

Adaptation of Finnish cross-country skiers to climate change

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Cross-country skiing has a long history in Finland, and it is a part of the national identity of Finns. This study on cross-country skiers' adaptation to changing climate describes groups of cross-country skiers with reference to their motives for skiing, and their perceptions and preferences on climate change adaptation tools. The data was collected by means of a web questionnaire contacting skiers in ski areas, mainly in southern Finland, and on the websites of ski associations. On the basis of a cluster analysis, we found three groups of skier types, each of which has different perceptions of means for adapting their skiing behaviour to the decreasing skiing opportunities close to home. One group of skiers, the 'social type' group, placed emphasis on skiing traditions and social reasons. This group is the most liable to give up skiing if the skiing conditions close to home are poor. The 'outdoor type' group, whose skiing motives were related to skiing environment qualities (nature, landscape, winter) and the 'technical type' group motivated by fitness objectives, were interested in behavioural adaptation, for example, travelling further away and using artificial snow tracks. With a better understanding of skiers' behaviour, it is possible to identify adaptation strategies that can help providers of skiing services, such as municipal agencies and the ski tourism industry, as well as skiers themselves, to prepare for climate change.

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Introduction

Cross-country skiing has a strong tradition in Finland, and skiing is often mentioned as part of the Finnish national identity. Outdoor recreation in general plays a very important part in the daily life of Finns. Almost all Finnish people participate in some form of recreation during the year, and two out of three engage in outdoor recreation every week (Pouta & Sievänen 2001). Cross-country skiing is one of the favourite outdoor recreation activities among Finns: 40% of the population go skiing 19 times during the winter season on average (Pouta & Sievänen 2001). Cross-country skiing is an everyday sport and leisure activity, but for many it is also a popular way to spend active holi-

days. Skiing is the main purpose of about 10% of tourist trips made to participate in outdoor and nature activities (Pouta & Sievänen 2001). Finnish people learn to ski by the age of five on average (Sievänen 1995), and 94% of the Finnish adult population have cross-country skiing skills (Pouta & Sievänen 2001). Exercise, relaxation, contact with nature, being with family or friends and spending leisure time are important motives for skiing (Sievänen 1995). In addition, skiing is considered an excellent way of taking exercise in order to enhance one's physical and mental health in all age groups (Wöllzenmüller & Wenger 2005). The Nordic concept of "everyman's right", the traditional right of free access, allows skiing in forests, fields and on ice-covered lakes. However,

skiing most often takes place on prepared ski tracks in recreation areas close to the home (even in larger cities) provided by the authorities responsible for recreation administration in municipalities. For an average Finn, a suitable ski area with prepared ski tracks is at a distance of approximately 1.5 kilometres from the place of residence (Pouta & Sievänen 2001).

Global warming and climate change are considered to be the most serious environmental problem affecting snow-based recreation and tourism (Elsasser & Bürki 2004; Willbanks et al. 2007; Scott et al. 2009), and cross-country skiing is considered to be one of the outdoor activities that is most sensitive to changing climate conditions (Scott et al. 2002; Neuvonen et al. 2005). Winters with permanent snow cover last 4–5 months (approximately 75 to 100 days) in southern Finland and in northern Finland 7 months (200 days) on average (Finnish Meteorological Institute 2008). Climate model projections show that winter temperatures are rising in northern Europe (Jylhä et al. 2004; Alcamo et al. 2007), and reveal a tendency towards warmer winters and reduced snow cover, particularly in southern Finland (Carter & Kankaanpää 2003). It is predicted that snow depth will decrease by 78% in southern Finland and by 48% in northern Finland in the next 100 years (Ruosteenoja et al. 2005). The decreasing number of days with snow cover, the lower snow depth and the rising air temperatures of winter days are expected to have direct influences on cross-country skiing, especially in southern Finland, where the majority of the Finnish population live (Neuvonen et al. 2005).

Sievänen et al. (2005: 3) point out that outdoor recreation and nature-based tourism are dependent on climate 'as a precondition for the activities' and on the weather 'for the action itself'. This means that changing climate will have an impact on the recreational environment, and will change recreation and travel behaviour (Scott et al. 2009). Outdoor recreation scenarios under changing climate show that in conditions of warmer winters, participation in cross-country skiing will decrease (Sievänen et al. 2005). There are differences among skiers in their sensibility to climate change impacts, depending on their demographic and socio-economic status (Pouta et al. 2009). A longer-term consequence may be that fewer young people will learn basic skiing skills compared with previous generations due to the lack of skiing opportunities close to home (Neuvonen et al. 2005).

There is a growing interest in studying adaptation methods and developing adaptation policies for winter tourism and recreation in conditions of warming climate, but most studies concerning skiing focus on alpine (downhill) skiing (e.g. Wall & Badke 1994; Abegg 1996; Elsasser & Bürki 2004; Sievänen et al. 2005; Scott & McBoyle 2007; Unbehaun et al. 2008). Neuvonen et al. (2005) suggest that short-term adaptation strategies for cross-country skiers when skiing conditions close to home are poor could include travelling to more distant locations, using artificial snow tracks, choosing snow-independent activities or investing in new types of recreation equipment using high-tech solutions. In the longer term, changes in winter recreation activity preferences and choices are to be expected. A further aspect of the situation is that deterioration of skiing infrastructure may become a serious problem (Perry 2004). Many countries have national strategies for climate change adaptation, which include the recreation and tourism sector (e.g. Breiling & Chamranza 1999; Marttila et al. 2005; Scott & McBoyle 2007). Moreover, climate change and winter tourism have also become an issue of concern to international policy makers and institutions such as the World Tourism Organisation (World Tourism Organization 2003; Scott et al. 2009).

