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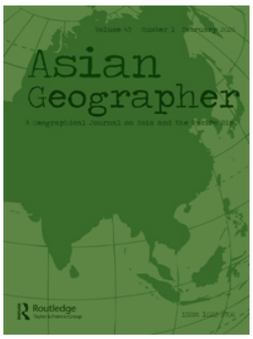

Asian Geographer

ISSN: 1022-5706 (Print) 2158-1762 (Online) Journal homepage: www.tandfonline.com/journals/rage20

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To cite this article: Ke Zhang, Lewis T.O. Cheung, Theresa W.L. Lam, Anson T.H. Ma & Lincoln Fok (17 Apr 2026): Exploring the segmentation of Chinese recreational divers based on recreational specialization, Asian Geographer, DOI: 10.1080/10225706.2026.2660099

To link to this article: https://doi.org/10.1080/10225706.2026.2660099

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https://doi.org/10.1080/10225706.2026.2660099

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Exploring the segmentation of Chinese recreational divers based on recreational specialization

Ke Zhang [a], Lewis T.O. Cheung [b,c], Theresa W.L. Lam [d], Anson T.H. Ma [e] and Lincoln Fok [a]

[a]Department of Science and Environmental Studies, The Education University of Hong Kong, Hong Kong, Hong Kong; [b]York Business School, York St. John University, York, UK; [c]Department of Social Sciences and Policy Studies, The Education University of Hong Kong, Hong Kong, Hong Kong; [d]School of Agriculture, Food and Ecosystem Sciences, University of Melbourne, Melbourne, Australia; [e]Fenner School of Environment and Society, Australian National University, Canberra, Australia

ABSTRACT

Recreational specialization has been a crucial theoretical concept in understanding tourists' traveling preferences. However, few studies have utilized this concept to explore the potential variations in divers' preferences for diving, including their sociodemographic characteristics. This limitation is especially relevant to Hong Kong's scuba diving tourism industry, as a perceivable absence of focus on understanding the factors determining divers' preferences has been documented, particularly among Chinese scuba divers. Considering this theoretical gap, this study collected data from 398 divers at four of Hong Kong's popular dive locations to narrow this research gap. Methodologically, k-means cluster analysis, one-way ANOVA, chi-square, and an independent sample t-test were utilized in analyzing the data to assist in answering the research questions of whether any significant difference between divers' sociodemographic features and their preferences could be observed across the possible divers' market segments, based on their levels of specialization. The results demonstrated that two Chinese scuba diver segments in Hong Kong could be identified based on their levels of specialization, including a cluster of "advanced divers" and another of "novice divers". In addition, divers' sociodemographic characteristics and preferences for diving have also shown a substantial variation between the two distinct market-based specialization segments. Based on these findings, research implications and limitations were systematically discussed and addressed, aiming to provide meaningful practical and theoretical support for future studies.

ARTICLE HISTORY
Received 22 January 2024
Accepted 4 December 2025

KEYWORDS
Diving preferences; segmentation; recreational specialization; scuba divers; market

Introduction

It is common knowledge that scuba diving generates remarkable economic and social benefits. For instance, Tapsuwan and Asafu-Adjaye (2008) revealed that scuba diving

CONTACT Lewis T.O. Cheung t.cheung@yorksj.ac.uk York Business School, York St. John University, Lord Mayor's Walk, YO31 7EX York, UK

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had substantial financial success, contributing a total value of US$54.96 million to Thailand's tourism economy around the Similan Islands. Concerning its social impacts, Gregory and Dimmock (2019) indicated that scuba diving could have numerous physical and psychological benefits, particularly among aged Australian women, to help enhance their sense of well-being.

Despite these well-documented benefits, studies also emphasized that increasing the volume of recreation, accompanied by growing tourist visitation without proper management planning, can reduce amenity values and aggravate biological damage to the travel destinations (Davis and Tisdell 1996; Hasler and Ott 2008; Kim, Lee, and Sirgy 2016; Musa 2002), leading to decreased tourist satisfaction from not returning and, in turn, harming the sustainable tourism economy (Gill, Schuhmann, and Oxenford 2015). In light of these challenges, scholars indicated that understanding factors contributing to tourist preferences would be significant and could somewhat help enhance tourist satisfaction and promote tourism sustainability (Giglio, Luiz, and Schiavetti 2015; Musa 2002; Musa, Kadir, and Lee 2006). To achieve this objective, several key theoretical and methodological approaches, including conjoint analysis (Pai and Ananthakumar 2017; Vukic, Kuzmanovic, and Kostic Stankovic 2015), market segmentations (Chen, Bao, and Huang 2014; Fung and Jim 2015; Hu and Yu 2007; Lee and Jan 2019; Park and Yoon 2009), and the choice experiment approach (Selomane and Van Ierland 2012; Zong et al. 2017), have been widely employed by researchers to better understand and model tourists' preferences for recreation and traveling. These methods are recognized for their effectiveness in enhancing tourist satisfaction and supporting tourism sustainability within the global tourism research framework.

Among these concepts, there is no denying that market-based segmentation is especially outstanding, given its advantage of facilitating efficient marketing planning and resource allocation by enabling an understanding of tourists' setting preferences (Otoo, Kim, and Choi 2020). However, a key issue is that it may oversimplify individual behaviors and preferences despite its great significance in segmenting and understanding tourists' market demands, as it often fails to capture the full complexity of personal preferences, particularly given the wide variation in tourists' engagement levels within a leisure context. To compensate for this shortcoming, a framework known as "recreational specialization" has been widely applied by scholars to describe the diversity of behaviors and preferences among outdoor recreationists. It segments the nuanced dynamics of how individuals engage with leisure activities, providing a detailed classification of participants along a continuum of expertise from novices to specialists (Bryan 1977; Stemmer et al. 2022).

