluster analysis did not directly examine avalanche-risk perception, terrain-choice behavior, retreat decisions, or other specific safety behaviors. It is therefore not possible to conclude that any particular cluster is more likely to engage in unsafe behavior. Future research should examine relationships between the participant profiles identified here and specific decision-making and safety behaviors.

Objective terrain-rating systems and related information infrastructure, such as those discussed by Yoshizawa et al. (2024), may also help participants select terrain appropriate to their experience and skills. Combining such information with a better understanding of participant heterogeneity could contribute to more effective safety management in BCSS.

5. CONCLUSIONS

This study segmented 1,309 BCSS participants in Japan using cluster analysis based on the multidimensional components of recreation specialization.

The behavioral dimension, represented by experience, and the cognitive dimension, represented by equipment and skill, showed broadly corresponding patterns across clusters. In contrast, the affective dimension, represented by attraction, self-expression, and centrality, did not necessarily vary in parallel with behavioral and cognitive specialization.

Several clusters had similar levels of behavioral and cognitive specialization but differed markedly in affective involvement. In addition, one group showed particularly high affective involvement despite relatively low experience and equipment scores.

These findings suggest that recreation specialization among BCSS participants cannot be adequately explained by a single continuum based solely on accumulated experience or technical skill. Instead, participants are characterized by different combinations of behavioral, cognitive, and affective specialization.

Safety education and information provision for BCSS should therefore consider differences in these multidimensional participant characteristics rather than treating all participants as a homogeneous group. Future research should examine how the participant profiles identified in this study are related to avalanche-risk perception, decision making, terrain selection, and specific safety behaviors.

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