There is an increasing need to monitor changes in recreational behaviour, and some trends and predictions have been presented (Cordell et al. 1999; Neuvonen et al. 2005; Sievänen et al. 2005; Scott et al. 2008; Unbehaun et al. 2008). It is necessary to obtain more information about types of skiers, their preferences, motives and skiing patterns under conditions of climate change, in order to gain a better understanding of potential adaptation strategies and skiing behaviour.

Outdoor recreation investments often have a long time perspective, since the most important decisions concern land use and also the use of other natural resources. Better scenarios and understanding of skiers' reactions and changing behaviour will help ski service providers and political decision makers to choose the best adaptation strategies, and to plan and make decisions on future skiing infrastructure investments. For cross-country skiing tourism, short-term predictions are also useful in order to respond at an early phase to the challenges posed by climate change. Information is needed to find ways of adapting management practices in ski areas in order to mitigate the consequences of changing conditions. When con-

sidering climate change, the mitigating of effects, such as reduction of travel-related emissions, should also be a concern. From the stand point of mitigation, travelling long distances in order to ski is controversial as an adaptation method, among other things due to the need to reduce our carbon footprint (Dubois & Ceron 2005). In northern Finland, winter tourism already plays an important role in the tourism sector and in the region's economic activity in general, but most tourism entrepreneurs have very little knowledge and hardly any adaptation strategies for dealing with climate change (Marttila et al. 2005; Saarinen & Tervo 2006), even though enterprises have experience of how variations in weather, and particularly weather extremes during the skiing season, impact their business (Tervo 2008).

The aim of this study is to increase our understanding of how cross-country skiers are likely to adapt their skiing behaviour to changing climate conditions. The objective is to study cross-country skiers' preferences and perceptions of the skiing environment, and in particular their interest and willingness to use different types of adaptation methods when skiing conditions are poor. First, we formed skier groups according to their motives for participation in skiing and describe typical skiing patterns. Second, we analysed skiing environment preferences and perceptions of adaptation methods in these skier groups. Motivation-based classification (see Légaré & Haider 2008) enables us to gain a deeper insight into the preference heterogeneity among cross-country skiers.

Factors affecting the behavioural adaptation of skiers under changing climate conditions

By understanding past behaviour, we gain insights that help us to predict future behaviour. Factors that explain recreational behaviour, particularly participation in a certain leisure activity, include activity-specific variables (i.e. skill level, past experience, access to equipment, access to recreation services and type of natural resources) in particular, and socio-economic factors such as gender, age, income and education in general (e.g. Manning 1999; Cottrell 2002). Further, attitudes, motivations, satisfaction, perceptions or preferences also contribute to the prediction of behaviour (e.g. Iso-Ahola 1986; Lea 1992; Pouta 2003).

De Freitas (2001, 2003) argue that there is little knowledge about the effects of climate on human behaviour, but behaviour can be used as a measure of human sensitivity and satisfaction, and behaviour is a reliable indicator of the significance of weather conditions. Weather conditions and the mental image of an area are salient variables in determining recreationists' satisfaction: human response to climate is interconnected with perceptions (de Freitas 2001). Weather preferences for a suitable ski area/skiing conditions consist of physical (e.g. rain or snow days, amount of snow) and aesthetic aspects (e.g. visibility, sunshine or cloud), which can be used in determining recreationists' behavioural responses and their sensitivity to and satisfaction with weather/climate conditions (de Freitas 2001). A study of autonomous adaptation in terms of future participation scenarios indicated that a decrease in mean snow depth and number of days with snow cover have direct influences on cross-country skiing opportunities, and that this development leads to decreased participation frequencies (Neuvonen et al. 2005). The place of residence and its environmental qualities are factors that configure peoples' preferences relating to their recreational environment, whereas income level or available leisure time may relate to constraints affecting individual's choices. None of the background factors alone, but always a set of factors, help to explain participation or non-participation in recreation activities (Sievänen et al. 2003). In the study by Pouta et al. (2009), sensitivity to climate change was found to differ among different population groups: an urban living environment, female gender and low social status were associated with a higher sensitivity to climate change.

