Tourists' motivations, learning, and trip satisfaction facilitate pro-environmental outcomes of the Antarctic tourist experience

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A B S T R A C T

Tourism in Antarctica has been growing and diversifying. While Antarctic tourists are purported to have meaningful interactions with the Antarctic environment, little empirical research exists to understand how motivations and trip characteristics of the Antarctic journey shape tourists' experiential outputs, which may in turn influence their pro-environmental outcomes. To examine these relationships, we conducted exploratory analyses using 242 pre-and post-trip surveys collected during the 2019–2020 Antarctic season. We identified four motivation types of Antarctic tourists: *experience & learning, adventure into Antarctica, social bonding,* and *trip of a lifetime*. Following the interactional model of tourist experience, we associated this motivation typology and trip characteristics with experiential outputs (*Perceived Learning, Measured Learning,* and *Satisfaction*) and pro-environmental outcomes (*Environmental Concerns, Management Preferences,* and *Behavior Intentions*). Our results indicated most tourists traveling to Antarctica already possessed high levels of pro-environmental attitudes and behavior intentions, leading to few significant changes after the journey. However, we found that the specific inputs of motivations and trip characteristics influenced experiential outputs in different ways -especially *Perceived Learning* and *Satisfaction*-, which were strongly associated with pro-environmental outcomes. Findings reinforce the importance of meaningful and transformative Antarctic tourist experiences in promoting sustainable human-environment interactions and provide new insights regarding tourists' learning and experiential outcomes.

Management implications: Tourists traveling to Antarctica hold a diversity of expectations and motivations. These motivations interact with trip characteristics to influence tourists' experiences. Enhanced understanding of these relationships could contribute to the Antarctic tourism industry efforts to develop strategic promotion, programming, and communication strategies that produce meaningful experiences and foster pro-environmental outcomes. As tourism diversifies, we should reflect on how the Antarctic tourist experience could become more customized and participatory, effectively inspiring Antarctic tourists to serve as stewards and ambassadors for the Last Frontier.

1. Introduction

Antarctica is under threat in the Anthropocene Epoch as global challenges, such as crumbling glaciers, invasive species, and wildlife diseases, are triggering irreversible ecosystem changes (Chown et al., 2012; Liggett et al., 2017). While tourism in fragile ecosystems can present an additional challenge, the largely self-governed Antarctic tourism industry has been recognized for its potential role in combatting these threats by providing immersive learning opportunities for tourists

who interact directly with Antarctica. Such a powerful experience can arguably lead to enhanced knowledge, attitudes, awareness, and pro-environmental behaviors (Powell & Ham, 2008). Similar positive outcomes have been linked to tourism and sustainability in other natural settings (Ardoin et al., 2015; Ballantyne et al., 2011; Falk et al., 2012; Falk & Staus, 2013; Ramkissoon et al., 2013; Ramkissoon & Mavondo, 2017), and such outcomes might intensify following a transformative experience with the Last Frontier. As Alexander et al. (2020) argue in some cases, positive tourism experiences and could inspire travelers to

become future ambassadors who would advocate for Antarctica conservation.

Like many natural destinations, Antarctica has been undergoing tourism expansion and diversification (IAATO, 2020; Liggett et al., 2017). Increasing pressure on these unique and potentially vanishing ecosystems might trigger tourists' interests in seeing them before they disappear. The International Association of Antarctic Tour Operators (IAATO) reported 74,401 Antarctic tourists in the 2019–2020 season, doubling the number just five years ago (IAATO, 2020). Meanwhile, diversification has resulted in new operations, variations in modalities (e.g., sea-borne vs. air-cruise trips), different lengths of journey, and an expanding portfolio of tourist activities from seven to 49 since the late 1990s (IAATO, 2019). Although these numbers are dwarfed by comparison with many iconic protected areas, the rapid growth and diversification of tourism on this wild and pristine continent is raising questions about sustainability and the potential for Antarctic tourism to generate meaningful experiences and pro-environmental outcomes.

Since the late 1990s, IAATO has gathered information on Antarctic tourists' demographic attributes. Researchers analyzing Antarctic tourism have utilized these statistics to characterize and better understand visitors (Bender et al., 2016; Cajiao et al., 2020; Liggett et al., 2011, Cheung et al., 2019). However, much of this work has focused on general profiling of tourists while research on tourists' experience is scarce. Some empirical studies sought to fill these voids. Those include studies of cognitive and affective outcomes (Powell et al., 2008, 2012; Powell, 2005), impacts of tourism diversification (Lamers et al., 2012), perceptions of and interaction with the environment (Roura, 2012; Tin et al., 2016), perceptions of environmental impacts (Eijgelaar et al., 2010), and potential development of ambassadorship linked to the tourism experience (Alexander et al., 2020; Vila et al., 2016).

These studies have contributed to our understanding of Antarctic tourists, but important knowledge gaps remain with respect to tourists' motivations, their experiences, and how such experiences may influence pro-environmental outcomes. The aim of this study is to improve our understanding of the relationships among input, output, and outcome variables inherent to the Antarctic tourists' experience to inform tourism management in support of Antarctica's sustainable future. Our specific objectives are to: 1. characterize Antarctic tourists according to their motivations, 2. examine the association of trip characteristics and motivations (inputs) with tourists' experience (output) and pro-environmental outcomes, and 3. explore if different components of trip experience mediate the relationship between the input and outcome variables.

2. Literature review

2.1. Nature-based tourism: an interactional model

Nature-based Tourism (NBT) is a form of leisure travel to enjoy natural attractions through different outdoor activities (Moore & Driver, 2005). Some authors argue that NBT provides opportunities for meaningful experiences with wildlife and natural history, thereby inspiring large numbers of visitors and influencing their environmental behavior (Ballantyne et al., 2011; Wolf et al., 2019; Ramkissoon et al., 2013). Ecotourism, a subset of NBT, also focuses on experiencing natural areas, but its defining characteristics lie in minimal impacts, conservation and community development outcomes, and increased awareness of natural and cultural values through learning (Chiu et al., 2014; Tisdell & Wilson, 2005). While Antarctic tourism falls within the broader realm of NBT, Antarctic tours are typically designed with deliberate educational programming and multiple learning opportunities, which are characteristic in ecotourism operations. Accordingly, we consider pro-environmental outcomes linked to the ecotourism experience be applicable in the Antarctic context (Castellanos-Verdugo et al., 2016; Falk & Staus, 2013).

The tourist or visitor experience has been widely studied. Cohen (1979)'s seminal work identified five modes of tourism experience based on motives, from superficial (i.e., desire of pleasure) to those more profound, such as the quest of meaning. Later studies have examined a variety of contributing factors to the tourist experience, such as the geographical settings, tourists' motivations, personalities, and expectations, and other cultural, economic and education elements (Moore & Driver, 2005; Morgan et al., 2010; Ryan, 2003; Uriely, 2005). In the outdoor recreation literature, the recreation experience production model illustrates the process through which visitor experience is acquired and how it is linked to visitors' motivations and preferences, as well as their subsequent trip, setting, and activity choices (Moore & Driver, 2005). Spatially and temporally interconnected, the tourist's experience also consists of pre-trip, during-trip and post-trip stages, each of which could influence or mediate the final outcomes produced by a journey (Gretzel et al., 2006).

Interactions between tourists and natural settings are a hallmark of all NBT settings, and such interactions can intensify in remote or extreme environments. Building on past research of human-nature interactions (Altman & Wohlwill, 1983), Powell et al. (2009, 2012) adapted the interactional model to NBT, suggesting that the interactive exchange between tourists' characteristics and their physical and social environment can influence their experiential outcomes. Powell et al. (2009) first applied this model to the NBT experience in Grand Canyon National Park, USA. Their results revealed the importance of both tourist and tour characteristics in predicting changes in knowledge and general environmental behavioral intentions of tourists. Powell et al. (2012) later used this model as a lens to explore the interactional effects of the Antarctic tourist experience.