Given its ability to reflect the varying levels of tourist segmentation relevant to tourism marketing assessment, it has been widely adopted as an enhanced segmentation approach for understanding diverse patterns of tourist participation preferences across different outdoor recreation settings. For example, Song et al. (2018) applied specialization-place attachment typology as the segmentation strategy to understand hikers' satisfaction and their likelihood of returning to revisit the Olle Trail of Jeju Island, aiming to develop new leisure market opportunities for hikers in Korea. Their study identified three distinct hiker groups: novice, affection-driven, and expert. Among these three clusters, they further revealed that highly attached hikers, categorized as the "experts," were generally more educated, reported greater satisfaction, and expressed a higher intention to revisit than their less attached counterparts, the "novices". Extend to the empirical research

beyond hikers, Kainzinger, Arnberger, and Burns (2019) also utilized the specialization framework. They classified whitewater boaters into three specialization categories, ranging from low, medium, and highly specialized groups of recreationists. This classification aimed to investigate whether significant differences existed in boaters' trade-off preferences for social, resource, and managerial attributes. According to their study's analysis, the result revealed significant variation across boaters' specialization and their preference for waiting time before launch, river difficulty and trip length. In particular, both medium and highly specialized boaters showed greater concern for longer wait times compared to their less specialized counterparts.

Although market segmentation is increasingly popular, there remains a lack of studies applying this methodology within scuba diving tourism research. Similarly, recreational specialization as an essential segmentation concept in understanding tourists' preferences has yet to be extensively applied, especially regarding the diving preferences of Chinese scuba divers in Hong Kong. Considering these research gaps, three research objectives were developed to address the perceived theoretical limitations in Hong Kong: (1) To identify distinct market segments of Chinese divers in Hong Kong based on divers' levels of recreational specialization; (2) to provide an enhanced segmentation approach based on divers' sociodemographic and diving preferences to label and describe the identified specialization segments; and (3) to develop management implications for enhancing divers' satisfaction and promoting long-term tourism sustainability, which aligns with the classified divers' market preferences and their associated demographic characteristics in Hong Kong. By studying these objectives, this study will help stakeholders determine the best recreational opportunities through practical marketing assessments, thereby enhancing divers' satisfaction and supporting Hong Kong's sustainable diving tourism development. From a theoretical perspective, this study will help address theoretical gaps in understanding the preference of Chinese scuba divers and enrich the theoretical significance of marine-based outdoor research in Hong Kong, specifically by applying the market-based segmentation concept.

The remaining sections of this study are structured as follows. The next section examines previous research on factors determining divers' diving preferences, ranging from exploring the theoretical insights concerning the significance of the market-based segmentation approach to studying the theoretical concept of recreational specialization. Then, the third section describes the designation and establishment of the study's survey and experimental methodology, followed by the analysis results reported in the fourth section. The final section discusses the findings in comparison with those of previous studies and intends to offer meaningful practical and theoretical implications for future investigation.

Literature review

Market segmentation

Market segmentation is a robust and low-cost methodology that helps divide a heterogeneous market group into homogeneous subgroups (Andreu et al. 2006; Chen, Bao, and Huang 2014; Park and Yoon 2009; Wen and Huang 2019). According to this methodology, two primary segmentation techniques are commonly used: the common-sense

and data-driven approaches (Dolničar 2004). Common-sense segmentation entails defining market groups based on the established profile attributes of respondents, with descriptors chosen for their insightfulness and logical connection to the segmentation criteria (Wen and Huang 2019), while data-driven segmentation uses algorithms based on statistical cluster analysis, correspondence analysis, and discriminant analysis, following hierarchical and standard segmentation approach to identify potential market groups (Dolničar 2003, 2004; Wen and Huang 2019).

The primary objective of market segmentation in tourism research is to assist stakeholders in developing the best recreational opportunities to meet tourists' demands and satisfaction (Dolničar 2004). In order to better achieve this objective, it has been integrated with various theoretical concepts to understand tourist preferences, with the aim of categorizing tourists for future marketing assessments. Among these theoretical concepts, sociodemographic variables of tourists, such as nationality, age, salary and gender, have been commonly used to help identify tourist market segmentation. For instance, Andreu et al. (2006) used tourists' sociodemographic characteristics and vacation patterns to explore the motivation-based factors underlying British tourists' preferences for visiting two resorts (Fethiye and Marmaris) in Mugla, Turkey. In addition, Naruetharadhol et al. (2022) used the demographic-based segmentation approach to classify Thai consumers into two groups to analyze their purchasing intentions for e-commerce airfares. They found that older individuals with high and middle incomes formed the first segment, while younger individuals with low incomes formed the second segment. More significantly, their study of 3,064 respondents found that price sensitivity and perceived ease of use significantly influenced e-commerce airfare purchasing intentions across both groups, with the older segment valuing entertainment more than those from the second segment. This research highlights the importance of demographic factors in understanding consumer behavior intention in the context of e-commerce airfare purchases in emerging economies.

Nevertheless, although incorporating tourists' demographic features is somewhat valuable for marketing analysis, studies pointed out the need for methodological improvements to avoid relying solely on respondents' demographics, which is equally crucial for enhancing and supporting future tourism management. For instance, Crawford-Welch's (1990) critique argued that "descriptive data, by their very nature, are of little analytical worth in that they are not capable of implying causality and are, in turn, poor predictors of behavior" (301). This argument is particularly crucial, given the fact that it has been further validated by Piercy, Campbell, and Heinrich's (2011) observations, which revealed that the demographic-based segmentation approach in the market research showed minimal significant differences between demographic segments, suggesting that such an approach may not effectively produce distinct segments or identify meaningful differences among target advertising consumers. Given these criticisms, they recommend extending future studies by integrating research concepts beyond demographic constructs, which may help better understand market differences.

On the subject of these limits, an alternative approach focusing on respondents' psychographic characteristics, such as attitudes, behaviors, and personality traits, has gained widespread recognition as a more effective method for conducting marketing segmentation assessments (Park and Yoon 2009; Sandy, Gosling, and Durant 2013). This exploration is crucial and evident, as a broad scholarly exploration has validated and supported

both its theoretical and practical significance. For instance, in tourism research, Wen et al.'s (2020) study suggests that understanding tourists' recreational needs and segmenting tourists based on their motivations would be more significant than assessing their demographics. In response to this point of view, it does happen a lot that theoretical concepts proposed to understand the developmental process of tourism-related marketing issues, which have been frequently documented in the existing literature, including motivation (Chen, Bao, and Huang 2014; Fung and Jim 2015; Pearce and Lee 2005; Wen and Huang 2019), recreational specialization (Chen and Chen 2013; Kim et al. 2010; Scott and Thigpen 2003), participation involvement (Hu and Yu 2007; Levitt et al. 2019), and environmental attitude (Kim and Weiler 2013). Of these, Bryan's (1977) concept of recreational specialization serves as a particularly valuable framework and is given central emphasis in this analysis. This is because the behavioral continuum it defines establishes the foundational logic for segmentation, while offering a coherent explanation for the variation in related tourist characteristics, such as recreationists' motivation and environmental attitude.