Recreationists and tourists have two main types of method for adapting to climate change: behavioural and technical (de Freitas 2003; Scott et al. 2009). In principle, recreationists have good opportunities to choose the activity, and the place and the time for their chosen leisure-time activity (i.d.), but in practice, the choices in the close-to-home environment are limited during the free time available in everyday life. Behavioural adaptation can be interpreted as a process where a person changes his or her previous behaviour pattern on account of changing environmental conditions or social setting. When studying behavioural adaptation as a future option, adaptation can be seen as a hypothetical intended way of behaving in the future. When studying the adaptation of cross-coun-

try skiers, it is essential to understand and know about the skier's past skiing behaviour. It is important to understand how important cross-country skiing is as a leisure activity for different people, and whether they have acceptable substitutes for skiing. Motivation for skiing is one of the relevant factors. Personal resources and commitment to cross-country skiing in particular is an issue. This refers, for example, to skiing skills as part of the person's investment ('capital') in leisure, or as a cultural relationship, for example, where skiing is identified as part of the local and national culture. Economic resources and the time available for outdoor recreation may act as a constraint on participation, which either upholds or hinders participation. In our study, we first classified skiers according to their skiing motivation and described these groups according to their socio-economic characteristics and skiing behaviour. In adaptation research, it is important to look at potential differences in people's behaviour that may explain their reactions to changing conditions, and to explore whether some of the factors are related to management practices that can be changed in order to assist the adaptation process of individual skiers.

Basically, people are used to adjusting their behaviour to their local climatic conditions, having 'a coping range' (Smit & Pilifosova 2003). There are a few studies on climate change and behavioural adaptation that focus on different aspects of behavioural explanations. Many focus on issues of spatial, temporal and activity substitution, and others are related to the concept of adaptive capacity (Scott et al. 2009). Adaptive capacity includes three different components: awareness (identification of weather extremes and changed climate); ability (having skiing skills, having the equipment, the distance to close-to-home skiing destinations, gender, age, income, willingness to travel in order to ski, sensitivity to weather conditions); and action (giving up skiing, willingness to travel for better skiing conditions) (e.g. Metzger et al. 2005). Grothmann and Patt (2005) introduced the idea of taking socio-cognitive variables into consideration in models of adaptation and adaptive capacity, and Blennov and Persson (2009) stress the role of beliefs in the process of realised adaptive capacity.

Adaptation to changed environmental conditions could also be described as a decision making process or a series of decisions. Driver and Brown (1975) presented a social-psychological model that explains the decision making process and fac-

tors that affect a person's decision at each stage of the decision making process. Environmental factors are influential at several stages of the process: messages from the environment arouse interest in participation and are used to evaluate the different options before making a choice. If the decision favours participation, experiences of actual participation subsequently either strengthen or weaken the behavioural tendency. If the evaluation of the experience is positive, the expected benefits have been realised. These benefits gained are then reassessed, and the result of the evaluation has an influence on the next decisions made on participation. When considering future adaptation, a hypothetical decision making process must be imaged on the basis of previous experiences (e.g. weather conditions and skiing) and expectations of the resources that will be available in the future. The latter factor is often based on the current situation concerning time and money. Indeed, interest and willingness to expend more in terms of time and money to obtain the same benefits, e.g. positive skiing experiences, can be studied if the informant is offered information about options that will be available in the future. A series of 'negative' decisions on participation may also teach a lesson: when poor skiing conditions occur often during the skiing season, a person may after some time prefer to give up the activity, or look for other adaptation tools, such as other ski areas/destinations or different types of equipment.

In the literature on recreation (i.e. studies on recreation trends in general, such as Cordell et al. 1999) there are only a few studies that include cross-country skiing as an activity, and there are even fewer focusing on the behavioural adaptation of cross-country skiers to climate change (e.g. Neuvonen et al. 2005). There are several ways for people to cope or adjust their recreational behaviour in changing climatic conditions, but very little is known about the mechanisms and influential factors (e.g. Scott et al. 2009). A downhill skiing study by Unbehaun et al. (2008) found out that snow-independent substitutes are accepted as a short-term compensation but not for the whole winter holiday, and it is acceptable to travel longer distances and pay more for skiing if the destination can offer suitable skiing conditions. Landauer and Pröbstl (2008) investigated cross-country skiers' preferences, and indicated that cross-country skiers in Austria consider that landscape and the winter experience are a fundamental part of the skiing experience. Technical adaptation strategies,

such as artificial snow or ski tunnels, are less preferred.

The skier's motivation is here assumed to be linked with his/her preferences as regards skiing environment and skiing services, and with behavioural changes. In our study, we first classified skiers according to their skiing motivation and described these groups according to their socio-economic characteristics and skiing behaviour. Classification of skiers according to their motivation offers a ground for discussing preferences regarding the skiing environment and skiing services and interest in choosing different types of adaptation method if skiing conditions change as a result of climate change.

Data and methods

Data

The data was collected with a web questionnaire from skiers, who were contacted personally in ski areas in the Helsinki region in southern Finland in February–March 2007. It was planned to decentralise the on-site delivery locations and dates of the data collection, but due to the extremely short winter season of 2006–2007 the possibilities for decentralisation were limited. Skiers from southern Finland were chosen because they may have had more experience of warm winters than skiers in other regions. In addition, skiers from recreational and skiing organisations such as Suomen Latu, Suomen Hiihtoliitto, Nesteen vaelajat, Oulun Hiihtoseura/Tervahiihto were invited to participate by offering a link to the web questionnaire on the organisations' website, or by delivering contact postcards containing information on how to access the web questionnaire. Attempts were thus made to contact a large number of skiers in ski areas as well as active skiers from skiing organisations. The web survey is an inexpensive way of achieving a large number of responses, and it is convenient for respondents to fill it out at home or otherwise in another comfort indoors rather than out of doors in winter. Also, it is possible to create a versatile and visually pleasing questionnaire that respondents can easily access. About 1500 contact postcards (in Finnish language) were distributed on-site in ski areas. The card consisted of information about the web address for the survey, the project itself, contact information and information on a travel prize, which it was assumed would

serve as an incentive to respond to the questionnaire.

