Last chance to see the ice: visitor motivation at Montenvers-Mer-de-Glace, French Alps

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Anthropogenic climate change is causing significant changes to the cryosphere. Glaciers and glacier tourism are directly impacted, and glacier tourism operators must adapt to the disappearance of their main resource. Recent studies carried out in this context have demonstrated that Last Chance Tourism (LCT) has emerged as the motivation behind viewing or visiting a natural resource before it disappears. Through a case study conducted on the most frequently visited French glacier destination (Montenvers-Mer-de-Glace, 1920 m a.s.l.), this research aims to better understand tourist motivation to visit glacier tourism sites and test the presence of LCT. Results from both qualitative and quantitative methods demonstrate that visitors come to Montenvers mainly for its environmental features and for LCT purposes. Exploratory Factor Analysis (EFA) shows that motivations can be classified into LCT and five other factors. Qualitative data identify 'Fame' as an unexpected motivational category, and different motivational dimensions of each category are explored. Concerning LCT motivation, four dimensions are revealed: observing, understanding, a sense of urgency, and witnessing environmental changes. Moreover, the more respondents are aware of climate change, the more they consider LCT motivations important. These results lead us to link LCT to cognitive dissonance. Finally, we propose that future research should explore LCT and its relationship with media coverage and pro-environmental behaviours.

Introduction

Visiting glaciers has become a popular activity for tourists (Welling et al., 2015). Among the 2.5 million annual visitors to New Zealand, more than 700,000 visit the Fox and Franz Josef glaciers (Purdie, 2013). In China and Canada, millions of people enjoy viewing and visiting glaciers each year (Wang et al., 2010; Groulx et al., 2016), and the same behaviours are evident in Europe (e.g. Furunes & Mykletun, 2012; Garavaglia et al., 2012). However, as demonstrated by Wang and Zhou (2019), glacier tourism activities are heavily impacted by climate change, and this is a challenge for stakeholders. In Bolivia, the Chacaltaya glacier has already vanished, undermining a large part of the regional economic activity related to skiing and glacier viewing (Kaenzig et al., 2016). New Zealand's glacier-related tourism experiences are facing increased difficulties related to access, landscape degradation, and rockfall hazards (Stewart et al., 2016). Similar difficulties are occurring at other glacier tourism destinations in Canada (Lemieux et al., 2018), Iceland (Welling & Abegg, 2019), Norway (Demiroglu et al., 2018), and China (Wang et al., 2010). However, few studies have been carried out on glacier tourism in the European Alps. Some studies have investigated the recent dynamics of summer glacier skiing (e.g. Falk, 2016; Demiroglu et al., 2018; Mayer et al., 2018), changes in the perception of glacier-associated landscapes from trek paths or huts (Smiraglia et al., 2008; Diolaiuti & Smiraglia, 2010), the adaptation of mountain guides facing climate change and their risk perception (Pröbstl-Haider et al., 2016; Salim et al., 2019), and changes in mountaineering activities (Mourey et al., 2019; Mourey et al., 2019). Nevertheless, the climate change implications for glacier tourism around the largest Alpine glaciers (e.g. the Aletsch, Gorner, and Fiesch glaciers in Switzerland and the Mer de Glace, Argentière, and Bossons glaciers in France) are still poorly understood. Moreover, no studies have been conducted on the impact of glacier changes on visitors' motivations in the European Alps.

Tourist motivation and climate change

Studies on tourists' motivations in the outdoor recreation context were born in the early 1960s with research on fishing satisfaction (Bultena & Taves, 1961). A 'behavioural approach' was developed by Driver and Toucher (1970) and provided the conceptual framework for tourism motivation studies (Manning, 2011). The approach argued recreationists participate in activities to fulfil goals and needs. In a wider tourism context, Dann (1977) developed the 'push and pull' theory, which stands for the proposition that

tourists are 'pushed' from everyday life and 'pulled' to destinations. Several methods have emerged to gauge visitors' preferences (Manning, 2011). Based on the approach of Driver and Toucher (1970), the Recreation Experience Preference (REP) scale was developed as a pool of items to quantitatively measure motivation (Manfredo et al., 1996). From a marketing perspective, the means-end chain (MEC) theory was developed to link the attributes of a product with consumer values (Gutman, 1982). The MEC was used by scholars to understand the factors that influence destination choice (e.g. Klenosky et al., 1993; Frauman et al., 1998).

In nature-based tourism contexts, studies have demonstrated that push factors can generally be divided into five main motivation clusters: escape, prestige, enhancement of kinship relationship, relaxation/hobbies, and novelty (Uysal et al., 1994). Environmental features, such as glaciers, rare fauna and flora, or marine reefs, can shape visitors' motivations as pull factors (Kim et al., 2003; Stewart et al., 2016; Piggott-McKellar & McNamara, 2017).

Climate-driven environmental change can also be considered a driver for this motivation. In Waterton Lakes National Park (Canada), the rising temperature is projected to increase visits up to 36% by the 2050s but, in the warmest scenario, decrease visits because of heatwaves in the 2080s (Scott et al., 2007). In other areas, vanishing destination attributes caused by climate change are fundamental for understanding the decrease in tourist visitation. For example, in Yulong Snow Mountain (China) and Glacier Country (New Zealand), 20% and 46% of the visitors surveyed, respectively, stated they would not come if the glacier disappeared (Yuan et al., 2006; Stewart et al., 2016). Research conducted on environmental-feature tourism has resulted in similar conclusions regarding, for example, areas with polar bears (Hall & Saarinen, 2010) and the Great Barrier Reef (Salvatierra & Walters, 2017), where vanishing attributes can lead to a decrease in tourism. However, tourist motivation is interlinked with the perception of destination attributes (Gössling et al., 2012). For example, media coverage presenting the Great Barrier Reef as 'dying' may facilitate its becoming a Last Chance Tourism (LCT) destination (Coghlan, 2012). However, although media may present certain destinations as LCT destinations, tour operators do not market these sites as such, showing that this motivation can arise without any marketing in this sense (Frew, 2013). This is the case with our case study, as the French media often present the glacier as an example of the consequences of climate change, but no mention of its drastic retreat is made by tourism operators.

Last Chance Tourism

Among other factors, climate change can drive LCT. This concept emerged in the literature in 2010 with papers from Eijgelaar et al. (2010), Hall and Saarinen (2010), and Lemelin et al. (2010). Dawson et al. (2011) have described the different terms that describe the desire to see a natural feature before it disappears, such as 'doom tourism', 'dark tourism', 'climate tourism', 'catastrophe tourism', or 'endangered destination tourism'. LCT is the most frequently used academic term (e.g. Eijgelaar et al., 2010; Swartman, 2015; Piggott-McKellar & McNamara, 2017; Groulx et al., 2019), and a book has been published to present in one volume several developments regarding this topic (Lemelin et al., 2013).