Recreational specialization

Bryan (1977) proposed the recreation specialization framework to identify and classify within-group diversity among anglers engaged in a single recreational activity. He defined *recreational specialization* as "a continuum of behavior from the general to the particular specialization, reflected by equipment and skill used in the sport and activity setting preferences" (175). In his observation, significant differences in behavior and attitudes were reported between anglers with low and high levels of specialization, demonstrating that more specialized recreationists with greater accumulation of time and experiences may be encouraged to embrace more pro-environmental awareness and recreational behaviors. Given Bryan's contribution, recreational specialization has been integrated with various theoretical concepts to study and understand tourism-related conservation and marketing management occasions. For instance, studies have integrated the specialization framework to understand tourists' site preferences (Chen and Chen 2013; Galloway 2012; Hopkin and Moore 1995; Kim et al. 2010; Lee, Graefe, and Li 2007; Martin 1997; Virden and Schreyer 1988), motivation (Chipman and Helfrich 1988; Dearden, Bennett, and Rollins 2006; Galloway 2012), and environmentally responsible behavior (Cheung, Lo, and Fok 2017; Han and Oh 2021; Thapa, Graefe, and Meyer 2005, 2006; Zhang et al. 2023a) over different types of outdoor recreations, including scuba diving (Anderson and Loomis 2012; Dearden, Bennett, and Rollins 2006; Thapa, Graefe, and Meyer 2005, 2006; Zhang et al. 2023a), birdwatching (Cheung, Lo, and Fok 2017; Kim et al. 2010; Scott and Thigpen 2003), fishing (Bryan 1977; Chipman and Helfrich 1988), and cycling (Chen and Chen 2013; Hopkin and Moore 1995).

Despite its wide theoretical recognition, Bryan's earliest measurements have been consistently criticized in the existing literature (Bryan 2000; Ditton, Loomis, and Choi 1992; McIntyre and Pigram 1992; Scott and Shafer 2001). This criticism arises because the historical research assessment concerning the use of the essence of specialization theory has faced some theoretical limitations, as claimed by Bryan (2000), who indicated that "researchers added to the body of knowledge through their studies and insights and led the productive debate on the theory's accuracy, power, and applicability" (18). For

instance, Scott and Shafer (2001) revealed that "despite a recognition that specialization is a developmental process, studies have yet to be undertaken to test the extent to which recreationists progress to more advanced levels of involvement over time" (321). Also, McIntyre and Pigram (1992) revealed that "measurement of recreation specialization has been limited to the observation and recording of behaviors associated with activities and has ignored, to a large extent, individual affective attachment to participation" (3). They commonly emphasized that specialization should be a dynamic and evolving process for individual engagement, suggesting that further research should adopt longitudinal approaches to track changes in individuals' specializations over time.

To remedy these deficiencies, McIntyre and Pigram (1992) emphasized that the recreation specialization model should be multidimensional in its measurements, including but not limited to integrating individuals' prior participation history and affective attachment. As such, they introduced more comprehensive theoretical concepts, such as integrating the cognitive, behavioral, and affective constructs to formulate an improved specialization framework. Likewise, Scott and Shafer (2001) redefined recreational specialization as developmental progress in behavior, skills, and commitment while describing this progress in terms of stages of engagement, career change, and turning points to enhance the measurement framework more comprehensively. Moreover, Ditton, Loomis, and Choi (1992) introduced the concept of social subworlds to re-conceptualize recreation specialization as "a process by which recreation social worlds and subworlds segment and intersect into new recreation subworlds and the subsequently ordered arrangement of these subworlds and their members along a continuum" (33). These refined and extended specialization frameworks are expected to serve as a vital managerial tool for guiding tourism development and contributing to the continued advancement of promoting sustainable tourism success, especially in nature-based tourism contexts, such as scuba diving recreation.

Diving preferences

Studies emphasized that factors influencing divers' choice of diving can vary significantly from the dive site's biological and physical condition (Giglio, Luiz, and Schiavetti 2015; Musa 2002; Musa, Kadir, and Lee 2006; Şensurat-Genç et al. 2022; Uyarra et al. 2005; Uyarra, Watkinson, and Cote 2009; Zhang et al. 2023b). Among these factors, coral conditions and marine species have been identified as particularly outstanding in attracting divers' participation (Musa 2002; Musa, Kadir, and Lee 2006; Uyarra et al. 2005; Uyarra, Watkinson, and Cote 2009; Zhang et al. 2023b). However, the fact is that divers are not homogeneous, and their preferences for diving can vary substantially (Bentz et al. 2016; Giglio, Luiz, and Schiavetti 2015; Kirkbride-Smith, Wheeler, and Johnson 2013; Musa 2002; Şensurat-Genç et al. 2022; Zhang et al. 2023b). For instance, Şensurat-Genç et al. (2022) revealed that gender can greatly influence divers' preferences. Specifically, they found that females preferred artificial reefs at a rate of 17%, which was higher than the rate of 15% for males in the Karaburun Peninsula, Turkey. In addition to sociodemographic attributes, studies also found that divers' diving experience could be an essential factor influencing their preferences for diving. For example, Kirkbride-Smith, Wheeler, and Johnson (2013) found that experienced divers strongly preferred natural coral reefs, whereas novice divers preferred artificial habitats over natural reefs in

Barbados. Despite these significant differences, Şensurat-Genç et al. (2022) argued that divers' preferences for historical wrecks did not differ based on their diving experience; in the case of Turkey, they remained interested in diving for historical shipwrecks, despite their limited experience with artificial wreck reefs.