A total of 1192 skiers visited the website, and 744 responses were completed well enough to be used for analysis. It is not relevant to determine the accurate percentage of the response rate in the case of an online survey that was open to all interested skiers. Specific questions were used in the questionnaire to ensure that the respondents were cross-country skiers. The respondents in the survey were mostly Finnish and the majority of them were from southern Finland.

Our data seems to be reasonably representative when compared with what we know about skiers in general, i.e. the skiing population in Finland. Only 7% of respondents in our data were under 25 years old, which is comparable to the figure of 9% for cross-country skiers who are under 25 years old presented in the Finnish National Exercise Survey (Kansallinen liikuntatutkimus... 2006). Our skiers were well educated, 61% having a university or polytechnic level degree. In other studies, participation rates are higher among population groups with a high educational level than among those with a lower education level (Pouta & Sievänen 2001; Kansallinen liikuntatutkimus... 2006).

Variables

The questionnaire consisted of 43 questions, including variables relating to skiing ability, the skiers' activity mode, awareness of climate change and behavioural flexibility, as well as adaptation options. The first part of the questionnaire consisted of basic questions relating to skiers' individual skiing habits, which were intended to collect information on skiing ability (i.e. skills, equipment and frequencies) and on skiing motives. Action-based adaptation measurements were used to measure skiers' temporal and spatial behaviour flexibility (i.e. favoured distance to ski areas, planning a skiing trip). The second part focused on preferences regarding ski services in general. This was followed by questions about previous climate change experiences and awareness of climate change. When asked about perceptions of possible adaptation options, respondents were given scenarios of skiing conditions that reflect a hypothetical future situation under conditions of climate change. The hypothetical situation was described for example as follows: 'if there was not enough snow in your favourite skiing area' or 'if there were several winters with lack of snow'. The

variables relating to ski area preferences and adaptation options are described in Appendices 1a and 1b. Preferences were mostly measured on the five-step Likert scale (see Likert 1977).

Analytical methods

In order to identify potential motive groups regarding skiing participation and in order to obtain detailed information on preference heterogeneity in the skier sample, a principal component analysis of skiing motives measured on a five-step Likert scale was first carried out. Skiers were grouped according to these skiing motive components using K-Means cluster analysis, and a three-cluster solution was found to be the best.

The skiing patterns and socio-demographic backgrounds of the skier type groups were studied using cross-tabulation with Chi-square tests. One-way ANOVA was used to analyse potential differences between the climate change adaptation options of the skier types. Multiple comparisons were made between the skier types using Tukey's tests (Tukey B and Tukey HSD). The aim was to find out which groups differ and whether the differences are statistically significant at $p \leq 0.05$. In order to test the reliability of the One-Way ANOVA, the Kruskal Wallis test for the same variables was also applied. The results of the Kruskal Wallis test were similar to the results of the One-Way ANOVA test. Finally, the sum variables of ski area and destination choice preferences were counted (Appendix 1a and 1b) in order to compress (Figs. 1–2) the salient information gathered from the original variables. All the results of the relationships presented in this study are significant at $p \leq 0.05$, unless otherwise stated.

Results

Skier types and current skiing behaviour

Skiers in this study participated in skiing activities 20–30 days in a season on average. The typical length of one skiing trip was 11–20 km on average. Nearly 30% of the skiers reported 11–30 km (one-way) to be an acceptable distance from home to the ski destination for a day trip. For a holiday trip more than half of the skiers were willing to travel more than 700 km. Skiers reported that the decision for making a day trip is typically spontaneous, but ski holidays are planned a couple of months

before the holiday begins. The classical skiing style was the most favoured way of skiing. Skiers reported that they prefer skiing alone: approximately half of them ski alone, nearly 20% with their partners and only 6.5% with friends. Almost all the skiers (86%) learned to ski as children, 12% at school age, and only 2% as adults. In the case of 62% of the skiers, skiing was taught by a family member. Other popular outdoor activities among skiers were jogging, cycling, walking and Nordic walking (including Nordic running and blading). Over 85% of skiers had cars at their disposal.

Principal component analysis revealed three components of skiing motives relating to the skiing environment, social setting, technical skills and interest in fitness (Table 1). The cluster analysis based on the principal component scores showed that there are actually three skier group types based on their skiing preferences (Table 2). Group 1 was called the 'social type', which emphasises the importance of traditions and time spent with family and friends when skiing. Group 2 is the 'outdoor type', which stresses the important qualities of the skiing environment, such as nature, landscape and winter. Group 3 is the 'technical type', which considers skiing a way of keeping fit and developing skills. The majority of skiers belonged to the outdoor and technical groups. The smallest group was the social group.