In this model, trip and tourist characteristics constitute the "input" elements. Trip characteristics refer specifically to the experience of guides and tour operators, trip itinerary and length of journey, activities, interpretation, educational, and learning opportunities offered (Powell et al., 2009). Tourist characteristics comprise socio-demographic (e.g., age, education, country) and motivational attributes of tourists. Among them, motivation is an important driving force behind tourists' travel decisions that can influence the experiential outcomes (Castellanos-Verdugo et al., 2016; Kim et al., 2015). Motivation is commonly measured by a battery of motivation domains and scales (Beh & Bruyere, 2007; Miller et al., 2020), but it can also be assessed through open-ended questions to capture a wider diversity of travel interests among tourists (Li et al., 2015; Manley et al., 2017). One travel motivation especially relevant to the polar region is last chance tourism, which has been defined as the interest of tourists to witness vanishing landscapes/seascapes and species that are threatened by climate change (Eijgelaar et al., 2010). Antarctica is a prime last-chance destinations that tourists may seek to visit "before its too late". Empirically, Vila et al. (2016) analyzed stakeholders' views (including tourists) about Antarctica as a last chance tourism destination, and found that not all Antarctic tourists are interested in protected the continent - many of them just want a last chance to glimpse a vanishing world.

In the interactional model, Powell et al. (2009, 2012) used the word "outcome" to cover variables evaluated *retrospectively* (after a trip experience), including variables such as learning and trip satisfaction as well as future pro-environmental actions to be taken by tourists. In this study, we re-conceptualize the former as "experiential outputs", and the latter as "pro-environmental outcomes". Accordingly, experiential outputs, such as learning and satisfaction, can be outcomes by themselves, but they may also be precursors or mediators for pro-environmental outcomes such as changes in attitudes, environmental concerns, and behavior intentions.

2.2. Experiential outputs of the NBT experience

In tourism contexts, learning is an active process resulting from the interaction with others and the informal settings where the activities take place (Falk et al., 2012). Learning is a uniquely personal and contextual experience that extends beyond the acquisition and

refinement of skills (Ballantyne et al., 2011; Falk & Staus, 2013; Gössling, 2018; Morgan, 2010). The choice of what, where, when, with whom, and why to learn rely largely on the tourists. Consequently, the perception of what has been learned can play an important role in producing trip experiences (Ballantyne & Packer, 2011; Falk & Staus, 2013).

Perceived learning and perceived benefits of travel have been examined for their role in constructing social experiences and acquiring skills (Asfeldt & Hvenegaard, 2014; Bakx et al., 2003; Stone & Petrick, 2013). These studies operationalized perceived learning using self-assessment questions in which the participants report how much they knew or had learned. Powell et al. (2008, 2005) measured changes in perceived learning of Antarctic tourists, finding an increase in their self-reported knowledge of the destination immediately after the trip. Beyond these investigations, little empirical work has explored the role of perceived learning as a driver of pro-environmental actions in NBT settings.

In contrast, measured learning is defined as the measured gains in specific cognitive knowledge (Bacon, 2016; Zsóka et al., 2013). In NBT research, measured learning during the tourism experience has been frequently analyzed (Kim et al., 2018; Powell & Ham, 2008; Tisdell & Wilson, 2005) but the results are mixed. Some authors argue that people with pro-environmental attitudes are more likely to seek environmental knowledge (Tisdell & Wilson, 2005). Others note that an increase in knowledge may not necessarily lead to short or long-term changes in actual pro-environmental behavior (Kim et al., 2018).

In this study, we conceptualize the learning experience of Antarctic tourists based on Kim et al. (2018)'s environmental knowledge construct, which differentiates perceived (subjective) learning and measured (objective) learning, as follows:

- **Perceived learning:** A tourist's self-assessment of knowledge increase concerning particular topics at the end of their trip (Bacon, 2016; Kim et al., 2018; Sitzmann, Ely, Brown, & Bauer, 2010)
- **Measured learning:** A tourist's cognitive change based on a comparison of objective knowledge quizzes administered before and after the trip (Kim et al., 2018; Sitzmann et al., 2010)

Satisfaction is another well-studied experiential output from a trip. Pizam and Ellis (1999) describes satisfaction is a subjective opinion based on a tourist's assessment after living different experiences. Satisfaction can be decisive in the creation of memories, behavior intentions, and attitudes toward a destination (Pestana et al., 2020). Despite extensive research, there is no consensus on the determinants of satisfaction (Marinao, 2018). Empirical research on satisfaction of Antarctic tourists is scarce. Powell et al. (2012) analyzed tourists' satisfaction and perceptions of trip quality immediately after the journey to Antarctica. They found that respondents were very satisfied with their overall experience, especially the quality of guides and interpretation.

2.3. Pro-environmental outcomes of the NBT experience

Pro-environmental outcomes can be defined as the positive change in attitudes, concerns, management preferences, and behavior intentions obtained through the tourism experience (Ballantyne & Packer, 2011; Chiu et al., 2014; Falk et al., 2012; Gössling, 2018). Research on pro-environmental outcomes and their antecedents is extensive (Larson et al., 2015; Ramkissoon & Mavondo, 2017; Landon et al., 2018; Yu et al., 2019). In a literature synthesis, Ardoin et al. (2015) concluded that outcomes related to measured learning had been more consistently reported than outcomes related to environmental attitudes and behavior intentions. Ramkissoon and Mavondo (2017) argued that pro-environmental behaviors could lead to more well-being and promote sustainability, and that collective learning could facilitate pro-environmental behaviors. Miller et al. (2020) examined the potential benefits of last chance tourism in the Arctic and found the polar

viewing experience facilitated visitors' pro-environmental behavior and ambassadorship intentions across all motivation groups. Studies in educational tourism and ecotourism settings have also identified perceived value of a destination and trip satisfaction as important precursors of tourists' pro-environmental outcomes (Bajs, 2015; Castellanos-Verdugo et al., 2016; Chiu et al., 2014).

Although pro-environmental outcomes from Antarctic travel may be expected and desired, empirical research demonstrating these outcomes is scarce. Powell et al. (2008)'s study of Antarctic tourists found that their knowledge of Antarctica increased significantly immediately after the journey; but three months after the trip, despite persistent knowledge gains, respondents only incrementally changed their pro-environmental behavior. A unique pro-environmental outcome advocated by the Antarctic tourism industry is the formation of ambassadorship through the "transformative" Antarctic experience. Alexander et al. (2020) examined this concept and defined an Antarctic Ambassador as "someone who has a connection to, knowledge of and passion for the Antarctic (as a space, place or idea), who represents and champions Antarctica and its values, and who supports Antarctica through communication and behavior" (Alexander et al., 2020, p. 6). Eijgelaar et al. (2010) analyzed the paradoxes of ambassadorship, last chance tourism and greenhouse emissions on Antarctic tourists. Their findings showed no improvement in proenvironmental behaviors among travelers, as at least 60% of their respondents did not feel that their travel had an impact on climate change, and less than 10% believed that their carbon emissions should be offset. Therefore, many questions continue to surround the role of tourists as potential ambassadors driven to reduce the impacts of climate change and protect the Last Frontier.

Despite limited research and inconclusive results, previous studies emphasize the importance of measuring pro-environmental outcomes as influenced by the tourist experience (Landon et al., 2018). In this study, we conceptualize pro-environmental outcomes as three main constructs:

- **Environmental concerns:** Attitude towards facts, one's own behavior, or others' behavior with consequences for the global environment (Fransson & Gärling, 1999).
- **Management preferences:** Level of support for potential management actions or practices that advance conservation and sustainable use of resources.
- **Behavior intentions:** The probability that individuals will undertake particular actions, inferred from people's statements (Hughes, 2013).

This above review reveals a significant research gap in Antarctic tourism, as no published study has compared perceived and measured learning or examined the potential mediating role of learning and satisfaction in the relationship between tourism inputs and pro-environmental outcomes.

3. Methods

3.1. Conceptual model

To address the identified research gap, we constructed a conceptual model based on Powell et al. (2009) (Fig. 1). Specifically, we examined the role of tourist motivation and trip characteristics as key inputs. We differentiated experiential outputs and pro-environmental outcomes to explore the potential role of satisfaction and learning as "mediators" or precursors of pro-environmental outcomes. We also differentiated perceived learning and measured learning to explore their respective influences on pro-environmental outcomes.