Given the complex factors that affect divers' preferences for diving (Musa 2002; Musa, Kadir, and Lee 2006), it is evident that an expanded study to understand divers' specific preferences is crucial, especially concerning their significant impact on divers' satisfaction and tourism sustainability. Within this context, studies using the segmentation methodology to track divers' preferences have been substantially recognized, given its significance in classifying divers into a same-batch subgroup to help stakeholders design and offer the best recreational opportunities to enhance divers' satisfaction. For example, Bentz et al. (2016) segmented the preferences and motivations of 425 divers diving in the Azores, using principal component analysis and cluster analysis, based on divers' sociodemographic characteristics and their level of specialization. Their analysis classified divers' preferences into four subgroups, including "sharks and manta rays," "unpolluted, uncrowded dive sites with underwater formations", "social aspects of photos, knowledge, family and friends", and "visibility, fish abundance, and easy diving." Meanwhile, divers' specialization degrees were divided into four types of segments, including "new divers," "casual divers," "active divers" (frequent participants in diving activities without the same depth of commitment as "committed divers"), and "committed divers" (those with a high level of psychological involvement and long-term dedication to diving, often structuring their leisure activities around the pursuit of diving experiences). Subsequent analysis confirmed a significant difference between divers' specialization and motivational preferences for diving in the Azores. Specifically, advanced specialized (active and committed) divers were more motivated to see sharks and manta rays or to appreciate unpolluted, undamaged, and uncrowded dive sites with underwater rock formations (such as caves, arches, and seamounts). In contrast, less-specialized divers (new and casual divers) were more motivated to seek knowledge expansion, adventure, the company of family and friends, underwater visibility, and the discovery of a variety of marine life.

Similar to the study conducted in Portugal, Albayrak, Caber, and Cater (2021) utilized the push and pull theory to investigate and classify divers' intentions and preferences for diving in Turkey. With the help of factor analysis, the pull structure was divided into "tourism and diving offerings," "safety and accessibility," "ancillary attributes," "new areas," and "unspoiled diving destinations". In contrast, the push structure was confirmed to be "exploration and excitement," "personal development," and "socialization and challenge." The eight measurements were then classified into four broad categories, in line with the assessment of examining divers' preferences after running a cluster analysis, including "enthusiastic positivists," "youthful hedonists," "amateur explorers," and "single regulars." The analysis showed that four groups of scuba divers had different push and pull motivations. Enthusiastic activists are highly motivated by both push and pull factors, while young hedonists are primarily motivated by specific push factors (exploration and excitement) and pull factors (new domains).

Furthermore, Paterson et al. (2012) also explored the demographic characteristics of divers, aiming to identify meaningful subgroups within the diving population and examine how these characteristics influence divers' overall satisfaction. Specifically, in

their Florida Keys study, they segmented divers by their specialization level to explore how this factor could shape divers' experience, expectations and satisfaction regarding marine resources. According to the analysis, they found a significant discrepancy between expectations and experience associated with divers' specialization, with very highly specialized divers scoring higher on expectations and experiences of easy diving conditions and good underwater visibility than the moderate and highly specialized groups of divers. More specifically, regarding the differences between divers' satisfaction and the impact of divers' specialization levels on their satisfaction, their analysis revealed that, across different specialization levels, the conditions of "relaxation" and "easy diving" were consistently rated as contributing most significantly to determining divers' satisfaction among the ten site attributes evaluated. These studies demonstrated the significant importance of understanding diverse market segments in promoting the success of sustainable scuba diving tourism, providing valuable insights that can inform future research and guide the development of targeted strategies for enhancing both tourist satisfaction and tourism sustainability.

Methodology

Study areas

Hong Kong is located in the eastern part of the Pearl River Delta in southern China. Its unique location has allowed a diverse range of marine life species to grow and thrive, with nearly 5,900 aquatic species and over 80 groups of stony coral, which have been richly recorded within Hong Kong waters (Ma et al. 2024). With such a unique geographical condition, many tourists have been attracted to travel to discover Hong Kong's rich marine ecology, stimulating the steady development of various water-based activities. Among these activities, scuba diving, snorkeling, and swimming have been widespread, merging in Hong Kong's marine protected areas (Zhang et al. 2023a; Zhang et al. 2023b; Zhang et al. 2024). Most of these activities have been found to occur in the eastern waters, owing to their superior underwater visibility and rich biological conditions (Zhang et al. 2023b). Therefore, to ensure representative sampling, this study selected four sites within the eastern waters for data collection, including Hoi Ha Wan Marine Park, Tung Ping Chau Marine Park, Sharp Island, and the Ung Kong Group (Figure 1).

Questionnaire design

A questionnaire-based research instrument was adopted to collect the research data. The survey's measurement indicators were designed based on previous literature, supplemented by consultations with professional diving instructors in Hong Kong (Table 1). The final questionnaire was divided into three sections, measuring divers' sociodemographic backgrounds, recreational specializations, and preferences for diving. Table 1 presents the proposed survey sections, from measuring divers' specialization to preferences for diving. The recreational specialization scale consists of 10 items, comprising the measurement construct of financial commitment, centrality to lifestyle, and knowledge and skill. Two items were deleted after conducting a pilot statistical analysis. The remaining ten items were then measured on a five-point scale (1 = strongly disagree, 5

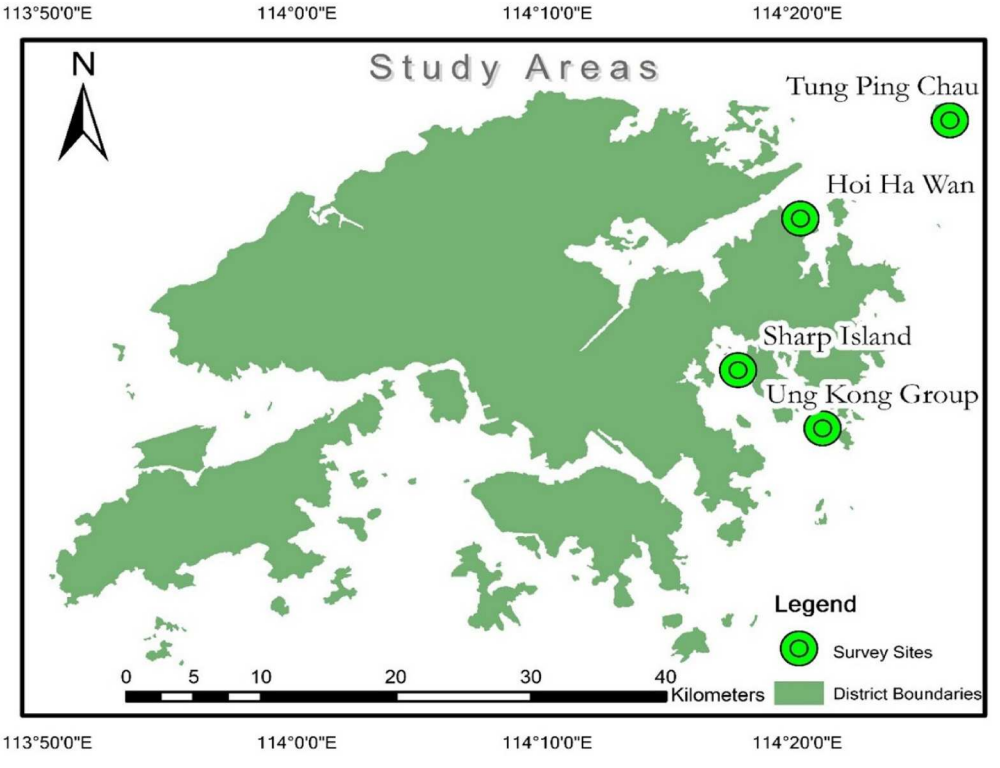

Figure 1. Study areas for data collection.