Polar bear viewing and Antarctic cruises were the first tourism activities labelled as LCT activities (Eijgelaar et al., 2010; Hall & Saarinen, 2010). Other empirical studies described the LCT motivation for tourists in Malaysia (Sumarjan et al., 2013) and the Pacific Islands (Prideaux & McNamara, 2013), and, more recently, this concept has appeared in publications related to coral reef tourism (Piggott-McKellar & McNamara, 2017). For glacier tourism, LCT motivation was used to describe the motivations of visitors to the Fox and Franz Josef glaciers (Stewart et al., 2016, 2017) and Athabasca glacier in Canada (Lemieux et al., 2018). It has also been considered by researchers in China (Wang et al., 2010).

Marketing and the media have been the main reasons for the development of a motivation to see vanishing features (Lemelin et al., 2010), and as a result, ethical questions have emerged about the balance between supporting sustainable economies and ecological preservation (Dawson et al., 2011). For example, research among tourism operators in the Arctic has demonstrated that many operators see LCT as an opportunity (Johnston et al., 2013), even if bringing visitors to endangered places is unsustainable (e.g. Wang et al., 2010). Other studies have also demonstrated the LCT paradox: among polar bear visitors in Churchill (Manitoba, Canada), the stronger the aspiration to protect the species, the stronger the desire to observe it before it disappears, even if this results in accelerated disappearance due to increased carbon emissions from travelling (Eijgelaar et al., 2010; Dawson et al., 2011). Moreover, visitors who travel long distances for LCT have also said they are highly concerned about climate change (Groulx et al., 2016). Tourism operators sometimes create carbon-offsetting mechanisms to compensate for the long distances travelled. However, a recent study demonstrated that the majority of LCT visitors to Canada are unwilling to pay a carbon tax to offset their ecological tourism footprint, even if they are aware of their trips' impact on climate change (Lemieux et al., 2019).

These results raise questions about the link between LCT and cognitive dissonance, the psychological state of holding two cognitive positions that are inconsistent (Aronson, 1969). When people hold a cognitive dissonance, they can respond to this tension and reach a consonance state by changing their behaviours to meet their beliefs or changing their beliefs to meet their behaviours (Kassarjian & Cohen, 1965). Commonly, in the tourism context, tourists who display cognitive dissonances justify their choices, for example, by denying their responsibility or arguing their travel is an exception (Juvan & Dolnicar, 2016). Cognitive dissonance is acknowledged to be part of climate change inaction (Gifford, 2011) and a barrier to the development of sustainable tourism. For example, many people who are environmentally conscientious in their everyday lives make unsustainable choices for their holidays (Juvan & Dolnicar, 2014). While no research to date has been conducted on the link between cognitive dissonance and LCT, several works have illustrated it is a common position for people engaged in climate change action (e.g. Semenza et al., 2008; Gifford, 2011). In the glacier tourism context, measurements can be made using a Nature Relatedness scale developed to analyse individual levels of connectedness with nature (Nisbet et al., 2009) and the relations between LCT motivation and climate change perception.

In this context, the objective of this paper is to (1) confirm the existence of LCT-related motivation for visiting glaciers of the Alps; (2) explore the motivational dimensions that shape LCT; and (3) explore the relation between LCT and cognitive dissonance. By considering the European Alps, this paper also acts a first step in filling the gap in the field of European glacier tourism.

Materials and methods

Geographical setting of the case study

Chamonix-Mont-Blanc (France) is one of the most popular destinations in the Alps. Every year, tourists from all over the world—49% of whom are foreigners—spend 4.7 million nights in the Chamonix valley.[1] Chamonix, a first-generation ski resort (Delorme, 2014), is defined as a 'four seasons resort' with 45% of tourist nights occurring in summer.[2] The town is surrounded by two massifs: the Aiguilles Rouges and Mont Blanc. Its fame is linked to the

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[1] Data from the Chamonix Tourism Office (interview with the Director, April 2017).

[2] Ibid.

presence of the Mont Blanc summit (4809 m a.s.l.), the highest in the Alps. The compound name 'Chamonix-Mont-Blanc' dates from 1921, and the Mont Blanc massif is considered the birthplace of mountaineering (Hansen, 1995). It continues to be one of the most popular places for this practice in the Alps (Salim et al., 2019).

The Mont Blanc massif includes 100 glaciers, including the Mer de Glace, which was first visited by English tourists in 1741 (Joutard, 1986). It is 11 km long, with an area of 30 km^2, and is the third largest glacier in the Alps after the Aletsch and Gorner glaciers located in Switzerland (Fischer et al., 2014). The Montenvers Mer de Glace was developed early as a tourist site and had more than 24,000 visitors in 1909, 200,000 visitors in 1954 (Debarbieux, 1990), and more than 400,000 visitors in 2018.[3] Visitors can take a cog railway from Chamonix to reach the Montenvers station at 1920 m a.s.l., from which they have access to a viewpoint on the glacier tongue (Figure 1) and the surrounding peaks (especially Aiguille Verte, 4122 m a.s.l.; Grandes Jorasses, 4208 m a.s.l.; and Aiguille des Grands Charmoz, 3445 m a.s.l.). Visitors can also hike, hike on the glacier, reach one of the five mountain huts located in the Mer de Glace basin, visit an ice cave dug every year, eat at one of the three restaurants, and visit the glaciers' interpretation centre. The cog railway is open all year, but 75% of visitors arrive during summer.

However, the glacier, which is a part of the area's history (Rowlinson, 1998), is now receding quickly. The glacier has receded since the mid-19th century (Grove, 1966) and has lost 1.5 km in length and 32% of its thickness since the beginning of the 20th century (Vincent et al., 2019). Downstream of the Montenvers train station, the glacier has lost about 100 m in thickness between 1990 and 2019 (Vincent et al., 2019). This retreat has already impacted the work of mountain guides (Salim et al., 2019) and climbing routes (Mourey et al., 2019) as access to mountain huts has diminished (Mourey & Ravanel, 2017) due to considerable changes to the landscape (Figure 2).

The reputation of the site, the size of the glacier, the retreat rate in response to climate change, and the impact of this retreat on the landscape make Montenvers a suitable site for studying LCT. To answer the research questions, we used two mixed methods: the administration of a quantitative survey together with a series of semi-structured interviews to obtain qualitative data as proposed by Frauman et al. (1998).

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[3] Data from the *Compagnie du Mont Blanc* (interview with the Montenvers Director, November 2019).