Guided by this conceptual model, we examined four research questions:

Q1: Is there a motivation-based typology of Antarctic tourists?

Q2. Are there differences in learning and pro-environmental outcomes before and after the trip?
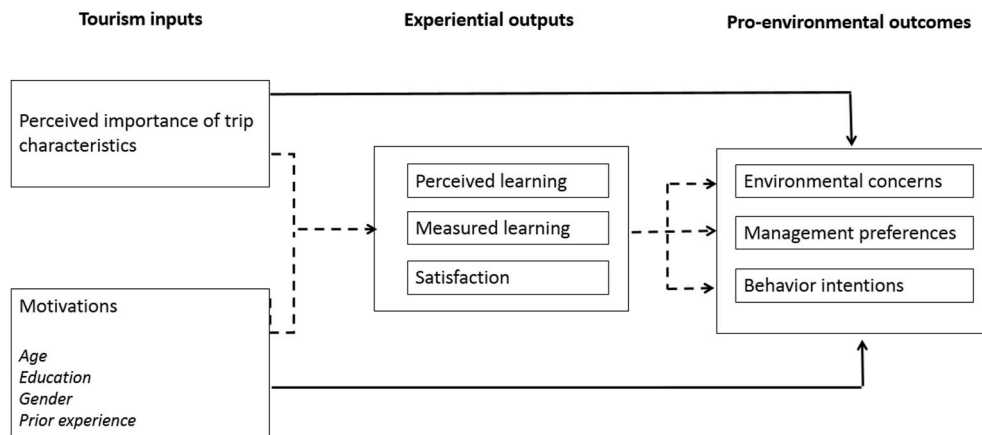
Tourism inputs   **Experiential outputs**   **Pro-environmental outcomes**

Fig. 1. Conceptual model showing the potential relationship between tourism inputs, experiential outputs, and their influence on pro-environmental outcomes.

Q3. What is the association of the perceived importance of trip characteristics and tourists' motivations (input variables) with experiential output and pro-environmental outcome variables?

Q4. Is there a potential mediating role of experiential outputs on the relationships between the input and outcome variables?

3.2. Survey administration and sample

Data were collected from December 2019 to March 2020. Three tour operators (2019 IAATO members) participated in the study, resulting in six trips surveyed. Participating operators of the traditional sea-borne peninsula modality (round trip cruise) distributed the pre-survey on the first day of embarkation and collected the post-survey on the last day of the tour before arriving at the port of disembarkation. Operators belonging to the air-cruise peninsula modality (one-way by air and other by cruise) were asked to distribute the pre-survey according to their mode of transport. Accordingly, if the outbound route was taken by air, surveys needed to be distributed and collected before landing in Antarctica and vice versa.

All passengers older than 21 were invited to participate in this survey even if they were traveling in the same group. To maximize consistency in survey administration, we provided the operators with survey packages containing printed questionnaires, protocols, scripts, and consent forms. These efforts resulted in 418 pre-and post-surveys for the sea-borne peninsula modality, and 137 pre-and post-surveys for the air-cruise peninsula modality. For the analyses reported in this paper, our sample is delimited to the *matched* pre-and post-surveys only (n = 242).

3.3. Questionnaire design

The survey instrument consisted of pre- and post-trip questionnaires available in English, French, and Chinese. Some questions were adapted from past research (i.e., Powell et al., 2008, 2009; Ballantyne et al., 2011; Manley et al., 2017) with wording adjusted for the Antarctic context. To assess the questionnaires' reliability and field protocols, we conducted a pilot of the pre-survey in February 2019 with Antarctic air-cruise tourists and subsequently clarified the wording and formatting.

The final version of the questionnaires contained 13 categories of questions divided into two sections. (Table 1). The first section of the pre-survey contained questions on demographics, *Perceived Importance of Trip Characteristics* (PITC) and travel motivation. The second section included four sets of questions on *Measured Learning* and the pro-environmental outcomes *Environmental Concerns, Management Preferences,* and *Behavior Intentions.* The post-survey questionnaire included two sections. The first section contained questions on *Satisfaction* and *Perceived Learning,* while the second section contained the same

questions about *Measured Learning* and pro-environmental outcomes as with the pre-survey. This survey instrument was approved by the Ethics Committee of Universidad Autónoma de Madrid CEI 102–1934.

3.4. Data analysis

To identify a typology of Antarctic tourists (Q1), we coded responses to the open-ended motivation question and attributed one label to every word or phrase. We repeated the process, until the point of saturation was reached (Saldaña, 2013). Labels with similar meanings were merged into categories, each of which was assigned as presence or absence to each respondent. To ensure reliability a second researcher reviewed the categories. The categorical (binary) motivation data were analyzed using the two-step clustering procedure in SPSS Ver. 25 (IBM, 2020a; 2020b). The final clustering solution was selected based on the Akaike Information Criterion (AIC), the silhouette measure of cohesion, and the separation index.

To assess changes in output and outcome variables following the trip (Q2), we applied the paired T-Tests to the individual items under the *Perceived* and *Measured Learning, Environmental Concerns* and *Management Preferences* constructs. We rescaled and log-transformed the dataset due to non-normality. For the individual items under the *Behavior Intentions* construct, because the questioning format was slightly different between the pre- and post-surveys, we applied one-sample T-tests to determine if responses were significantly above zero (not likely or not more likely) in the pre- and post-surveys, respectively. We used Chi-square tests to identify changes in quiz scores (*Measured Learning*).

We developed and validated scales for addressing Q3 and Q4. We used Cronbach's alpha to assess the reliability of items underlying the experiential output and pro-environmental outcome scales. *Perceived Learning* (α = 0.90) and *satisfaction* (α = 0.86) values demonstrated strong reliability. For the pro-environmental outcomes, our *Management Preferences* scale showed acceptable reliability (α = 0.72). We reduced the general *Environmental Concerns* to two items: "when humans interfere with nature it often produces disastrous consequences" and "humans are seriously abusing the environment". These items showed moderate reliability (α = 0.61), with no improvement by adding other NEP items. Accordingly, we combined these two items to represent one component: *humans abusing nature.* We also decided to retain *climate change concern* as an additional single-item variable pertaining to *Environmental Concerns* because (a) it is very relevant in the Antarctic context and (b) it was the only variable showing an observable change among the respondents.

To determine the dimensionality of trip characteristics (i.e., PITC) and *Behavior Intentions* variables, we performed Factor Analysis using Varimax with Kaiser Normalization in SPSS Ver. 25 (IBM, 2020a). PITC was defined by Factor 1 *tour operators and guides experience* (two items, λ

Table 1

Operationalization of constructs used to measure input, output, and outcome variables for Antarctic tourists, corresponding to the conceptual model in Fig. 1.

Variables	Measurements and Items Included	Survey Version
Tourism inputs		
Tourists' characteristics	Nine items (open-ended or categorical format): country, age, gender, education, past experience in nature-based tourism	Pre
Motivations	One open-ended question, "*What is your primary reason for taking this Antarctica trip?*"	Pre
Perceived importance of trip characteristics (PITC)	Seven items (11-point Likert scale from "not important at all" to "extremely important"): guides and operator experience, vessel amenities, itinerary, operators support for conservation, educational and interpretative opportunities	Pre
Experiential outputs		
Perceived Learning	Seven items (11-point Likert scale from "nothing at all" to "a huge amount"): self-reported learning about continents' origin, marine and terrestrial ecosystems, human history, human impacts, and policy	Post
Measured Learning	Eight true/false quiz questions based on Antarctic tour operators' websites: Antarctic ecological, historic, geology, and management	Pre/post
Satisfaction	Six items (11-point Likert scale from "not satisfied" to "extremely satisfied"): visitor satisfaction with interpretation and education opportunities, length of journey, activities, and excursions, itinerary, and overall service	Post
Pro-environmental outcomes		
Environmental Concerns	Four items from the NEP scale (Dunlap, 2008) (11-point Likert scale from "strongly disagree" to "strongly agree", or from "not at all worried" to "extremely worried"): respondents' views about ecological limits, balance of nature, human domination, and ecological catastrophe dimensions. Three additional items on Antarctica-focused concerns, including climate change, overfishing, and overtourism.	Pre/post
Management Preferences	Four items (11-point Likert scale from "strongly oppose" to "strongly support"): opposition or support to existing or potential management actions for Antarctica, including limitation of tourists, seasonal restrictions, designation of protected areas, and responsible travel.	Pre/post
Behavior Intentions	Nine items (11-point Likert scale from "no more likely" to "way more likely."): Future behavior intentions (following year), such as recycling, financial support, and sharing information. Note: the post-survey asked how *much more* likely tourists were to engage in a specific behavior after the trip.	Pre/post