The classification made it possible to study the socio-economic characteristics of the skier types in more detail. All the groups were dominated by men, but relatively speaking, the most male dominated was the technical type group. There were no statistically significant differences in age class between the groups, but the social type group had more older skiers compared to other groups, while the technical type group had the youngest skiers. As regards skiing company, the technical skiers tended to go skiing alone more often than the others, whereas the members of the outdoor and social groups preferred skiing in company. Technical skiers preferred the skating skiing style. The availability of a car was highest in the technical type group, although not to an extent that was statistically significant (Table 3).

Most of the skiers in all groups went day-skiing spontaneously (more than 70% of occurrences in all groups). There were no significant differences of opinion as to how far the skiers are willing to go/travel for skiing in the case of a day trip: the preferred distance from home was 11–30 km, although 3–5 km was preferred in the social group.

Table 1. Principal component analysis of skiing motives.

Skiing motives	Component 1 Skiing environment	Component 2 Social features	Component 3 Technical skills and fitness
Nature experience	0.855		
Winter experience	0.825		
Landscape	0.772		
Silence and peace	0.738		
Recreation	0.721		
Sustaining skiing traditions		0.780	
Time with family/friends		0.662	
Keeping fit			0.853
Improving technique			0.735
Eigenvalues	3.55	1.38	1.03
Interpretation, %	39.45	15.37	11.49
Total variance explained, %			66.3

Table 2. K-means cluster analysis of principal component scores.

Principal components	Motive clusters and mean score		
	Social type	Outdoor type	Technical type
Skiing environment	-0.177	0.607	-0.485
Social features	0.431	0.525	-0.739
Technical skills and fitness	-1.393	0.457	0.321
Total: N=744	N=162 (21.8%)	N=285 (38.3%)	N=297 (39.9%)

Table 3. Group characteristics.

	Social type	Outdoor type	Technical type
Gender	Male 50.6%, female 46.3%	Male 51.6%, female 46.7%	Male 67.3%, female 39.2%
Style	Classical	Classical and skating	Skating
Length of skiing trip	Shortest (6–10 km)	Longest (21–30 km)	Medium (11–20 km)
Skiing frequency	Infrequently (6–10 days/season)	Frequently (more than 80 days/season)	Regularly (31–50 days/season)
Skier type	Mostly day skiers/ leisure type	Mostly holiday skiers/ fitness type	Mostly holiday skiers/ fitness type

The members of the outdoor type group were ready to travel further than the members of other groups, even as far as 31–100 km, for a day trip.

Behavioural and perceptual differences between skiers under conditions of climate change

In general, all the skier groups were aware of climate change and it was considered a threat to

cross-country skiing. Experiences of climate change differed between the groups: the members of the social type group had fewer experiences of climate change than the others. If skiers had to choose an alternative for their regular ski area today because of changed skiing conditions, more than 70% of the respondents of all groups would prefer going to ski in areas with reliable snow in Finland rather than elsewhere (abroad).

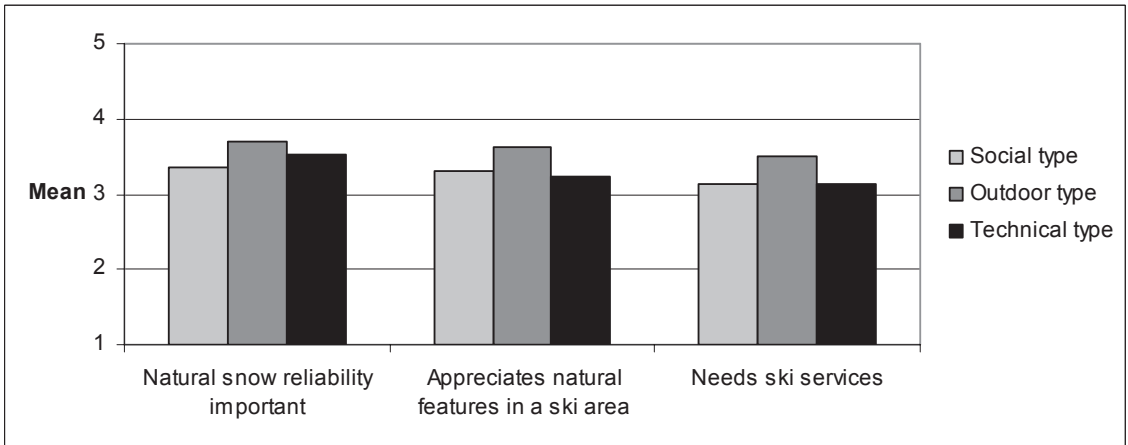


Fig. 1. Preferences regarding particular ski area features among skier group types (1=not important...5=very important).

Preferences regarding the important characteristics of ski areas expressed by different skier groups differed to some extent (Fig. 1, Appendix 1a). The most important characteristics of a ski area in general were related to ski service features, such as good track conditions, natural features such as natural snow reliability and closeness to home. The members of the outdoor type group assessed most characteristics, such as natural features (e.g. the size of the area) and services (e.g. good parking places) more positively than the other groups. In this regard, the technical type group was very similar to the outdoor type group. The social type group differed the most from the other groups, considering natural features such as closeness to home, snow-reliability, service features such as good track conditions and technical features such as artificial snow possibilities and availability of a ski tunnel less important in a ski area.