Table 1. Measurements for divers' recreational specialization and diving preference.

Recreational specialization	References/ source
I would rather go diving than do anything else	(Anderson and Loomis 2012; Bryan 1977; Cheung, Lo, and Fok 2017; Chipman and Helfrich 1988; Galloway 2012; Thapa, Graefe, and Meyer 2006; Zhang et al. 2023a)
Diving is a large part of my life	
I can really be myself when I am diving	
Most of my outdoor recreational activities are aimed at diving	
I have invested a lot of money in diving equipment	
I have acquired a lot of diving equipment	
I often learn about the newest diving equipment available	
I am very knowledgeable about diving and marine wildlife	
I can easily identify marine organisms without an identification key	
I am an experienced diver	
Diving preferences	
Naturalness/pristineness	(Dearden, Bennett, and Rollins 2006; Giglio, Luiz, and Schiavetti 2015; Gill, Schuhmann, and Oxenford 2015; Musa 2002; Paterson et al. 2012; Uyarra et al. 2005; Uyarra, Watkinson, and Cote 2009; Zhang et al. 2023a)
Biodiversity/ecological	
Uniqueness of sites	
Water quality & clarity	
Coral density/coverage	
Site area environment	

= strongly agree). Then, divers' preferences for diving comprised six items and were measured on a five-point scale (1 = very low, 5 = very high). In the end, the respondent's sociodemographic information was introduced, including gender, education, age, and monthly salary.

Sampling method

This study focused on Chinese scuba divers who had dived in Hong Kong's marine protected areas. Data were collected between the summers of 2021 and 2022. During this period, a convenience sampling approach was employed, given its significant advantage of being less expensive and time-consuming under the then prevailing travel and social restrictions of the COVID-19 pandemic (Taherdoost 2016). A total of 550 surveys were successfully distributed to the target respondents with assistance from local dive shops, instructors, and commercial vendors near the dive sites. All respondents who filled out the survey were at least 18 years old and had dived at least once. The valid sample consisted of 398 responses after filtering out 152 incomplete responses, resulting in a response rate of approximately 76%.

Data analysis

This study employed a two-step statistical procedure to study the proposed research questions. The first step involved K-means cluster analysis using raw data from the 10 specialization items to identify Chinese divers' potential market segments in Hong Kong. Then, a discriminant analysis was conducted to validate the identified clusters. After the discriminant analysis was confirmed, the second step was to use chi-square and one-way ANOVA to determine whether significant differences in divers' sociodemographic characteristics and diving preferences could be identified within the classified segmentations. Lastly, an independent sample t-test was used to examine whether and how divers' specialization groups could differ in their preferences when diving in Hong Kong's marine protected areas. All data were analyzed via SPSS 28.0.

Results

Sample profile

According to Table 2, 193 respondents were male and 205 were female, accounting for 48.5% and 51.5% of the total respondents, respectively. Most responders (45.7%) were young divers aged 18-29, with only a few (7.8%) aged 50 or older. Regarding divers' educational backgrounds, most (80.6%) had received an undergraduate degree or higher. In comparison, fewer had only a secondary level of education (19.3%), while respondents with less than a secondary level of education were not observed in this investigation. Concerning respondents' monthly salary, a considerable number of respondents (55.2%) earned HKD 29,999 or less. On the contrary, only 18.1% had a monthly income of more than HKD.40,000.

Table 2. Respondents' socioeconomic demographic characteristics.

Variables	Categories	Frequency	Percentage %
Gender	Male	193	48.5
	Female	205	51.5
Age	18–29	182	45.7
	30–39	123	30.9
	40–49	62	15.6
	50–59	27	6.8
	60 or above	4	1.0
Education	Primary	0	0
	Secondary level	77	19.3
	Undergraduate	229	57.5
	Postgraduate	92	23.1
Monthly salary (HKD)	9,999 or below	24	6.0
	10,000–19,999	92	23.1
	20,000–29,999	104	26.1
	30,000–39,999	54	13.6
	40,000–49,999	32	8.0
	50,000–59,999	17	4.3
	60,000 or above	23	5.8
	Retired	26	6.5
	Did not answer	26	6.5
Total	/	398	100

Dimensions of recreational specialization

The exploratory factor analysis was adopted to extract the latent factor structure within the specialization framework (Choudhry, Fang, and Lingard 2009; Kaiser 1960, 1974). According to Table 3, the result of this study's Kaiser–Meyer–Olkin statistic was 0.872 (>0.5), with a chi-squared test yielding a result of 2774.985 ($p < 0.001$), confirming this study's theoretical and methodological effectiveness of performing further factor analysis (Choudhry, Fang, and Lingard 2009; Kaiser 1974).

After confirming the suitability of the data for factor analysis, an exploratory factor analysis was conducted. Specifically, principal component analysis was used as the factor extraction method, followed by varimax rotation to identify the latent factor dimensions related to divers' specialization. The analysis yielded three factor-based

Table 3. Exploratory factor analysis.