= 3.03) and Factor 2 *activities and education opportunities* (five items, λ = 1.12), which explained 43.3% and 16% of the total variance, respectively. Similarly, for *Behavior Intentions*, we found Factor 1 *policy* support (five items, λ = 4.3) and Factor 2 financial support (two items, λ = 1.09), explaining 61.47% and 15.68% of the total variance, respectively. The single item *sharing information* was analyzed as an additional *Behavior Intentions* variable as it did not align well with either factor but was deemed important for the analysis. We removed the item "Use public or alternative transportation to reduce CO_2 emissions" from the analysis as this was inconsistently reported by tourists. After confirming the

reliability and validity of the scales and subscales in our survey, we used aggregate scale means in subsequent analyses.

Due to the non-normality of data, we computed Spearman correlations to analyze the correlations among *PITC* variables, experiential outputs, and all pro-environmental outcomes (Q3). The Kruskal-Wallis rank test was applied to compare motivation groups on experiential outputs and pro-environmental outcomes.

We used the mediation analysis package for R (Tingley et al., 2014) to explore the mediating role of experiential output variables (Q4). Following the mediation procedures, we first developed three regression models (Baron & Kenny, 1986). In our models, *PITC* variables were the independent variables (X), experiential outputs were the mediating variables (M), and pro-environmental outcome variables were the dependent variables (Y). Two simple linear regression models tested the relations of X→Y, and X→M, and a third multiple regression analyzed the relations of X + M→Y. To determine if the mediation effect was statistically significant (different from zero), we applied the bootstrapping test for its robustness with non-normally distributed data (Hayes & Preacher, 2014). . The statistical significance of ACME (Average Causal Mediation Effects) was used in our models to validate the existence of a mediating effect.

A complete mediation analysis requires numeric variables (Tingley et al., 2014) and was thus inappropriate for the categorical motivation variable. We applied the same sequence of three regression models explained above to explore the role of experiential outputs in the relationships between the input (motivation) and outcome variables without the bootstrapping procedure (Iacobucci, 2012). Considering the exploratory nature of this study and the small sample size, we used $p = .1$ as the significance level for all of these tests to avoid false-negative interpretations (Kim & Choi, 2021).

4. Results

Our final sample consisted of 242 pre and post matched surveys with a response rate of 22% across the six vessels surveyed. Half of the respondents (50%) reported as Australians. The remaining half reported different nationalities including the USA (27%), Canada (7%), UK (5%), and New Zealand (5%). The mean age of participants was 61 years old, with 50% of tourists within the age range 60–80 years old. About 18% of respondents were 40–60 years old while just 12% were younger than 40 years old. Among all groups, college (42%) and postgraduate (40%) degrees were the most common education categories.

4.1. Q1: typology of Antarctic tourists based on motivations

A total of 233 tourists responded to the motivation question, resulting in 41 labels which were grouped into 11 different categories (Fig. 2). The two-step clustering procedure generated four clusters as the highest cluster quality solution with a 0.4 silhouette measure of cohesion and separation index.

The *experiencing & learning about wild Antarctica* group (72, 31.0%) consisted of tourists highly interested in wildlife, landscape, and scenery features as well as enjoyment (e.g., traveling for pleasure and fun) (Fig. 2). "Learn more about Antarctica and its environment" and "understanding its influence in climate change" were important travel motivations for these tourists, who showed less interest in visiting Antarctica as a way to socialize with family and friends. Compared with the other groups, this group included the most diverse travel motivations.

The *social bonding in wild Antarctica* group (66, 28.3%) mentioned socializing as their main travel motivation. This includes the interests of traveling with family and friends, celebration (e.g., anniversaries and honeymoons), or spending time together during a holiday (Fig. 2). Interestingly, in more proportion than the other groups, this group also mentioned visiting Antarctica as they considered it as a last chance tourism destination. While wilderness constitutes an important part of
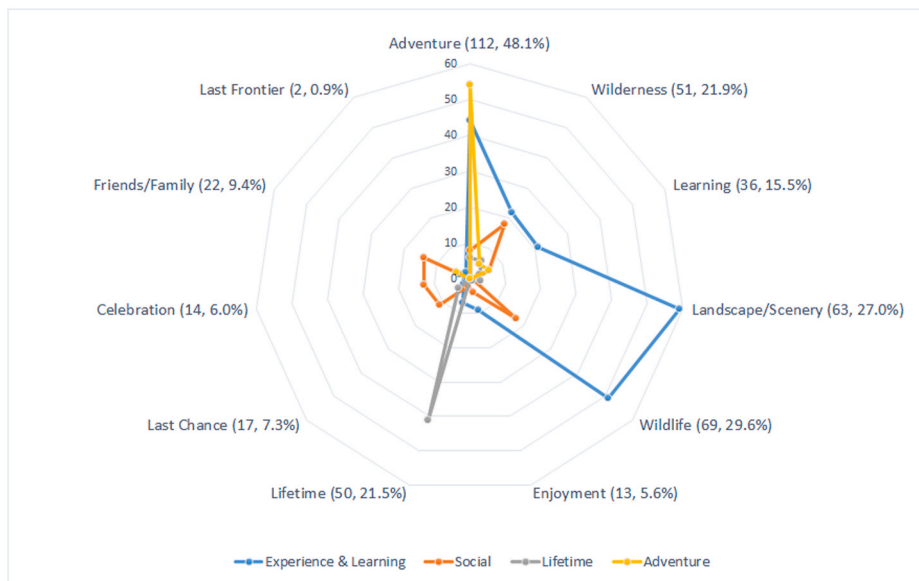
Fig. 2. Antarctic Tourism Motivation Typology. Cluster analysis revealed four identifiable color-coded motivation groups, visualized by frequencies of specific motivations reported within groups. Numbers in parentheses beside each of the 11 motivation categories correspond to the total number of responses per category and the general percentage of respondents who describe this theme within the overall sample (n = 233). . (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

their travel motivations, tourists under this group were less interested in adventure and were less likely to describe Antarctica as the trip of a lifetime.

The *adventure into Antarctica* group (54, 23.1%) included tourists who considered Antarctica as an adventure destination with associated activities. Tourists under this group mentioned visiting Antarctica as part of their bucket list (e.g., setting foot on all seven continents), an interest in exploring new places, and having a "new adventure in the wilderness". In a lower proportion, traveling for learning and traveling with friends and family were also part of their travel motivations. Notably, there was no mention of landscape, scenery, or wildlife as a motivation in this group (Fig. 2).

Tourists in the *trip of a lifetime* group (41, 17.5%) indicated consistently that visiting Antarctica constituted the "dream of a lifetime" after years of planning. Some tourists in this group were motivated to take the journey to fulfill a personal promise (i.e., visiting Antarctica as a promise made to a beloved person). In a moderate proportion, tourists under this group associated their motivation with the notion of Last Chance tourism, saying they needed to visit Antarctica "before it disappears" or it is "ruined by humanity". In contrast with the *adventure* group, this group sought out Antarctica with an unwavering focus on a personal commitment and goal rather than simply checking off a "bucket-list" (Fig. 2).

We observed a few demographic differences among motivation groups. The *experience & learning* and *social bonding* motivation groups comprised higher proportions of females (69% and 61%, respectively). Individuals in the *experience & learning* (49%) and *social bonding* (44%) groups were also more likely to have college degrees, while post-graduate education was more common for the *adventure* (43%) and *trip of a lifetime* (41%) groups. Average ages ranged from 59 to 63 years old among groups, but tourists in the *social bonding* group were typically younger than those in other groups. Almost all participants across motivation groups (96%) reported this was their first trip to Antarctica. However, the *adventure* (65%) and *experience & learning* (68%) groups reported the highest percentages of previous NBT experiences within the last three years (Supplementary material, Table S1).