Research design

We used a mixed-methods approach implemented with a concurrent triangulation strategy (Creswell, 2009). We conducted a quantitative survey to glean the motivational factors underlying tourism visits and run statistical analyses of motivations and other visitor characteristics like climate change perception. The qualitative interviews were conducted to explore the structure of LCT motivational factors and identify any other potential factors. The two methods were simultaneously carried out as follows.

Quantitative method

To learn about the visitors' motivations and test the occurrence of LCT, we used a survey based on the Recreation Experience Preference (REP) scale developed by Manfredo et al. (1996). The motivational part of the survey contained 20 motivational items (Likert scale 1 = not important; 5 = very important). From the original scale, we selected 14 items relevant to our research questions from four main categories: relation to others, learning, environment, and activity. We added two motivational items concerning the specificity of the study site (glaciers and ice caves) and four items concerning LCT derived from studies conducted by Stewart et al. (2016) and Lemieux et al. (2018). To explore the participants' relation to nature and the links to motivation, we used the Nature Relatedness Scale (NR-S), a psychometric test developed by Nisbet et al. (2009). We added four items on climate change, demographic characteristics, holiday plans (e.g. length of trip and date of first visit), and landscape perception (e.g. satisfaction and expectations). The survey (Appendix 1) was carried out using tablet computers with *SphinxMobile* software (Ganassali, 2014) and was self-completed by respondents. A pre-test (n = 10) was conducted in June 2019, which led to the revision of the survey by deleting one question concerning the NR-S that was not clearly understood by the participants and adding three questions concerning motivations we had not expected. The pre-test also allowed the tabs used to be parameterised and reduced the risks of data entry errors. The final survey contained 54 questions and took an average of six minutes to complete.

Qualitative method

For the semi-structured interviews, the interview guide (Appendix 2) contained 16 main questions constructed around three themes: demographic characteristics, trip information, and

motivation. The motivation sections were based on the MEC theory, mainly used in marketing and in the leisure field, with the latter tending to focus on destination choice, heritage, outdoor experiences, and accommodation choices (McIntosh & Thyne, 2005). We also used the technique of laddering (Klenosky, 2002). The interviewer first asked the participants to list their motivation for visiting the site. For each item listed, the respondents had to explain why the motivation was important for them. The process continued until the respondent was unable to list new reasons. Each of the 26 interviews lasted 15–30 minutes and was recorded with the permission of the respondents and with all the respondents remaining anonymous.

Data collection

It took nine days to collect the data from these two methods. Field campaigns took place only on sunny days, during the peak summer season (June and July 2019) and in winter (December 2019). Those two periods were chosen because attendance is highest then. The same recruitment technique was used for both quantitative and qualitative methods, but, to ensure diversity, respondents to one method could not respond to the other. During the opening time period (9 a.m.–5 p.m.) and on the main viewpoint, visitors aged 18 and over were randomly invited to participate in French or English. When we met a group, we briefly described the study and offered each member had a chance to participate. During the initial interviews, we noticed that when the survey was explained before the interview, the respondents mainly focused on the climate change aspects and it was difficult to glean their deeper motivations. To limit this difficulty, we explained the study after data collection. According to the Montenvers director, some people bypass the viewing area and use the train to reach one the five mountain huts of the Mer de Glace basin and to practise alpinism and climb. Because both the interview guide and the survey concern motivation to come to the viewpoint, such visitors were excluded from data collection. To make up for the limited time available in December, a team of eight researchers participated in the winter data collection, while only one researcher participated in the summer data collection. When a team of researchers was available, the first authors conducted the interviews. When only one researcher was present, the interviews were randomly conducted between two quantitative collections.

Analyses

The quantitative survey was analysed using SPSS v.26 (Cronk, 2019) and descriptive statistics, exploratory factor analyses, and Spearman correlation were used to explore the underlying motivations (Williams et al., 2010).

All the interviews were transcribed, and a conventional content analysis was applied (Hsieh & Shannon, 2005). Also referred to as 'inductive category development' (Mayring, 2000), this method consists of coding the text to capture key concepts emerging from each open question. Each concept is then recoded to highlight its different components. For this study, three coding levels were used to identify the motivations and values underlying them without using preconceived categories (Kondracki et al., 2002).

Limitations

This study had some unavoidable limitations. First, as mentioned by Lemieux et al. (2018), quantitative closed-ended questions cannot exhaust the motivations. Also, the sample was limited to English and French speakers present during peak attendance, which meant visitors from time-constrained commercial tours were underrepresented. Moreover, the study was limited to visitors who came to see the glacier from the viewpoint, thus excluding climbers and alpinists. Time constraints for visitors and their desire to enjoy their visits explain the short duration of the interviews. Ideally, future research would conduct these interviews prior to the visits. Finally, there are no data about the demographics of the visitors; our sample was limited to respondents who were on hand and we could not test its representativeness.

Results

The results section provides information about the sample and the characteristics of the respondents. The section then describes visitors' motivations and provides the results of the exploratory factor analyses (EFA) and the different correlations between variables.

Sample

The quantitative survey was completed by 447 respondents, among whom 13 (2.72%) were removed because they provided incomplete responses or were under 18. The final dataset includes 434 respondents, 342 (79%) in summer and 92 (21%) in winter, and has less than 5% missing values.

Characteristics of the respondents

The respondents were 18–80 years old (median: 41) with equal numbers of men and women. Fifty-seven percent were university graduates, 54.1% were French, and 74.4% of the foreigners come from the European Union or Switzerland (Table 1). Most of the respondents planned their holiday without any tour operator (88.9%) and spent three nights or more in Chamonix (53.5%). Most of the visitors surveyed (60.2%) were visiting Montenvers for the first time, and most of the second-time visitors came less than five years ago (51.7%) and during summer (78.5%). Some of the respondents did not plan to visit another tourist site during their trip (42.1%) or to visit the *Aiguille du Midi* (40.5%), one of the highest tourist sites in the Alps (3842 m a.s.l.), reachable by a cable car and also located in Chamonix.

Concerning climate change and the environment, 90.8% of the respondents believed climate change exists, 82.5% believed humans are responsible for climate change, and 72.8% acknowledged that their actions impact the environment.

Motivation to visit Montenvers

We first describe motivations and then give the results of the EFA.

Statistics of the motivations

Figure 3 illustrates that the three main reasons for visiting Montenvers were 'seeing the beauty of the landscape', being 'close to nature', and 'seeing the glacier' followed by LCT items. Conversely, items concerning the 'relation to others' received low scores, suggesting these are less important. The mean score for each item illustrates that the four LCT items come first (4.03), just ahead of the five environment items (4.00). The three learning items follow (3.72), then the two attraction items (3.26). Finally, the six relations to other items come last (2.62).