		Factor Loading		
Constructs	Measurement	1	2	3
Centrality to lifestyle	I would rather go diving than do anything else	0.837		
	Diving is a large part of my life	0.803		
	I can really be myself when I am diving	0.802		
	Most of my outdoor recreational activities are aimed at diving	0.635		
Financial commitment	I have invested a lot of money in diving equipment		0.897	
	I have acquired a lot of diving equipment		0.856	
	I often learn about the newest diving equipment available		0.769	
Knowledge and skill	I am very knowledgeable about diving and marine wildlife			0.904
	I can easily identify marine organisms without an identification key			0.846
	I am an experienced diver			0.802
Eigenvalue		5.533	1.255	1.110
% Variance explained		55.334	12.551	11.099
Cronbach alpha		0.862	0.893	0.891

Variance explained = 78.98%, KMO = 0.872, Bartlett's test of sphericity = $x^2(45) = 2774.985$; $p < 0.001$, Varimax Rotation Method

dimensions (Choudhry, Fang, and Lingard 2009; Kaiser 1960), which together explained 78.98% of the total variance in the ten measurements within the specialization framework. The factor loadings for the three factors ranged from 0.635 to 0.904, which exceeded the critical value of 0.50, as recommended by Osborne and Fitzpatrick (2012) and Kaiser (1974). Following an examination of the factor loadings and their alignment with the specialization literature, the three factors were confirmed and labeled as centrality to lifestyle, financial commitment, and knowledge and skill. The first factor, centrality-to-lifestyle, represents divers' desire to dive as a way of life, reflecting how deeply diving is into their daily routines, identities, and personal values. The second factor, concerning divers' financial commitment, captures how individuals are willing to allocate financial resources, such as equipment, travel, and training, to sustain their participation in diving. Finally, the third factor, knowledge and skill, reflects divers' self-assessed competence and accumulated experience in scuba diving, which are essential for personal safety and responsible interaction with the marine environment. Together, these three dimensions reflect the multidimensional nature of recreational specialization and offer a more nuanced understanding of divers' varying involvement and commitment levels. This finding aligns with the conceptualization of recreation specialization proposed by McIntyre and Pigram (1992). In the reliability assessment, Cronbach's alpha values for these three factors ranged from 0.862 to 0.893, indicating that they all had obtained an acceptable internal consistency for their excellent reliability value greater than 0.70 (Taber 2018).

Recreational specialization-based segmentation of Chinese scuba divers

A hierarchical cluster analysis was utilized to assess the clustering-associated dendrograms and determine the raw data's reasonable representation using the three-factor structure (Wen and Huang 2019). Subsequently, the K-means clustering method was applied to group divers into two clusters based on their specialization, following the three-factor structure identified in the initial hierarchical analysis (Wen and Huang 2019). Consequently, the two cluster groups were classified into divers with a high specialization and divers with a low specialization diving level. Cluster 1 comprised 253 cases (63.6% of respondents). This cluster was labeled "advanced divers" due to its relatively high mean scores on specialization frequency across all measurements. On the contrary, Cluster 2 contained 145 cases (36.4% of respondents). These divers were labeled "novice divers" because their mean specialization frequency scores were lower across all measurements than those of their counterparts. Table 4 presents the mean

Table 4. Means of specialization items among the two clusters.

	Level of specialization			
Measurements	Advanced divers Cluster 1 $N = 253$ (63.6%)	Novice divers Cluster 2 $N = 145$ (36.4%)	Mean difference	*F*-value Significance
Centrality to lifestyle	,52029 (4.47)	-,90782 (3.29)	−1.18	356.161***
Financial commitment	,54493 (3.88)	-,95082 (2.09)	−1.79	428.036***
Knowledge and skill	,50613 (3.41)	-,88312 (1.96)	−1.45	321.524***

Note: *** $p < 0.001$. (Mean values were measured on a five-point Likert scale, with 1 being strongly disagree and 5 being strongly agree).

scores for the two clusters measuring divers' specialization and the results of a one-way ANOVA assessing whether differences in mean scores across the three specialization factors are statistically significant. The analysis revealed statistically significant differences in the means of all three specialization factors across the two clusters. The two groups differed most regarding the measurement factor of financial commitment ($F = 428.036$), followed by centrality to lifestyle ($F = 356.161$). Comparatively, the groups differed somewhat less in terms of the measurement factor of knowledge and skill ($F = 321.524$).

Cluster validation

A discriminant analysis validated the cluster solution (Mumuni and Mansour 2014; Wen et al. 2020). Throughout the assessment, the specialization dimension was an independent variable, while membership in the two-cluster solution was placed as the dependent variable. As shown in Table 5, one discriminant function was extracted because only two distinct clusters were successfully identified. The extracted function achieved an eigenvalue greater than one, accounting for 100% of the variance in the specialization dimension. The canonical correlation for the function was 0.824, indicating a strong relationship between the function and group differences. Also, the square of this correlation ($0.824^2 = 0.68$) indicated that the specialization group explains 68% of the variance in the dependent variable. The relatively small value of Wilk's Lambda (0.32) indicated an excellent separation of the groups. Moreover, the chi-square test of Wilk's Lambda (447.678) showed that the overall separation of groups achieved using the discriminant function was highly significant at $p < 0.001$ (Mumuni and Mansour 2014; Pearce and Lee 2005).

After identifying significant group differences through discriminant analysis, the discriminant function coefficients were assessed to determine which predictor variable contributed most to the function (Mumuni and Mansour 2014; Pearce and Lee 2005). As shown in Table 6, the magnitudes of the standardized discriminant function coefficients suggest that financial commitment was the most critical predictor in discriminating between the groups, followed by centrality to lifestyle and knowledge and skill. Although this ordering differs slightly from the rank derived from mean differences in Table 4, such variation is not unexpected given the distinct purposes of univariate and multivariate analyzes. This slight difference arises because while Table 4 compares each variable independently across clusters, the discriminant analysis considers the combined effects of all predictors and their intercorrelations when determining their relative contributions to group separation (Stella 2019). This multivariate perspective allows a more refined

Table 5. Validation of the two-cluster solution using discriminant analysis.

(a) Significance of the Discriminant Function

Function	Eigenvalue	Variance	Canonical correlation	Wilks' lambda	*Chi-square*	Significance
1	2.111	100%	0.824	0.321	447.678	<0.001

(b) Final Cluster Centroids

Cluster	Function 1
1. Advanced divers	1.097
2. Novice divers	−1.914

Table 6. Canonical discriminant function coefficients and loadings.

Measurements	Unstandardized Coefficients	Standardized Coefficients	Discriminant Loading
Financial commitment	0.821	0.570	0.716
Centrality to lifestyle	0.620	0.451	0.653
Knowledge and skill	0.646	0.481	0.620
(Constant)	0.000	–	–

understanding of which variables best distinguish the groups when modeled simultaneously. Hence, the prominence of centrality to lifestyle over knowledge and skill in the discriminant function does not contradict the univariate findings but reflects each construct's unique explanatory power within the multivariate model. This result supports the robustness of the segmentation structure by showing consistent patterns across analytical approaches, albeit with minor shifts in variable salience. Most importantly, since the discriminant function remains statistically significant, it further indicates that the model offers a valid and meaningful distinction between the two identified divers' specialization segments.