4.2. Q2: differences in learning and pro-environmental outcomes before and after the trip

Comparisons of individual output and outcome items between the pre- and post-surveys revealed generally positive but variable changes.

For example, *Measured Learning* increased overall but changes varied across the eight quiz questions. The overall mean scores of the knowledge test increased significantly from 4.86 to 5.57 (corresponding to 9% increase) between the two survey (t (241) = −6.35, p = .0001). Chi-square tests, however, revealed significant variability across the individual quiz questions.

Perceived Learning and *Satisfaction* were only assessed in the post-survey. The overall mean satisfaction was high (M = 9.41). Most (93.3%) tourists were extremely satisfied with the "overall quality of the trip", being the highest mean among all items tested. Respondents were also extremely satisfied with the "educational, learning opportunities provided" (85%), and "the level and amount of interpretation provided" (78%). The overall mean score for *Perceived Learning* was M = 8.14. With the highest percentages among all items tested, tourists reported having learned a huge amount about "Marine ecosystems" (60%) and "human history in Antarctica" (51%).

We found no significant changes before and after the trip for the *Environmental Concerns* construct *humans abusing nature. humans are seriously abusing the environment* We did not find any significant changes in climate change concern. Under the *Management Preferences* construct, the items "limit the number of visitors to Antarctica" (t (241) = 2.17, p = .030) and "establish seasonal restrictions on human access to sensitive sites" (t (241) = 1.80, p = .072) showed a significant increase in means after the trip.

The overall mean for the nine *Behavior Intentions* items in the pre-survey was M = 7.96, reflecting tourists had a strong intent to adopt pro-environmental behaviors even before the trip. When assessing individual items of the post-survey we found that "sharing information" (M = 8.59), "support policies and regulations that limit tourist activities in sensitive natural areas" (M = 8.16) and "minimize impacts when visiting natural areas" (M = 8.01) had the highest means. The overall mean for nine *Behavior Intentions* items in the post-survey was M = 7.36. All items on the post-survey were significantly different from zero, indicating tourists were much more likely to perform these pro-environmental behaviors after the trip.

4.3. Q3: association of perceived importance of trip characteristics and tourists' motivations with experiential output and pro-environmental outcome variables

Kruskal-Wallis tests revealed few differences in *PITC* among motivation groups, with one exception. The *trip of a lifetime* group reported a

higher mean for the variable *activities and education opportunities* when compared with the other three groups (H (3) = 8.05, p = .044). Pairwise comparisons revealed significant differences with the *adventure* (p = .069) and *social bonding* (p = .069) groups, specifically.

With respect to outputs, we found highly significant correlations between the *PITC* variable *activities and education opportunities* and both *Perceived Learning* (ρ (240) = 0.38, p < .0001) and *Satisfaction* variables (ρ (240) = 0.26, p < .0001) (Table 2). *PITC* variable *operator and guides' experience* were also significantly correlated, to a less extent, with *Perceived Learning* (ρ (240) = 0.12, p < .043) and *Satisfaction* (ρ (240) = 0.19, p < .002). Regarding the pro-environmental outcomes, both *PITC* variables were significantly correlated with the *Behavior Intentions*. The variable *Operator and guides experience* was linked to the dimensions of *policy* support (ρ (240) = 0.13, p < .035), financial support (ρ (240) = 0.12, p < .044) and *sharing information* behavior (ρ (240) = 0.13, p < .037). While *Activities and education opportunities* were associated with *Management Preferences* construct (ρ (240) = 0.12, p < .048) and the dimensions of *policy* support (ρ (240) = 0.15, p < .015) and financial support (ρ (240) = 0.17, p < .005) corresponding to *Behavior Intentions* (Table 2).

Only two significant correlations were identified between motivation groups with the output constructs. Kruskal-Wallis tests (Table 3) revealed significant differences in means for *Perceived Learning* (H (3) = 7.53, p = .056), with the *trip of a lifetime* group reporting the highest levels of this output (M = 8.66) significantly higher than the *social bonding* group (p = .053). *Measured Learning* outputs were also different (H (3) = 6.67, p = .082), with the *experience & learning* group (M = 0.13) reporting the highest overall mean, significantly higher than the *adventure* group (p = .082).

4.4. Q4: the role of experiential outputs on the relationships between the input and outcome variables

4.4.1. Mediation analyses for perceived importance of trip characteristics (PITC)

Based on the mediation analysis protocols (Baron & Kenny, 1986), we obtained significant results for the linear regression X→M when *PITC* = X and *Perceived Learning* = M (Fig. 3a). The variable *tour operators and guides experience* was significantly associated with *Perceived Learning* (β = .15, t (240) = 1.66, p < .097). Similarly, *activities and education opportunities* were significant associated with *Perceived Learning* (β = 0.54, t (240) = 6.14, p < .0001). Conditional on our model

assumption X→M→Y (Fig. 3a), and using *PITC* as the input variable, the mediation analysis showed that *Perceived Learning* could partially explain the relationship with the outcome variables *Environmental Concerns* and with the *Behavior Intentions* dimensions of *policy* support, financial support, and *sharing information.*

We also performed the mediation analysis protocols for the relation X→ M, when *PITC* = X and *Measured Learning* = M, and mediation analysis for the relation X→M→Y. Regression results showed no significant associations for both *PITC* variables, nor did we identify any significant mediation effect of *Measured Learning* (Fig. 3a and b).

We obtained significant results for the linear regression X→M when *PITC* = X and *Satisfaction* = M. The variable *tour operators and guides experience* was significantly associated with *Satisfaction* (β = .12, t (240) = 2.59, p < .010). Similarly, *activities and education opportunities* were significantly associated with *Satisfaction* (β = 0.18, t (240) = 3.96, p < .0001). Conditional on our model assumption X→M→Y (Fig. 3b), our mediation analysis showed that *Satisfaction* could partially explain the relationship with the outcome variables *Management Preferences* and the *Behavior Intentions* dimensions of *policy* support, financial support, and *sharing information.*

4.4.2. Exploring the mediating role of experiential outputs with motivation groups

We developed multiple linear regressions to investigate whether motivation (a categorical variable) and experiential outputs were significantly associated with pro-environmental outcomes (X + M→Y).

Our results indicated that the *adventure* group and *Perceived Learning* were significantly associated with the three dimensions of the *Behavior Intentions* construct (Fig. 4a); *sharing information* exhibited the largest regression coefficient (β = 5.67, t (228) = 7.38, p < .0001). When analyzing the relationship of this same motivation group and *Measured Learning* (Fig. 4b), we also found significant relationships with the *Behavior Intentions* dimension *sharing information* (β = 8.53, t (228) = 31.10, p < .0001) and *Management Preferences* (β = 0.43, t (228) = 2.86, p = .005). Similarly, the *adventure* group and *Satisfaction* were significantly associated with the *Behavior Intentions* dimensions *of policy* support and financial support (Fig. 4c), with the latter exhibiting the highest coefficient (β = −4.16, t (228) = −5.09, p < .0001).

The *trip of a lifetime* group and *Perceived Learning* were significantly associated with the outcome variable *Management Preferences* (β = −0.53, t (228) = −2.31, p = .021). When we analyzed this motivation group and *Measured Learning,* we also found significant associations with the *Management Preferences* (β = −0.49, t (228) = −2.10, p = .036). Similarly, this motivation group and the *Satisfaction* output variable were significantly associated with the variable *Management Preferences* (β = −0.56, t (228) = −2.43, p = .016).

5. Discussion

This research strives to improve our understanding of the inputs, outputs, and outcomes of Antarctic tourists' experience (Fig. 1). The conceptual model we proposed resonates with past conceptualizations of the basic linear and temporal structure of the tourist experience (Gretzel et al., 2006). However, our model also demonstrated that input (e.g., motivations, trip characteristics) and output variables (learning, satisfaction) interact in different ways to influence pro-environmental outcomes.