Exploratory factor analyses

EFA were used to understand the motivation factors for visiting Montenvers and test the hypothesis that LCT constitutes a prominent factor. After removing items loaded at more than 0.30 in different factors and items not loaded above 0.40 (Steven, 2012), 11 items loaded in five individual factors explained 79.9% of the total variance (Table 2). With a Kaiser-Mayer-Olkin (KMO) of 0.750 and Bartlett's Test of Sphericity of .000, the factor analysis is

acceptable (Kim & Mueller, 1978).

Factor 1, including items related to the desire to discover and learn new things, was labelled 'learning motive'. Factor 2, including items related to natural landscapes, was labelled 'environment motive'. Factor 3, containing items about the relation to others and willingness to talk about the trip, was labelled 'storytelling motive'. Factor 4, including LCT items, was labelled 'LCT motive'. Two items from the LCT category were removed because of cross-loading in both the LCT motive and the learning motive, suggesting a learning dimension of LCT. Factor 5, including items expressing the desire to relax or experience inner peace, was labelled 'tranquillity motive'.

The results of the mean score for each factor (Table 3) demonstrate that the environment motive is the predominant factor (mean = 4.51). It is also a consensual factor with low variance (V = .404) and low standard deviation (σ = .635). The LCT motive is the second most important factor (mean = 4.28) with a variance similar to the next three factors (V = .921). The results demonstrate that LCT exists at the Montenvers site.

Correlation analyses

NR-S and Climate Change perception (CC-P)

To understand the correlation between the motivation factors and the NR-S and CC-P, we began by determining the structure of the different items included in these two categories. An EFA was conducted with seven items and with an acceptable KMO (n = .712) and a Bartlett's Test of Sphericity of .000; it demonstrated three different factors (Table 4).

The first factor comprised items concerning opinions about climate change, which was labelled CC-P. The second factor included items related to the personal relationship to nature, which we labelled nature relatedness (NR). Finally, the third factor corresponded to opinions regarding humans' use of nature; this was labelled nature use. A mean score was calculated for each factor, and, notably, only 0.9% (n = 4) of the respondents 'disagree[d]' or 'strongly disagree[d]' with the proposition that climate change exists. To determine whether the factors were reliable for the correlation analysis, we calculated Cronbach's alpha for each factor, and the CC-P (α = 0.726) and NR (α = 0.815) were acceptable (Nunnally, 1978). As nature use was below 0.70 (α = 0.534), we excluded it from the correlation analysis.

Correlation tests

Table 5 illustrates the results of the correlation analysis. As expected, the motivation factors moderately correlated with each other, confirming that the LCT motive was related to the learning motive. The LCT motive moderately correlated with CC-P ($r = 0.367$, $n = 416$) and NR ($r = 0.316$, $n = 425$). The results indicated the more the visitors were conscious about climate change and the glacier's future disappearance, the more they desired to engage in LCT. Moreover, environment and tranquillity factors correlated slightly both with the willingness to visit Montenvers in case of glacier vanishing (VW) and with landscape satisfaction (LE). T-tests were run between motivation factors and different socio-demographic characteristics (first time or not at Montenvers, living in city or countryside, domestic or international visitors) but no significant relationship was found.

Qualitative results

Five categories of motivation with 17 dimensions emerged from content-coding the interviews: Environment, LCT, Fame, Discovery, and Human attributes (Table 6).

Environment

The category 'environment' was identified in 22 of the 26 interviews and included five dimensions: 'Natural attributes' described features that visitors may have wanted to see (e.g. mountain, glacier, snow). 'Relation to nature' reflected the desire to be close to nature:

> 'We come here for the nature, to change scenery a little bit, although it seems Chamonix is very polluted by trucks and cars. But here, we can feel the nature'. [translated from French]

'Scenery' reflected the willingness to experience the landscape and was linked to the more abstract 'search for beauty' dimension. 'Accomplishment' was identified as a terminal value for this motivational category.

LCT

LCT-related motivation was reported in 20 of the 26 interviews. This confirmed the presence of LCT at the Mer de Glace. Moreover, this motivation appeared mostly spontaneously at the

beginning of interviews. Four dimensions appeared regarding LCT. 'Observation' was the first and most common one, reflecting the desire to 'see' the effects of climate change and the ice retreat:

> 'We wanted to see the evolution of the Mer de Glace; we often hear about it on TV, the melting of the glaciers, we're looking at it, it's sad'. [translated from French]

'Urgency' reflected the willingness to come before it is too late:

> 'A lot of people told us, "Go there now because afterwards there won't be ice anymore". Then, we arrived in Chamonix on April, and we thought we had to go fast! [translated from French]

'Understanding' reflected a desire to understand what climate change implies:

> We always hear about climate change and today we want to see what it means. I think you can really see what it means when you see the glacier. [translated from French]

'Witnessing' referred to a motivation to talk about environmental changes across generations:

> 'I have a book I bought for my grandson. It's a picture book of what's going on... And then, we took our grandson with us. I think it's important for the children to see... to see that it has melted'. [translated from French].

Fame

This category appeared in 12 of the 26 interviews and suggested the reputation of the site was a reason to visit. It included two different dimensions that corresponded to recognition of the site. The 'Famous' dimension concerned the reputation of the site itself, as the Mer de Glace is considered 'unmissable':

> 'You have to go at least once in your life'. [translated from French]

'Opportunity' referred to visitors who did not know the site before their arrival in Chamonix:

> 'We did not know we could go up there, so let's go!' [translated from French]

Discovery

This category was present in 10 of the interviews and included the desire to 'discover new things':

‘We came here out of curiosity, to discover the place’. [translated from French]

‘Tranquillity’ included the desire to find harmony, calm, and ‘hedonism’ as terminal values:

‘We wanted to have pleasure, to be calm’. [translated from French]

Human attributes

This last category included all the motivations related to the presence of facilities. ‘Physical activity’ included the desire to go for a walk or a hike. ‘Touristic offer’ referred to the on-site tourist facilities, such as the ice cave or the Montenvers train:

‘And we wanted to take that train, which is still something old...’ [translated from French]

‘History’ corresponded to the notion of heritage and the desire to discover the story of the site, particularly the history of the train (built between 1905 and 1909) and mountaineering:

‘What we loved here is to see all this alpine context, mountaineering [...], young people who were there in groups to climb here. It’s beautiful to see this, this mountain culture, and all these people who are passionate about climbing, I think it’s really extraordinary’. [translated from French]

Discussion

Last chance to see the ice

Existence and paradox of LCT motivation

The results, both quantitative and qualitative, confirm the significance of LCT for visitors at Montenvers. First, respondents highly rated four items related to the desire to see a natural feature before its disappearance. The EFA then revealed a factor specific to LCT (i.e. LCT motive), which was second in terms of importance behind factors related to the environment

(i.e. environment motive). Third, the qualitative interviews revealed motivation linked to LCT in 20 of the 26 cases. These results were consistent with a recent study conducted at the Athabasca glacier (Canada), suggesting glaciers are now considered LCT destinations (Lemieux et al., 2018).