Regarding climate change adaptation, the technical and outdoor groups would favour technical adaptation strategies if conditions for skiing were poor. They also placed value on natural features, such as snow reliability and service features, such as good track conditions. The technical type group did not appreciate natural features, such as back-country skiing (i.e. skiing without prepared tracks), landscape beauty and service features, such as public transport as much as the other groups. Opinions on service features, such as versatile tracks, and natural features, such as silence and peace, differed among all the groups, the outdoor

type group considering these options more important than the others. Natural features in a ski area, such as silence and peace, were more important to the social type group, whereas service features, such as versatile tracks, were more important to the technical type group. The social type group would most likely give up skiing under poor skiing conditions (Fig. 2, Appendix 1b).

Regarding the acceptance of substitute options under poor snow conditions, none of the groups would be ready to travel to the same place at the same time as usual, but they would rather choose a region with reliable snow conditions. The outdoor and technical groups would prefer to book their holidays when they are sure of snow in the area (Fig. 2, Appendix 1b). The social type group could be attracted by snow-independent activities as an adaptation option. All-season activities, snow-independent activities and cultural activities as substitute options were preferred by the social and outdoor groups. The technical type group was not attracted by these options, although indoor activities were accepted by all groups to some extent.

This study indicates that Finnish skiers are not willing to pay for skiing in general. The majority of skiers expect some support from society for the provision of skiing services. There were, however, some differences between the skier type groups in their perceptions of the division of financial responsibilities. The technical type group would be ready to buy a ski card (a fee for track use). The

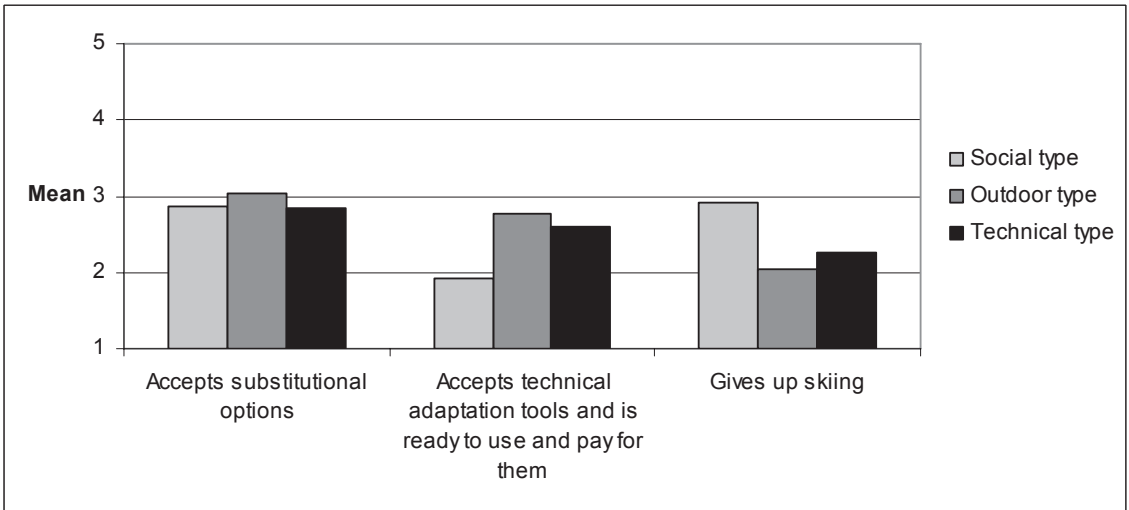


Fig. 2. Acceptance of adaptation options among skier group types (1=not likely...5=very likely).

social type group could imagine paying parking and service fees, but compared to the other groups, this group considered that additional financing for ski areas is not needed, and that society does not necessarily have to support skiing.

The outdoor and social type groups considered that support for services might be needed, in the form of taxes and track fees combined, in order to maintain services in ski areas. According to the outdoor and technical type groups, artificial tracks and ski tunnels could be financed by a combination of taxes and track fees, but the social type group thought that no additional financing is needed. Attitudes to taxes or track fees as sole forms of support were not favourable. In the case of artificial snow and ski tunnels there were significant differences among all three skier groups as regards their attitudes to paying for these options. The technical type group had the most positive attitudes to paying for artificial snow and ski tunnels. Because the social type group was the least interested in artificial snow, ski tunnels and the availability of services in general, a comparison between only the outdoor and the technical type groups was made. It revealed (although at a 0.10 significance level) that the outdoor type group preferred taxes whereas the technical type group could imagine paying track fees in order to use artificial snow or tunnels. The outdoor type group had more positive opinions on the need to finance services than did the technical type group (Fig. 3).

Discussion and conclusions

The purpose of this study was to provide information on skiers' perceptions and preferences in changing climate conditions. The study identified skier type groups that differ in their skiing behaviour and preferences regarding different adaptation options in a potential future situation of climate change. In this study, the classification (clustering) of cross-country skiers made it possible to focus in more detail on the adaptation strategies and preference heterogeneity of skiers. The clustering procedure revealed three skier type groups. The first group was called the 'social type', which emphasises the importance of skiing traditions and time spent with family and friends when skiing. The second group was the 'outdoor type', which stressed important qualities of the skiing environment, such as nature, landscape and winter. The third group was the 'technical type', which considered skiing a way of keeping fit and developing skills. The majority of the skiers belonged to the outdoor and technical type groups. The smallest group was the social type group. The members of the outdoor and technical type groups had high skiing frequencies, and they were also younger than the skiers in the social type group.