5.1. Motivation-based typology of Antarctic tourists

We identified four distinct motivation groups of Antarctic tourists, including those seeking: 1) *experience & learning* (31%), 2) *social bonding* (28.3%), 3) *adventure* (23.1%), and 4) *trip of a lifetime* (17.5%) (Fig. 2).

Empirically-based motivation typologies are rarely reported in polar settings, but this grouping aligns with a few polar studies which reported different motivation categories. For example, Manley et al. (2017)

Table 2
Spearman correlations of Perceived Importance of Trip Characteristics (input) variables vs. experiential outputs and pro-environmental outcomes reported by Antarctic tourists (n = 242).

	PERCEIVED IMPORTANCE OF TRIP CHARACTERISTICS	
	Operator and guides' experience	Activities and education opportunities
	ρ (p)	ρ (p)
Experiential outputs		
Perceived Learning	**0.12 *(.043)* ***	**0.38 (<.001) ****
Measured Learning	−0.05 *(.404)*	−0.09 *(.143)*
Satisfaction	**0.19 *(.002)* ***	**0.26 (<.001) ****
Pro-environmental outcomes		
Environmental Concerns		
Humans abusing nature	−0.01 *(0.837)*	−0.03 *(.635)*
Climate change	−0.05 *(0.37)*	0.01 *(.824)*
Management Preferences	−0.03 *(.631)*	**−0.12 *(.048)* ***
Behavior Intentions		
Policy support	**0.13 *(.035)* ***	**0.15 *(.015)* ***
Financial support	**0.12 *(.044)* ***	**0.17 *(.005)* ****
Sharing information	**0.13 *(.037)* ***	0.07 *(.257)*

Significance levels: ‡ p < .1, *p < .05, **p < .01, ***p < .001.

Table 3
Results of Kruskal-Wallis one-way analysis of variance examining differences in experiential outputs and pro-environmental outcomes for different Antarctic tourist motivation groups.

MOTIVATION CATEGORIES						
	Adventure n = 54	*Exp. and learning n = 72*	*Lifetime of a lifetime n = 41*	*Social bonding n = 66*	*Kruskal-Wallis test*		
	M (SE)	*M(SE)*	*M(SE)*	*M(SE)*	H	df	p
Experiential outputs							
Perceived Learning	8.13 (0.18)	8.08 (0.18)	8.66 (0.17)	7.84 (0.20)	7.53	3	**.056** ⱡ
Measured Learning	0.01 (0.03)	0.13 (0.02)	0.10 (0.03)	0.10 (0.02)	6.67	3	**.082** ⱡ
Satisfaction	9.30 (0.11)	9.40 (0.09)	9.59 (0.07)	9.39 (0.08)	1.95	3	.580

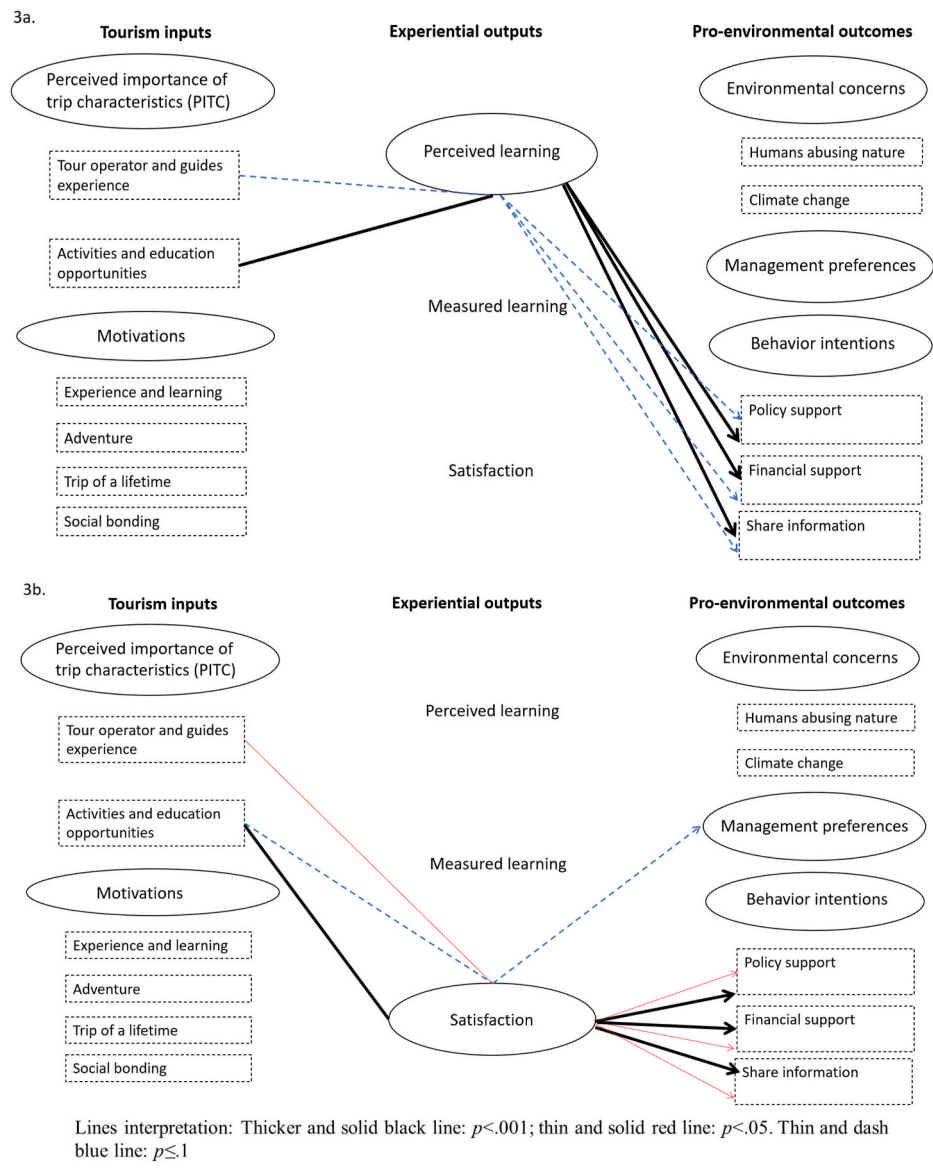Significance levels: ⱡ p < .1, *p < .05, **p < .01, ***p < .001.

Fig. 3. Graphical summary of mediation analysis results when analyzing *PITC* as the input variable and experiential outputs as the potential mediators in the generation of pro-environmental outcomes for Antarctic tourists. Fig. 3a shows the statistical significance when *Perceived Learning* was tested as a mediating variable while Fig. 3b shows the statistical significance when *Satisfaction* was tested as a mediating variable. In both cases, *PITC* was the input variable and pro-environmental outcomes were analyzed as the output variable.

Lines interpretation: Thicker and solid black line: *p*<.001; thin and solid red line: *p*<.05. Thin and dash blue line: *p*≤.1

analyzed the motivation of Arctic cruisers with an open-ended question, and their motivation categories captured elements similar to our groups, such as lanscape, wildlife, adventure and learning. Recently, Miller et al. (2020) created a typology of polar bear tourists using K-means clustering based on different aspects of the polar bear experience. Their motivation groups vary from "holistic viewers" to "no expectations," and specific interests (e.g., wildlife observation, cultural interactions) were embedded within these groups. Several highly cited motivations

that emerged from Powell et al.'s (2008) study of Antarctic tourists (e.g., enjoyment of nature, wildlife, adventure, and wilderness) constituted the same defining characteristics in our *experience & learning* group. Quotes from Powell et al. (2008) alluding to the lifetime significance of the Antarctic journey also resonated with the sentiments expressed in our *trip of a lifetime* group.