Moreover, as Dawson et al. (2011) observed for polar tourism, the more the visitors at Montenvers were aware of the anthropogenic origin of climate change, the more they wanted to see the glacier before it disappears despite the impact of the greenhouse gas emissions caused by their tourism. This statement was supported by the distances Montenvers visitors travelled (up to 18,816 km from their residences, 1,642 km on average). The relationship between LCT factors and NR also demonstrated that the higher respondents scored their NR, the more important they considered LCT to be. This result is relevant to the cognitive dissonance theory: visitors know they contribute to climate change and agree with natural conservation but travel long distances to see glaciers. In other tourism contexts, studies have demonstrated that travellers experience cognitive dissonance between their tourism choices and environmental opinions (e.g. Juvan & Dolnicar, 2014; Juvan et al., 2016). While this calls into question the responsibility of developing tourism sites that require visitors to emit high levels of GHG, the awareness present in the understanding dimension of LCT can help facilitate acceptance of the climate message, which can help transform knowledge into actions (Trolliet et al., 2019).

Motivational dimensions of glacier tourism

The main motivations to visit glacier tourism sites were related to environmental features. The results above demonstrated that the scenery is the main motivation for visiting Montenvers and other glacier tourism sites (e.g. Garavaglia et al., 2012; Welling et al., 2015). The Hierarchical Map Value (Leppard et al., 2004) presented in Figure 4 synthesises the findings. The levels of abstraction demonstrate that the environment category consisted mainly of concrete attributes (e.g. seeing glacier and summits), whereas LCT consisted mainly of abstract attributes (e.g. seeing the glacier because it is considered a marker of climate change). The importance of the environmental and LCT items was consistent with findings from New Zealand where visitors were attracted to the glaciers, nature, and LCT (Stewart et al., 2016) and Canada where nature, discovery, and LCT were the main motivations for tourists visiting Athabasca glacier (Lemieux et al., 2018). The correlation between EFA factors confirmed LCT contains learning dimensions, as suggested by Groulx

et al. (2016). The unexpected emergence of reputation-related motivation illustrated that this glacier site is sometimes unknown to tourists before they arrive in Chamonix.

In contrast to a study carried out in New Zealand (Purdie et al., 2020), visitors to Montenvers were aware of the glacial retreat before arriving at the site, which was also the case at the Forni glacier in the Italian Alps (Garavaglia et al., 2012). As 93.3% of the Montenvers' visitors stated that the landscape met their expectations, changes in the landscape caused by the glacier retreat (Diolaiuti & Smiraglia, 2010) will not necessarily reduce the site's attractiveness. However, changes in glacier access may be a problem for stakeholders at Montenvers and other places (Rasul et al., 2019). Finally, Wang et al. (2020) suggest LCT could also increase visits to glacier tourism sites. Consequently, we argue that LCT can bring new people to these sites, and we hypothesise that their visits can increase their pro-environmental behaviours.

LCT and glacier tourism implications for pro-environmental behaviours

The key findings from research on climate change perception and communication demonstrated that visitors: (1) had a superficial understanding of climate change (Weber & Stern, 2011; Moser, 2016); (2) thought changing their behaviour would not make a difference (Semenza et al., 2008); and (3) had difficulty in transforming willingness into action (Gifford, 2011). It has also been demonstrated that cultural worldview and knowledge about climate change (Shi et al., 2015) as well as attachments to places (Goldberg et al., 2018) are important elements for increasing public concern about climate change and improving the acceptance of climate change policy and behaviour changes. For example, a recent study on the Great Reef Barrier illustrated that the more people felt part of the environment, the more they protected it (Goldberg et al., 2018).

Moreover, beyond the dramatic discourse about the consequences of climate change, the use of visited or virtual landscapes as a means of communication seems to be an important part of climate change action (Sheppard, 2005). These different elements, the importance of the learning motivation and the different dimensions of LCT, lead us to consider glaciers as a vector for improved knowledge on the impact of climate change. From this perspective, glacier tourism operators can enhance climate change awareness by using interpretation strategies (e.g. Howard, 1999) that can increase pro-environmental behaviours (e.g. Powell & Ham, 2008; Marschall et al., 2017).

Montenvers includes the following features: (1) Along the 580 steps leading to the glacier from the train, signs indicate the glacier's position in different years; (2) a glacier interpretation centre was built in 2012; (3) many old photographs and explanatory panels are scattered on the site; and iv) a glaciologist is present at the main viewing area during the three summer months to inform visitors about the glacier's evolution. Moreover, a project is being developed to make this site a major centre for climate change education.[4]

As discussed in other studies on LCT (e.g., Lemelin et al., 2010; Dawson et al., 2011), the media play a key role in preparing visitors and instilling a sense of urgency to see the disappearing natural resource. This applies to the Mer de Glace, which is one of the most famous glaciers in France, and the one most frequently used by journalists to illustrate climate change's consequences. For example, the Europresse database provides 108 articles published in the French press since 2010 containing both the terms 'Mer de Glace' and 'Changement climatique'. This should lead to future research regarding the media's impact on the development of LCT motivation. Future studies could also investigate the relationship between LCT and cognitive dissonance by, for example, revealing how tourists 'justify' their choices, similar to research by Juvan et al. (2016). Moreover, research could assess the role interpretation materials play in increasing pro-environmental behaviours in glacier tourism and the LCT context.

Conclusion

The results of the mixed methods research, using push and pull and MEC theories, conducted at Montenvers indicated that visitor motivations can be divided into six main categories: the environment, LCT, learning, the fame of the site, discovery, and human attributes. LCT motivation was present among visitors and included four distinct dimensions: observation, understanding, urgency, and witnessing. LCT motivation correlated with both Learning factors and visitors' awareness of climate change and relationship to nature. The correlations supported the LCT paradox that seems to be related to cognitive dissonance: the more the visitors were aware of the human impact on climate change, the more they desired to see the glacier before it disappears, thus contributing to climate change. This paradox raises two questions: (1) what are the consonance justifications for glacier tourism, and (2) what is the impact of possible post-visit consciousness and its effect on pro-environmental behaviour?