Regarding the group centroids, cluster 1 (advanced divers) has a positive value of 1.097, whereas cluster 2 (novice divers) has a negative value of −1.914 (Table 5), further confirming that the two clusters were appropriately assigned. Then, the classification matrix was examined to determine whether the function was a valid predictor (Table 7). The results show that the function correctly classified 253 cases in the high-specialization group (advanced divers) and 145 cases in the low-specialization group (novice divers). Overall, the discriminant function could correctly classify 99.5% of the respondents into their respective clusters, indicating high reliability of the clustering solution.

Describing clusters with demographics and diving preferences

A chi-square test was conducted to determine whether the two clusters differed significantly according to divers' sociodemographic profiles. Table 8 shows significant differences among clusters regarding divers' gender, age, educational background, and monthly salary. Divers in cluster 1 (advanced divers) were primarily males, aged 18–29 or 30-39, with a bachelor's degree or above, and a monthly income of HKD 20,000–29,999, excluding those who are retired or do not disclose their income status. Comparatively, divers in cluster 2 (novice divers) were mainly female, also aged 18–29

Table 7. Classification of results.

Actual Cluster (Number of Cases)			Predicted group membership		
			Cluster 1	Cluster 2	Total
Original	Count	Advanced Divers	252	1	253
		Novice Divers	1	144	145
	%	Advanced Divers	99.60	0.40	100.00
		Novice Divers	0.70	99.30	100.00
Cross-v	Count	Advanced Divers	248	5	253
		Novice Divers	2	143	145
	%	Advanced Divers	98.00	2.00	100.00
		Novice Divers	1.40	98.60	100.00

Note: 99.5% of the grouped cases are correctly classified.

Table 8. Results of cluster analysis based on divers' demographic characteristics.

Demographic status	Cluster 1 (AS) $N = 253$	Cluster 2 (NS) $N = 145$	Statistics significance
Gender			$x^2 = 7.70$, $df = 1$, $p = 0.006$
Male	136	57	
Female	117	88	
Age			$x^2 = 16.62$, $df = 4$, $p = 0.002$
18–29	98	84	
30–39	84	39	
40–49	49	13	
50–59	20	7	
60 or above	2	2	
Education			$x^2 = 10.86$, $df = 2$, $p = 0.004$
Primary	0	0	
Secondary	57	20	
Undergraduate	130	99	
Postgraduate	66	26	
Monthly salary (HKD)			$x^2 = 25.05$, $df = 8$, $p = 0.002$
9,999 or below	6	18	
10,000–19,999	58	34	
20,000–29,999	65	39	
30,000–39,999	38	16	
40,000–49,999	27	5	
50,000–59,999	12	5	
60,000 or above	14	9	
Retired	14	12	
Did not answer	19	7	

Abbreviations: AS, Advanced divers; NS, Novice divers.

or 30-39, with a bachelor's degree or above and a monthly income of HKD 20,000–29,999, again after excluding those who are retired or do not disclose their income status.

Besides looking at how divers' segmentations differed from their sociodemographic characteristics, this study also looked at how divers' preferences for diving could vary between the two classified segments. To achieve this objective, the two specialization segments were treated as the independent variable, while divers' preferences concerning the dive sites' "naturalness", "biodiversity", "uniqueness", "water quality", "coral density", and "site area environment" (Giglio, Luiz, and Schiavetti 2015; Gill, Schuhmann, and Oxenford 2015; Musa 2002; Musa, Kadir, and Lee 2006; Uyarra et al. 2005; Uyarra, Watkinson, and Cote 2009; Zhang et al. 2023b) were set as the dependent variable. An independent sample t-test (Table 9) revealed statistically significant differences between the two diver segments in their diving preferences. Specifically, biodiversity/ecology, uniqueness of sites, coral density/coverage, and site area environment were all statistically

Table 9. Segment differences in divers' diving preferences.

	Advanced divers		Novice divers				95% confidence level		
Preference items	Mean	SD	Mean	SD	*T*-Score	*P*-value	Lower	Upper	Cohn's d
Naturalness/pristineness	3.92	0.87	3.90	0.78	0.16	0.877	−0.158	0.185	0.02
Biodiversity/ecological	4.10	0.90	3.90	0.90	2.19	0.029*	0.021	0.391	0.22
Uniqueness of sites	3.78	0.87	3.56	0.84	2.50	0.013*	0.048	0.400	0.26
Water quality & clarity	3.48	1.17	3.50	1.24	−0.15	0.883	−0.263	0.227	0.02
Coral density/coverage	3.69	0.95	3.49	0.91	2.03	0.043*	0.007	0.390	0.22
Site area	3.40	0.71	3.17	0.68	3.16	0.002**	0.087	0.373	0.33

Note: *$P < 0.05$; ** $P < 0.01$

significant at $p < 0.05$. Advanced divers consistently reported higher mean scores on these preference attributes than novice divers, suggesting that they place greater importance on biodiversity, site uniqueness, coral density, and site area when selecting dive sites in Hong Kong. Comparatively, divers' preferences for naturalness and water clarity were not statistically associated with their specializations, implying that while divers choose dive destinations for various reasons, nature and water quality remain essential to most divers regardless of their levels of recreational specialization.

Discussion and conclusion

This study applied a market segmentation using the concept of recreational specialization to distinguish Chinese divers' preferences when diving in Hong Kong's marine protected areas. The cluster analysis classified these divers into two clusters, with the first labeled "advanced divers (Cluster 1)" and the second labeled "novice divers (Cluster 2)". Compared with their counterparts, advanced divers represented the majority of the sample. Results show statistically significant differences between the two groups of divers in terms of their demographics and preferences.