Our results are also comparable to those in other NBT settings. For example, Beh and Bruyere (2007) identified different visitor segments
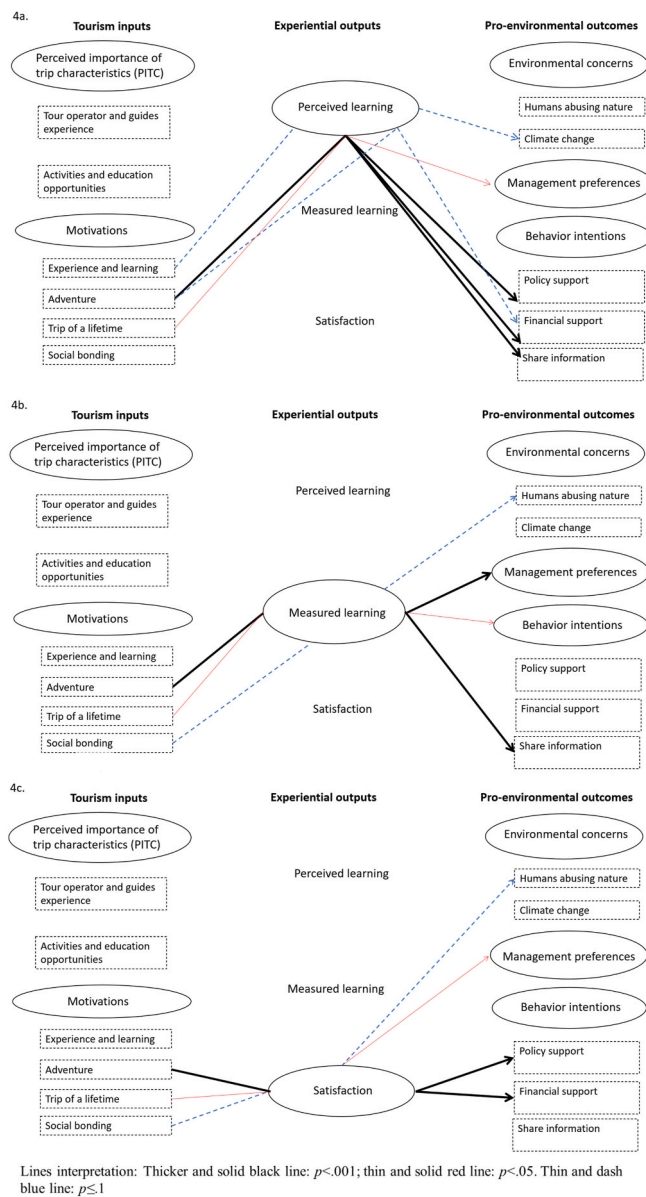
Fig. 4. Graphical summary of multiple regression analyses to assess the influence of motivation groups and the output variables. Fig. 4a shows the influence of *Perceived Learning*, Fig. 4b shows the influence of *Measured Learning* and Fig. 4c shows the influence of *Satisfaction* in facilitating pro-environmental outcomes. In all cases, the input variable corresponds to the different motivation groups and the output variables corresponds to pro-environmental outcomes.

based on motivation scales and K-mean clustering. Their "learner" group, similar to our *experience & learning* group, reinforced the idea of learning as an essential output of NBT experiences. Rice et al. (2020) also identified similar motivation categories among the visitors to Grand Teton National Park, including scenery, socialization, adventure, sharing, and achievement.

The motivation groups we identified illustrate nuanced differences that could help to define unique segments of the Antarctic tourism market. For example, Adventure is a common motivation among both Antarctic and NBT tourists (Huddart & Stott, 2019). Past research on adventure tourism in NBT settings has noted that adventure activities could be emotionally, cognitively, and often physically engaging due to the immersive experiences they produce (Su et al., 2020). Our study revealed a distinct *adventure*-oriented group of Antarctic tourists who

may be less interested in learning and specific ecosystem components than many tour operators expect.

Although *social* motivations to take the Antarctic journey have been reported (Powell et al., 2008), our study confirms its importance as the second-largest group in our sample. Social bonding via luxurious visits to unique environments is growing in NBT destinations around the world, and Antarctica is no exception (Huddart & Stott, 2019). Considering future trends and the characteristics of the Antarctic tourism operation, we can expect a potential increase of these tourists in Antarctica. Hence, our results underscore the importance of understanding the motivations of both the *adventure* and *social bonding* groups of tourists to better connect them with opportunities for a transformative experience (Morgan, 2010; Wolf et al., 2019).

We found that visiting Antarctica as a last chance tourism destination was often mentioned by the *social bonding* and *trip of a lifetime* groups. Tourists' desire to witness the world's most endangered sites before they vanish is a phenomenon also studied in other natural settings (Lemelin et al., 2010). Examples include the Great Barrier Reef (Piggott-McKellar & McNamara, 2017) and the Arctic (Groulx et al., 2016; Miller et al., 2020). Kucukergin and Gürlek (2020) argue environmental deterioration exacerbated by climate change and other threats has triggered a new travel trend, which can add to ecosystem stresses but also present opportunities. As Miller et al. (2020) point out, these "last chance" tourists may be keen in connecting with nature and have a stronger intent to engage in pro-environmental behaviors.

5.2. Experiential outputs produced by the trip

Among the three experiential outputs (i.e., *Perceived Learning, Measured Learning,* and *Satisfaction*) we analyzed, most respondents reported high satisfaction levels on their journey and emphasized the overall quality of the trip. This result corroborates with Powell et al. (2012)'s study in which over 97% of their respondents selected the top categories for overall trip quality, despite using a different satisfaction scale. Satisfied visitors are common in many NBT settings (Moore & Driver, 2005; Tonge et al., 2011) but exceptionally high levels of satisfaction may be more peculiar to polar tourism. As Miller et al. (2020) point out; this could be associated with the uniqueness of the travel experience and the high-end quality of operations.

We identified a 9% overall increase in tourists' *Measured Learning* after the trip, but the changes varied across individual quiz questions and the increases were not even across motivation groups. These results corroborate with Ballantyne et al.'s (2011, 2009) observations that increases in knowledge after a trip are not necessarily assured and could vary based on different motivations and interests. In the Antarctic context, Powell et al. (2008) analyzed the retention of knowledge of tourists immediately after the journey and highlighted the need to investigate the long-term retention of knowledge and its influence on reinforcing pro-environmental outcomes. In other NBT settings, research has shown that visitors who received informative material after the trip maintained or increased scores on measured learning (Hughes et al., 2011). However, tracking these long-term effects, while valuable, can be complex and costly (Ardoin et al., 2015).

We found differences with respect to motivation groups with the questions examining *Perceived Learning*. Across different motivation groups, results showed that the *trip of a lifetime* group had significantly higher mean values on both overall and specific *Perceived Learning* items. These results indicate the importance of *Perceived Learning* as an experiential output, aligning with past research illuminating the importance of visitor perceptions in the construction of tourism experience (Asfeldt & Hvenegaard, 2014), which is especially important for Antarctica where the aim is to create advocacy for the conservation of the continent.

5.3. Trip-related changes in pro-environmental outcomes

When analyzing specific items of the general *Environmental Concerns* construct before and after the trip, we found that tourists were less likely to think that humans abused the environment and reported no increase in their concern about climate change. These findings align with Powell et al.'s (2008) results that did not show attitude changes among Antarctic tourists. Such patterns may be an artifact of a "ceiling effect", which has also been reported in past NBT studies (Ardoin et al., 2015; Larson et al., 2015). When visitors arrive with high levels of pro-environmental values, beliefs, and behaviors, the detection of additional changes produced by the tourism experience becomes challenging.

Despite the absence of notable changes in pro-environmental outcomes, follow-up analyses suggested that tourists with the lowest levels of pre-trip *Environmental Concerns* were most likely to exhibit changes after the trip. This suggests that the positive effects of the Antarctic experience may be more pronounced for tourists who are less predisposed to care about environmental conservation. For specific *Behavior Intentions* statements, we also found that tourists tend to be "much more likely" to visit natural areas, support tourism policies, and share information following their trip. Similar changes were also reported from studies in other NBT settings (Ballantyne et al., 2011).

5.4. Motivations and trip characteristics association with experiential outputs and pro-environmental outcomes

We found that both components of *PITC* were important attributes to tourists, with the variable *tour operators and guides experience* rated as most important. We also found that the two *PITC* trip attributes were significantly correlated with the experiential outputs *Perceived Learning* and *satisfaction,* reinforcing Powell et al. (2012) results arguing that trip attributes affect tourists' satisfaction and perceptions.