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[4] Interview with *Compagnie du Mont Blanc* Marketing Director, February 2020)

This last question concerns the responsibility of glacier tourism operators in implementing pro-environmental measures. Glaciers are powerful objects and serve as witnesses of climate change's effects; therefore, glacier tourism sites should become 'ambassadors' of climate change by using interpretative elements like those set up at Montenvers.

Finally, we propose the following research initiatives. First, more research is required to further examine the dimensions of the LCT motivation that was highlighted here. Furthermore, future research could study the cognitive dissonance of glacier tourists by examining the relationship between visitors' motivations, climate change representations, and justifications they use to reach consonance state. Second, research is necessary to examine the impact of media coverage on the development of visitor motivation. Third, investigating the impact of visiting glacier tourism sites on climate change awareness and pro-environmental behaviour before and after visits is indispensable.

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Tables

Table 1. Demographic and visitation characteristics.

Demographic	Categories	Sample N = 434
Sex		*n = 433*
	Female	219 (50.6 %)
	Male	214 (49.4 %)
Age		*n = 434*
	Range	18-80
	Median	41
Country of residence		*n = 418*
	France	226 (54.1 %)
	United Kingdom	42 (10 %)
	Belgium	33 (7.9 %)
	U. S	17 (4.1 %)
	Switzerland	14 (3.3 %)
	Canada	13 (3.1 %)
	Other	83 (19.8 %)
Living…		*n = 431*
	In a town or its periphery	256 (59.4 %)
	In the countryside	175 (40.6 %)
First visit		*n = 432*
	Yes	260 (60.2 %)
	No	172 (39.8 %)
Glacier previously observed		*n = 260[a]*
	Yes	154 (59.2 %)
	No	106 (40.8 %)
Length of the stay		*n = 430*
	One day or less	125 (29.1 %)
	1 to 2 nights	75 (17.4 %)
	3 to 5 nights	87 (20.2 %)
	5 to 7 nights	92 (21.4 %)
	More than 7 nights	51 (11.9 %)

[a]: Only for visitors who never came before

Table 2. EFA of motivations of the visitors at the Montenvers-*Mer de Glace*[a].

	Factor Loading				
	1	2	3	4	5
	Learning	Environment	Story Telling	LCT	Tranquility
To develop my knowledge about this place	0,894				
To learn more about glaciers	0,835				
To discover new things	0,594				
To see the beauty of the landscape		0,784			
To be close to nature		0,736			
For others to know that I went there			0,692		
To have a story to tell			0,682		
To see a landscape that will not be the same in the future				-0,924	
To see the glacier before it disappears				-0,794	
To be calm					0,700
To be alone					0,539

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Table 3. Mean scores for motivation factors.

	N	Mean	Std. Deviation	Variance
Environment motive	431	4,514	0,63597	0,404
LCT motive	430	4,287	0,95989	0,921
Learning motive	430	3,550	0,97243	0,946
Story Telling motive	425	2,532	1,0515	1,106
Tranquility motive	413	2,419	0,98229	0,965

Table 4. EFA of visitors' Nature Relatedness (NR) and Climate Change Perception (CC-P).

	Factor Loading		
	CC-P	NR	Nature Use
Human is responsible for climate change	0,877		
The Mer de Glace will disappear as a result of the climate change	0,574		
Climate change is real	0,552		
I always think about how my actions affect the environment		0,894	
My ecological conscience affects my way of life		0,756	
The protection of nature is not necessary because it is strong enough to withstand human impacts			0,651
Humans have the right to use natural resources as they wish			0,555

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.[a]
a. Rotation converged in 6 iterations.

Table 5. Spearman correlation between motivation factors, NR, CC-P and other scales related to glacier evolutions.

	Learning motive	Environment motive	Story Telling motive	Tranquility motive	NR	CC-P	LE	VW	GD
LCT motive	,422**	,461**	,271**	,102*	,316**	,367**	0,077	0,010	,360**
Learning motive		,316**	,288**	0,073	,217**	,128**	-0,001	-0,072	,161**
Environment motive			,139**	,116*	,232**	,269**	,205**	,177**	,241**
Story Telling motive				,172**	0,051	,103*	,122*	0,010	,135**
Tranquility motive					0,062	-0,043	,171**	,242**	0,000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

LE = Landscape Expectations (1 = No, 2 = Maybe no, 3 = Maybe yes, 4 = Yes); VW = Venue without glacier anymore (1 = No, 2 = Maybe no, 3 = Maybe yes, 4 = Yes); GD = The glacier will disappear (1 = Strongly disagree, 5 = Strongly agree); NR = Nature Relatedness (1 = Strongly disagree, 5 = Strongly agree); CC-P = Climate Change Perception (1 = Strongly disagree, 5 = Strongly agree).

Table 6. Summary of motivational dimensions for each category

Category	Dimension	Category	Dimension
Environment		Fame	
1	Natural attribut	10	Famous
2	Relation to nature	11	Opportunity
3	Scenery	Discovery	
4	Search for beauty	12	Discover new things
5	Accomplishment	13	Hedonism
LCT		14	Tranquillity
6	Observation	Human attribute	
7	Urgency	15	Physical activitiy
8	Understanding	16	Touristic offer
9	Witnessing	17	Historic