The outdoor type group was the most flexible group: they would be most likely to be able to adapt to the changes caused by climate change. They are willing to travel longer distances than at

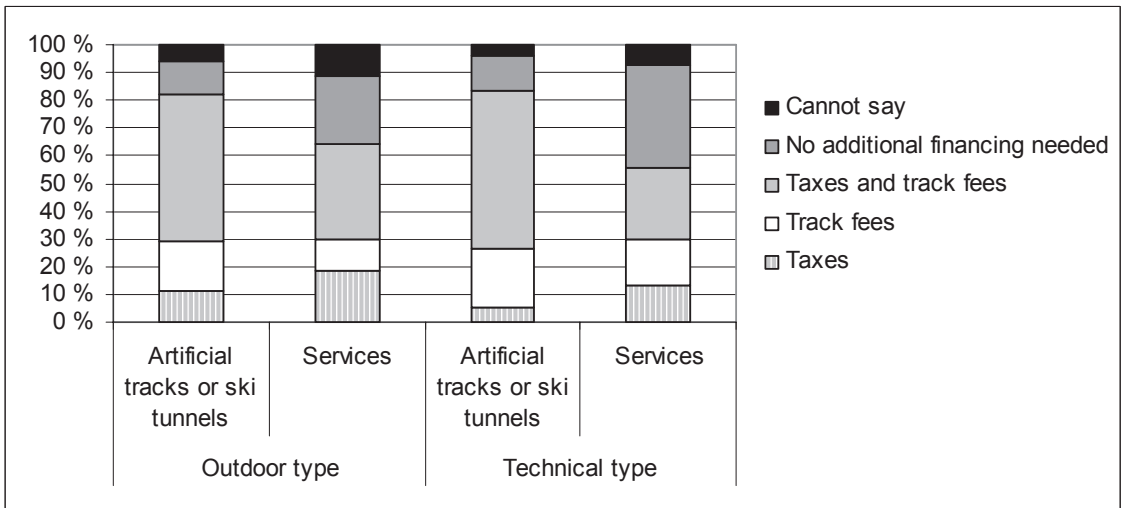


Fig. 3. Comparison of the outdoor and technical groups' preferences regarding additional financing for services and technical track options at ski areas.

present to areas with reliable snow, although rather further north in Finland than abroad. This group accepted various substitute activities, such as snow-independent or all-season activities instead of skiing if warm winters were to cause poor skiing conditions, but they also accepted technical adaptation tools, such as artificial snow or ski tunnels. By contrast, the technical type group was not interested in substitute activities in ski areas. Natural snow-reliability is important, but this group also had positive attitudes to technical adaptation options, such as artificial snow and ski tunnels, and would even be ready to pay for them if necessary. The social type group did not believe in climate change as much as the others. They accepted substitutes, such as snow-independent activities, but they did not accept technical adaptation tools, such as artificial snow or ski tunnels. The study by Neuvonen et al. (2005) anticipated that some skiers might give up skiing if the conditions for skiing were to deteriorate. In our study the social group is identified as the type of skiers that are most likely to give up skiing. Skiing did not seem to be the main interest of the members of this group, and they would rather search for other alternative recreational activities to replace skiing. According to Pouta et al. (2009), female gender, lower socio-economic status and an urban living environment are associated with a higher sensitivity to climate change.

When considering future adaptation strategies for cross-country skiing, the needs, perceptions and preferences of skiers should be taken into account. Potential future skiers are most likely to be the skiers who have perceptions and preferences similar to those of the members of our 'technical type' and 'outdoor type' groups. In general, skiers do not seem to be very loyal to any specific ski areas. It can be assumed that skiers who are willing to travel to northern ski areas in the future are probably the skiers whose perceptions and preferences are close to those of the outdoor type group in our study. Under conditions of climate change, in southern parts of the country, ski areas should concentrate more on artificial snow and ski tunnels, which attract skiers similar to the technical type group, because their attitudes towards paying for skiing possibilities are more positive and because environment-related qualities, such as landscape beauty and nature values, are less important. The technical type of skiers are potential users of ski tunnels and artificial snow tracks also for the reason that they do not need very long skiing routes.

Adaptation research aims, by forecasting future demand and identifying preference groups, to ensure that as many people as possible benefit from adaptation procedures (see Mendelsohn 2000). There is, on the one hand, a need to arouse interest by showing that there are possibilities, even in

the case of cross-country skiing, to adapt to the consequences of climate change. On the other hand, by identifying the development needs of ski areas and studying different ways of keeping ski areas attractive, it is easier to find and realise future adaptation strategies. Compared to alpine skiing, cross-country skiing is more vulnerable to climate change (Scott et al. 2002; Perry 2004; Landauer & Pröbstl 2008). Regarding suitable adaptations for cross-country skiing in a climate change situation, there are several adaptation strategy options for ski areas that skiers consider acceptable. However, the question arises whether skiers are likely to change their behaviour and how.