First, concerning the relationship between divers' specialization segments and their preferences for diving, advanced divers (Cluster 1) were found to be strongly motivated by the dive sites' naturalness, biodiversity, uniqueness, and coral density. This finding is consistent with Anderson and Loomis's (2012) research, which indicated that specialized divers were more concerned about the acceptability of healthy coral, fish, and other marine biological conditions, such as whale sharks and manta rays. Additionally, it is consistent with Dearden, Bennett, and Rollins's (2006) finding that increasing divers' specialization could significantly influence their perceptions of the importance of observing underwater plants and creatures. However, despite these consistencies, the present study was found to contradict Bentz et al.'s (2016) research findings, which revealed that divers with increased specialization were more motivated to discover undamaged and uncrowded dive conditions, especially with underwater rock formation features, such as caves, arches, and seamounts. The discrepancy between the current and previous findings may be due to the difference in individual divers' personalities. Specifically, adventurous divers may be more willing to dive in complex diving conditions, such as submarine caves and seamounts. Conversely, divers with less adventurous personalities may be more inclined to pursue a more generally widespread set of preferences for coral coverage and underwater visibility.

Second, our study found that the two diver segments did not significantly differ in their preferences concerning the dive site's naturalness and water quality, meaning that both segments of divers cared about the natural environment and water quality to a comparable extent. This result implies that while divers choose dive destinations for various reasons, these factors remain equally important concerning site selection for the two specialization groups. One possible explanation for this phenomenon may be concerning the fact that water quality and naturalness are valued not only for their aesthetic appeal but also for their critical role in ensuring both divers' and marine ecosystems' safety, visibility, and overall health sustainability, making maintaining a high baseline standard essential. Under these conditions, it is reasonable to expect that any

decline in these environmental factors would likely leave both divers' safety and enjoyment vulnerable, regardless of the diver's level of specialization.

Third, this study confirmed significant sociodemographic differences between the two segments (Table 8). The advanced diver segment was predominantly comprised of males. While both segments were highly educated, with the majority holding an undergraduate degree or higher, the advanced diver segment had a notably higher proportion of postgraduate degree holders (26.1%) compared to the novice segment (17.9%). This analysis was consistent with the findings of Anderson and Loomis (2012), who found that most specialized divers are generally males over females. Despite such consistency, the present study has also been found to disagree with Anderson and Loomis's (2012) discovery in the same study, which indicated that no significant differences in income levels, marital status, or ethnic group composition were identified among the different specialization levels of divers. The disparity in results between this study and previous research may stem from cultural differences in how recreationists perceive and value scuba diving. Specifically, diver populations in Hong Kong and the Florida Keys may approach scuba diving with different expectations and values influenced by their respective cultural contexts. Chinese divers in Hong Kong may view scuba diving as a physically demanding activity that requires significant skill and financial investment, leading to a higher proportion of younger, more financially invested individuals in the advanced specialization group. In contrast, Western divers might perceive scuba diving as a more holistic recreational activity that does not necessarily demand high equipment or experience, resulting in less pronounced sociodemographic differences across divers' specialization levels.

By integrating these findings, this study provides stakeholders and scholars with both practical and theoretical implications for understanding scuba diving tourism-related market segmentations, particularly how divers' different specialization segments and demographic features could impact their preferences for diving in Hong Kong. Regarding its industrial implications, the study clearly shows that divers' preferences would differ significantly from those of the two identified segments. Advanced divers prioritize the dive site conditions with extraordinary biodiversity, uniqueness, coral density, and more prominent site areas. Both advanced and novice divers value naturalness and water clarity, but their preferences for these attributes do not differ significantly from those of the other four conditions. Based on these analyzes, the management authorities are advised to offer explicit promotional materials about the dive sites in Hong Kong, allowing divers to select the best diving destinations that align with their specialization and desired preferences. Similarly, commercial diving companies or organizers could also refer to the preferences and demographic features of their potential customers to tailor their products to fulfill the requirements of different groups of scuba divers.

Regarding theoretical implications, this study used the recreational specialization framework to segment divers into two subgroups. This market-based segmentation approach has yet to be applied to understand the development of scuba diving tourism in Hong Kong. This study proves that the two market segments, defined by divers' specialization level, are effectively and statistically differentiated by their preferences among divers diving in Hong Kong's marine protected areas. These findings fill a theoretical gap in understanding the market segmentation of divers in Hong Kong's scuba diving tourism and further confirm the critical role played by specialization segments in determining divers' diving preferences. Overall, this study's theoretical

knowledge and practical management strategies provide a valuable reference for understanding the current development of scuba diving tourism in the Chinese market.

Although this study presents an in-depth understanding of divers' diving preferences based on the segmentation of divers' specializations, some limitations should also be appropriately aware of and must be addressed, in order to better support future studies' investigations. First, the findings generated from the current study may not be generalizable to understanding divers from other cultural backgrounds, as the present study focuses solely on the diving preferences of local Chinese scuba divers. As a result, future studies are recommended to confirm the segmentation framework of specialization for categorizing divers from various cultural backgrounds. In addition, the present study only identified two clusters, as opposed to earlier studies that have used exploratory factor analysis and other statistical classification methods to categorize divers into three or more groups within a recreational specialization framework (Albayrak, Caber, and Cater 2021; Anderson and Loomis 2012; Bentz et al. 2016; Paterson et al. 2012). To move beyond this two-cluster model and align with more nuanced frameworks, future studies may develop the clusters by integrating additional research variables or theoretical frameworks to segregate divers into three or more segments to study the variations of their diving preferences more effectively. Lastly, as described in the methodology, this study's experimental data may not accurately represent all scuba divers in Hong Kong due to the data collection shortage during the pandemic. Therefore, the data collected in this study may have some sample bias due to the impact of the restrictions on pandemic prevention, calling for the launch of future data collection among divers during the peak diving period. For this reason, additional data collection should be conducted after the pandemic to uncover a more diverse and reliable sample for understanding Chinese divers' market segmentation and preferences in Hong Kong.

Acknowledgements

The authors would like to thank the student research assistants of the Education University of Hong Kong for helping in questionnaire surveys.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by General Research Fund (GRF) of the Research Grants Council of Hong Kong [grant number RGC Ref No. 18611919].

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Human Research Ethics Committee of The Education University of Hong Kong (protocol code 2017-2018-0122 and 01-02-2019) for studies involving humans.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

Data will be available upon requests.

ORCID

Ke Zhang https://orcid.org/0000-0002-4619-896X
Lewis T.O. Cheung https://orcid.org/0000-0002-1619-0473
Theresa W.L. Lam https://orcid.org/0000-0001-9032-4217
Anson T.H. Ma https://orcid.org/0000-0001-9301-9728
Lincoln Fok http://orcid.org/0000-0001-6467-4985

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