Figures caption

Figure 1. Localisation of the Montenvers - Mer de Glace site.
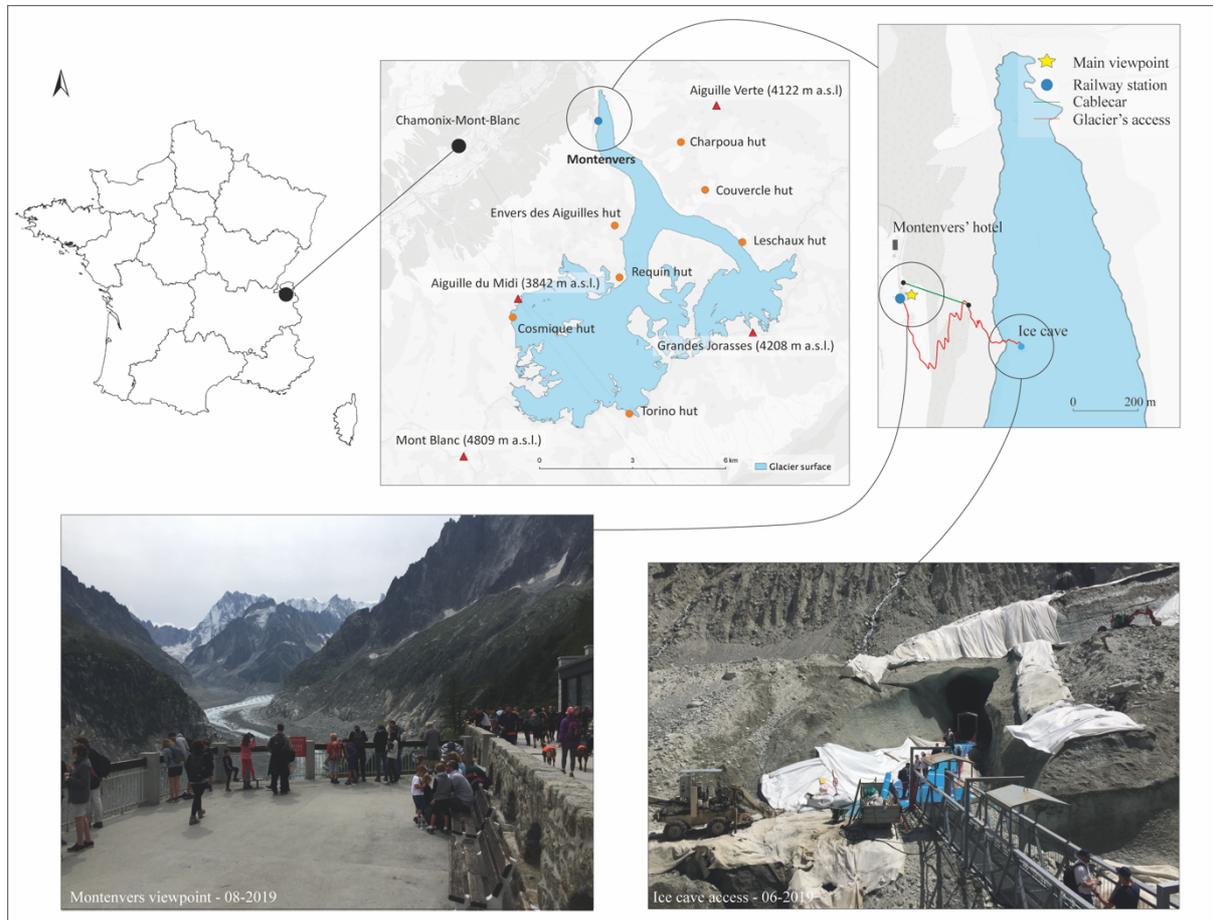
Figure 2. View on the Mer de Glace and the railway station; a) in 2019 (ph.: CMB); b) in 1949 (coll. ETH Zurich).
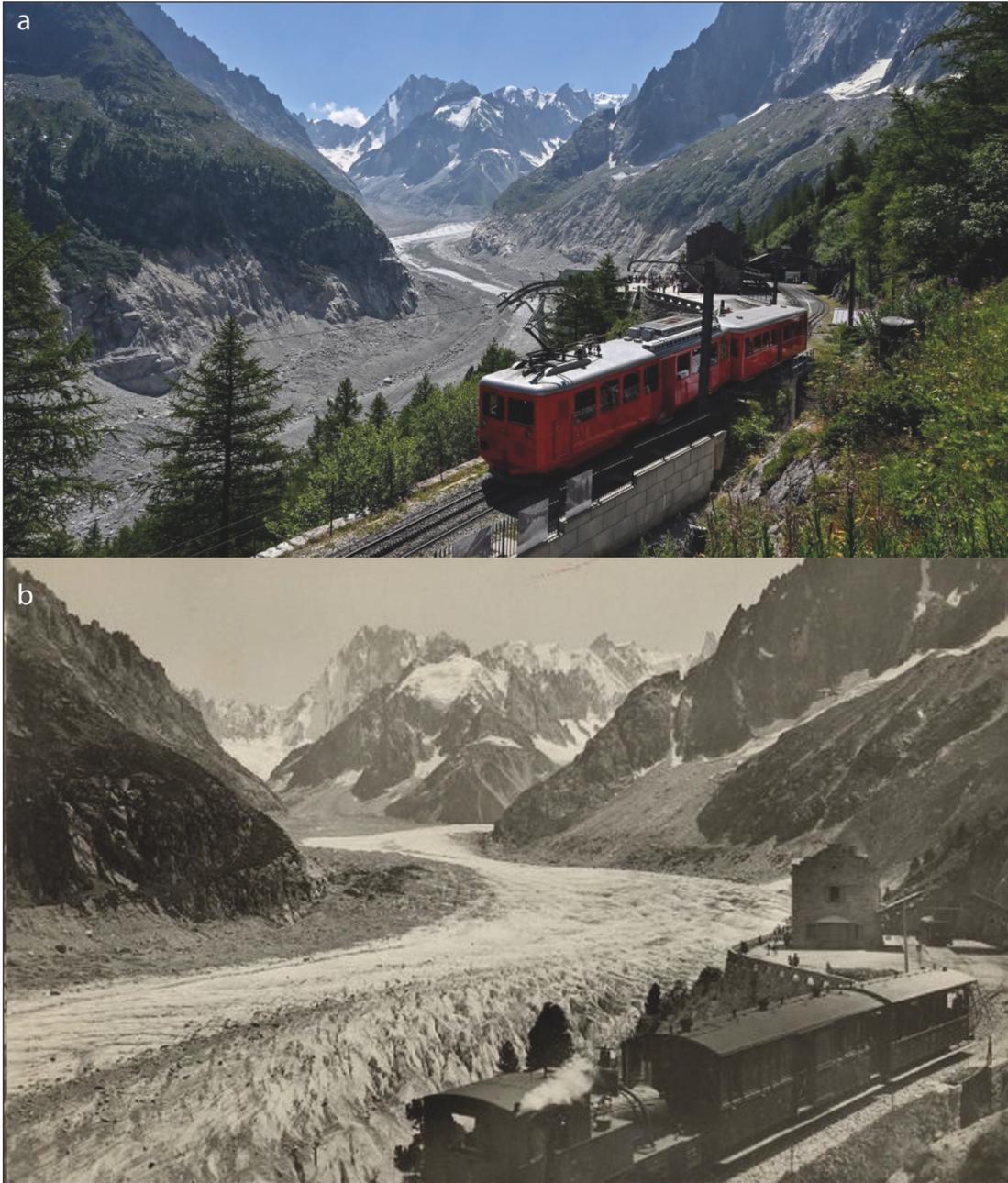
Figure 3. Scores for descriptive motivations. Items are