The *trip of a lifetime* group was significantly correlated with the experiential outputs *Perceived* and *Measured Learning*. However, none of the motivation groups were directly correlated with pro-environmental outcomes. This finding underscores the importance of understanding how different types of "free choice" learning might be influenced by unique interests and motivational orientations (Falk & Staus, 2013).

In contrast to Miller et al. (2020), who found the polar bear viewing experience was significant in facilitating pro-environmental outcomes for all motivation groups, our results showed that only certain combinations of motivation groups and experiential outputs were significantly associated with pro-environmental outcomes. For example, the *adventure* group was most likely to report increases in *Behavior Intentions*, especially if their *Perceived Learning* and *Satisfaction* were high. This reveals the importance of creating meaningful, memorable, and long-lasting experiences for *adventure* tourists. The *trip of a lifetime* group, in combination with all the experiential outputs, showed a positive association with *Management Preferences*. This suggests that tourists taking the Antarctic trip as their lifetime dream or personal fulfillment may be more inclined to support specific policies and management actions designed to protect Antarctica.

Our mediation analysis results for *PITC* suggest that *Perceived Learning* and *Satisfaction* could mediate relationships between tourism inputs and pro-environmental outcomes, especially for the variables on the *Behavior Intentions* construct (Figs. 1 and 3). These results align with past research in which perceived learning was shown to influence various pro-environmental outcomes (Bacon, 2016; Kim et al., 2018). Therefore, perceptions and trip-related satisfaction are decisive in the creation of memories, behavioral intentions, and attitudes toward a destination (Pestana et al., 2020, Ramkissoon & Mavondo, 2017). By enhancing satisfaction and perceived learning, tour operators could increase tourists' potential to advocate for a specific cause as well as their engagement in actions in support of a destination's protection. Ultimately, these shifts suggest that tourism may help to create Antarctic

ambassadors who could embody the key elements of the ambassadorship concept (Alexander et al., 2020; Bajs, 2015; Tisdell & Wilson, 2005).

5.5. Limitations

Our study has some important limitations. The complexity of Antarctic tourism operations makes it infeasible to maintain a researcher onboard a ship or plane for administering surveys. Our study relied on the support of tour operators (i.e., tour leaders) for the distribution and collection of surveys among passengers. This had a direct impact on the response rates and potentially unexpected deviations from the survey administration protocols.

The demographic attributes of our sample bear considerable similarities with others that have been previously reported in Antarctica, showing that the majority of Antarctic tourists are elderly, highly educated, and have previous nature-based tourism experiences (Powell et al., 2009, 2012). However, sampling bias remains a concern. Australians were the most dominant nationality in our sample, which is different from the two most dominant groups reported by the IAATO statistics (2019), namely American and Chinese tourists. Little is known about nationality-related differences in Antarctic tourists. Considering the emerging markets and diversification of the Antarctic tourism industry, future work should be expanded to incorporate different modalities and tour operators.

Our scope of conceptualization limited the number of indicator items and variables in our analyses. Specifically, we only analyzed the relationships of input and output variables and the potential mediating effect of experiential outputs. Consequently, we have not exhausted all the potential causal models that may account for correlations in the variables we observed. A structural equation modeling approach might shed more light on the nuanced relationships among these inputs, output, and outcome variables (Fiedler et al., 2018).

Despite expanded response scales, our survey instruments did not effectively address the ceiling effect of tourists' responses. Although our open-ended motivation question afforded inclusive responses in constructing the typology, categorical/binary data generated were not suited to mediation analysis protocols. A larger and more diverse data set, including qualitative data, would afford us a deeper understanding of the nuances of our motivation typology and the complexity of tourism outcomes.

5.6. Management and research implications

We derived the first empirically based motivation typology of Antarctic tourists, which illustrates a diversity of experiences sought. A better understanding of tourists' motivations can advance the tourism industry's efforts in developing promotion, programming, and communication strategies to facilitate meaningful experiences and pro-environmental outcomes. For example, instead of focusing only on the well-known Antarctic wildlife and landscapes, promotional stories specifically highlighting the transformative nature Antarctic journeys could resonate with prospective tourists in the *trip of a lifetime* group. Additionally, recent research has suggested that sharing has an important role in shaping the tourist experience and perceptions of a destination through the development of social connectedness (Kim & Fesenmaier, 2017). Communication strategies focused on social media could therefore be particularly relevant to the *social bonding* group, facilitating shared experience and potential support for a special destination where bonds may be strengthened.

For some Antarctic tourists, actual post-trip gains in knowledge may not facilitate pro-environmental outcomes. However, perceptions of what has been learned could accomplish this goal. Because the guides' and tour operators' experience is an attribute highly valued by tourists, tour operators could work with their uniquely qualified trip leaders to design interpretive strategies for specific audiences. These strategies

should extend beyond participation in formal lectures. As argued by Ramkissoon and Mavondo (2017), collective learning could facilitate pro-environmental outcomes among tourists. Therefore, learning opportunities could be designed to integrate diverse contents and delivery formats (e.g., learning games) that appeal to tourists with different motivations (e.g., *social bonding*), some of whom may not be initially inclined to Antarctica protection. Such creative educational experience might not only attract many tourists who value education as an important trip characteristic; it might also sustain interest and participation throughout the trip even among those who do not, solidifying thematic take-home messages that lead to long-term attitudinal and behavioral change.

The amount and availability of educational opportunities onboard is an attribute valued by tourists and may constitute a crucial element when deciding on a trip. Recent increases in Antarctic citizen science projects, such as the FjordPhyto (Cusick et al., 2020), the Mapping Application for Penguin Populations, and Projected Dynamics (MAPPPD, 2020), offer excellent potential to integrate hands-on learning into the tourist experience. Informal reports suggest that tourists participating in these citizen science projects tend to enhance their Antarctic engagement not only by increasing their learning (measured and perceived) but also by increasing their overall trip satisfaction (M. Mascioni, personal communication, November 15, 2020). The growing body of citizen science literature would be useful in informing future programming choices, alignment with specific tourist motivation groups, and systematic program evaluations (Larson et al., 2020).

Unpredictable global change has made Antarctica a preeminent "last chance tourism" destination. As tourism operations on the continent continue to diversify (Carey, 2020), more participatory, immersive, and intentionally differentiated opportunities may be needed to cultivate an expanding corps of Antarctic ambassadors. IAATO operators are crucial stakeholders and should be leaders in achieving this goal guided by a conservation-oriented philosophy. As Alexander et al. (2020) contend, there is a need of taking tourists from "talking the talk" to "walking the walk" concerning pro-environmental actions and outcomes. To the end, IAATO operators can play an active role in materializing this concept by empowering their guests with the tools they need to become life-long advocates for the Last Frontier.

Further dedicated and longitudinal research would provide new insights regarding Antarctic tourists' motivations, experience, and outcomes (Ramkisson & Mavondo, 2017, Hayes & Preacher, 2014), and the relationships among different constructs (i.e., place attachment, place satisfaction) and pro-environmental outcomes (Ramkisson et al., 2013). At a broader level, as authors have analyzed the concept of last chance tourism and implications of Antarctic ambassadors, a big question arises: Is promoting travel to this vanishing destination to become an ambassador worth the environmental tradeoffs? How can we reconcile the ethical and ecological consequences of travel to Antarctica with the potential benefits of enhanced advocacy and stewardship? Alexander et al. (2020) underscored the need to maximize the positive effects of interactions with the place and investigate ways in which ambassadorship can be effectively cultivated in support of the conservation of our Last Frontier. This need is taking on a new urgency as we venture into a post-pandemic and warmer world.

Management implications

Tourists traveling to Antarctica hold a diversity of expectations and motivations. These motivations interact with trip characteristics to influence tourists' experiences. Enhanced understanding of these relationships could contribute to the Antarctic tourism industry efforts to develop strategic promotion, programming, and communication strategies that produce meaningful experiences and foster pro-environmental outcomes. As tourism diversifies, we should reflect on how the Antarctic tourist experience could become more customized

and participatory, effectively inspiring Antarctic tourists to serve as stewards and ambassadors for the Last Frontier.

CRediT authorship contribution statement

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jort.2021.100454.

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