Most skiers are interested in travelling further north in order to use areas with reliable snow conditions. About 40% of Finns are used to travelling for outdoor and nature-related activities, and 10% of these trips are made to participate in cross-country skiing (Pouta & Sievänen 2001). Many skiers are in the habit of taking skiing holidays. On the other hand, if a ski area faces a winter with lack of snow, snow-independent activities can be reported as alternative options for skiing in such a winter (compare, e.g., with the cross-country skiing study of Landauer & Pröbstl 2008, and downhill skiing studies of Moen & Fredman 2007 and Unbehaun et al. 2008). The substitute activities can be used as a tool to enable ski areas to survive shorter winters and to keep the areas attractive (Unbehaun et al. 2008). Many skiers in our study are also willing to accept technical solutions to ensure skiing conditions. Technical adaptation is often mentioned as a suitable adaptation strategy for downhill skiing (Harrer 1996; Mohnl 1996; König 1998; Bürki 2000; Moen & Fredman 2007; Pröbstl et al. 2008; Unbehaun et al. 2008; Scott et al. 2009), but nearly all technical adaptation measures require a certain amount of financial capacity (Pröbstl 2006). Owing to the wide spatial distribution of ski tracks it is expensive and also difficult to maintain or build an infrastructure under poor snow conditions. Also, ecological aspects must be taken into account when planning such activities, as artificial snowmaking may cause unwanted environmental impacts (see Pröbstl 2006). Finnish skiers expect society to provide support for skiing activities and are not in general willing to pay for opportunities to ski. This study reveals that in order to continue skiing even under poor snow conditions, the members of the technical type group were those who could imagine paying for skiing itself, but not necessarily, for instance, for com-

pensating activities, whereas the outdoor type group members expressed willingness to pay for alternative recreational activities in a ski area, but not necessarily for skiing itself. Serving different skier groups according to their expectations, preferences and needs will thus present a challenge for ski tourism enterprises.

The information gathered in this study contributes to the planning and decision making processes involved in seeking suitable adaptation strategies and policies for cross-country skiing in Finland. Because cross-country skiing is a health-supporting winter activity, from society's point of view the local and regional supply of skiing opportunities is valuable, and it could therefore be justified to argue that society should support adaptation strategies aimed at the local and regional provision of municipality and state skiing services. As a solution for financing these services, a ski card (i.e. a day fee for using tracks) could be an option for areas with well-kept ski tracks or ski tunnels and artificial snow tracks in Finland, too: ski cards have long been used in many ski areas in Central Europe (e.g. Ramsau in Austria). It is not necessary to implement all the possible adaptation strategies in all ski areas under conditions of climate change, but rather to search for strategies that are viable in a certain area with certain conditions and resources. Cooperation between ski areas and ski service providers can be used as a tool that will allow more possibilities to be offered to skiers and ski areas alike.

More research is needed to clarify preferences and acceptance of adaptation methods among Finnish cross-country skiers. In this study, the sample of skiers was limited, and an improved (spatially more representative and larger) sampling of skiers could offer an even better basis for identifying different skier groups and the key elements of adaptation methods. Cooperation with ski areas could also provide new ideas for adaptation methods to be tested.

Research on behavioural adaptation applying more general theories of human behaviour would be helpful to expand our knowledge and understanding of adaptation processes. The theory of planned behaviour (TPB) by Ajzen (1991) is one of the most common theories of human behaviour, and it has been applied, e.g. to the study of nature-related leisure behaviour (Ajzen & Driver 1991; Hrubes et al. 2001). By applying more theoretical approaches, for example TPB theory, as one option for behavioural adaptation studies it would be

possible to produce better predictions of the future demand for ski services. This would offer significant new insights into the adaptation strategies that might be used by the ski tourism industry and public providers of ski services to ensure their survival in conditions of climate change.

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Appendix 1a. Sum variables of ski area preference attributes. *Text in italics contains original variables from the questionnaire, inserted into suitable sum variable groups.*

1. Ski services =

Good public transport to the area
Good parking places
Services in the area
Good track conditions
Versatile tracks

2. Natural features =

Snow reliability
Possibilities for backcountry skiing
Landscape beauty
Silence and peace
Size of the area
Closeness to home

3. Technical adaptation tools =

Artificial snow possibilities
Ski tunnel in the area

Appendix 1b. Sum variables of destination choice preference attributes. *Text in italics contains original variables from the questionnaire, inserted into suitable sum variable groups.*

1. Natural snow reliability =

Cooperation with snow-reliable areas
I would travel to a snow-reliable region at the same time
I would travel to the same place but at a different time
I would book my holiday when being sure of snow in the area

2. Acceptance of substitutes =

I would travel to the same place at the same time
I would choose an area with snow-independent activities
I would choose an area with artificial snow or ski tunnel possibilities
Artificial snow tracks
Ski tunnel
Offering all-season outdoor activities in addition to skiing
Offering indoor activities
Offering snow-independent activities
Offering cultural activities

3. Give up skiing =

I would not go skiing at all in such a winter