ranked in descending order according to their means score.
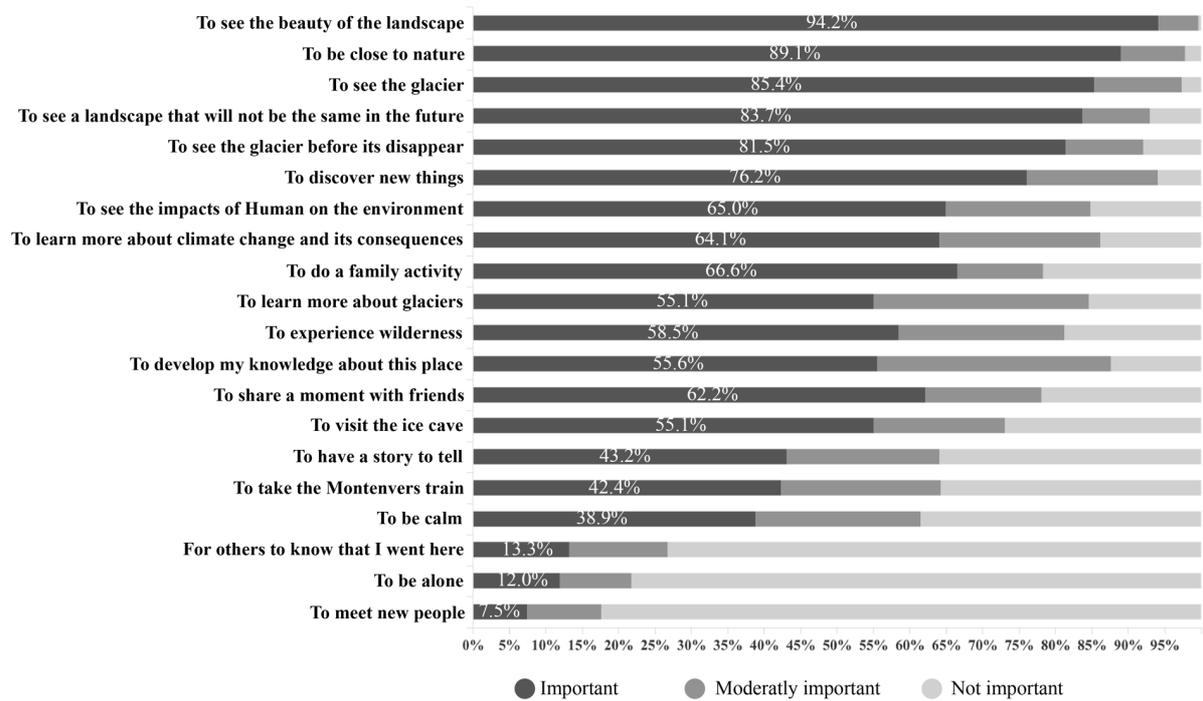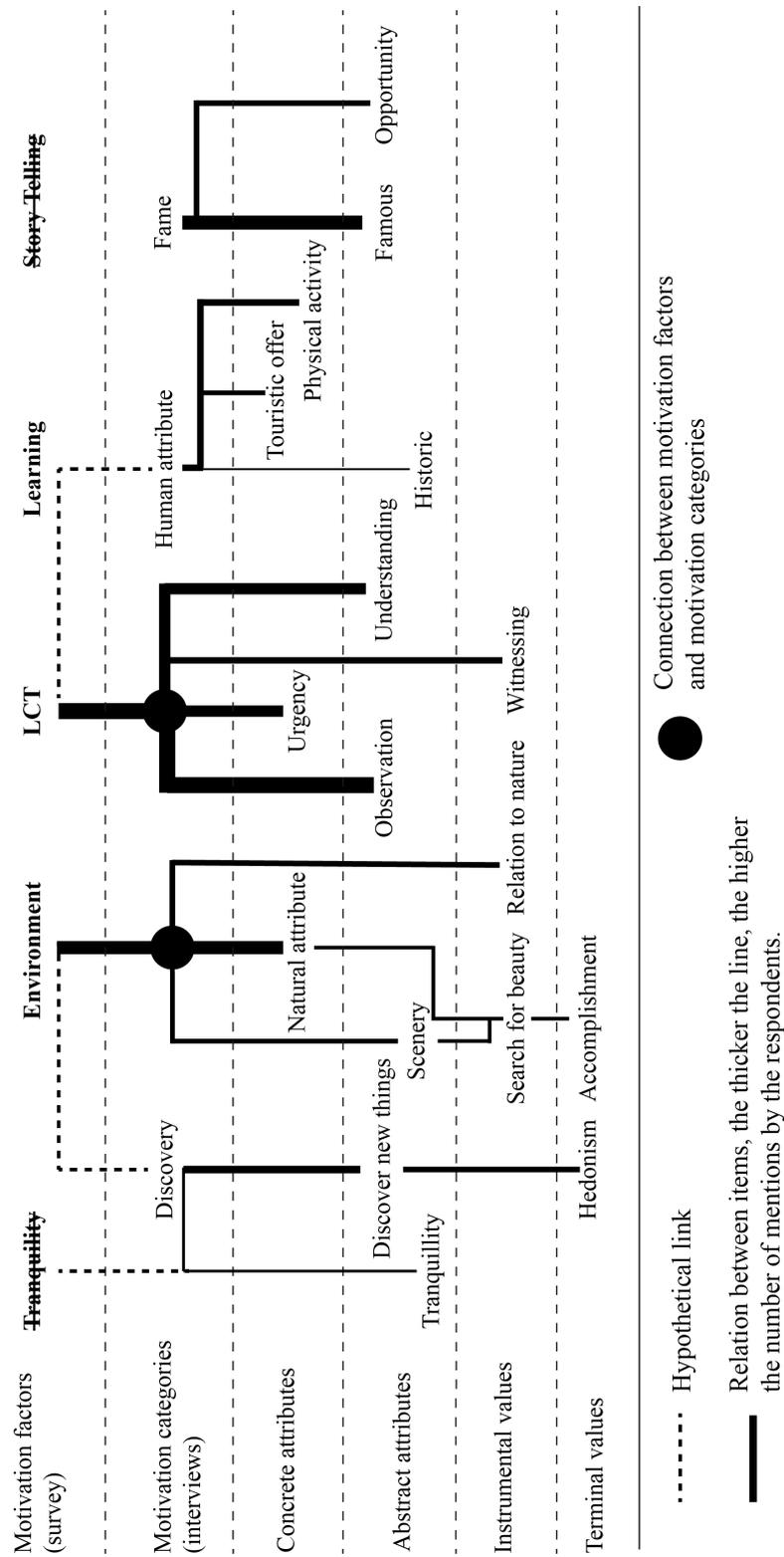
Figure 4. Modified HMV presenting the relation between motivation items arose from both methods.

Appendix

Appendix 1. Questionnaire used for the study

Appendix 2. Interview guide

Acknowledgment