Consumer adoption of sustainable shellfish in China: Effects of psychological factors and segmentation

Citation

Ou Wang[*,†, 1] and Simon Somogyi[†, 2]

[1] School of Accounting, Finance and Economics, University of Waikato, Private Bag 3105, Hamilton, New Zealand.

[2] School of Hospitality, Food & Tourism Management, University of Guelph, 50 Stone Rd E, Guelph, ON, Canada

[†] These authors equally contributed to the paper.

[*] Corresponding author: Ou Wang, ou.wang@waikato.ac.nz

T +64 7 838 4758

Highlights:

Understand motives, purchase intention and segmentation for sustainable shellfish in China.

Two consumer segments with different purchase intentions for sustainable shellfish species.

Three motives have significant influences on the purchase intention in the total sample.

Attitudes toward the water environment is an important motive in one of the two segments.

1 (The number of words: 5834)

2 **Consumer adoption of sustainable shellfish in China: Effects of**

3 **psychological factors and segmentation**

4

5 **Abstract**

6   China's large and increasing demand for aquatic products has had a significant effect

7 on the sustainability of global water ecosystems. This study explored the effects of

8 psychological factors and segmentation on Chinese consumers' adoption of sustainable

9 shellfish. Data were collected by using a web-based questionnaire in three Chinese cities:

10 Beijing, Guangzhou and Chongqing (with a total sample size of 643). Descriptive analysis,

11 cluster analysis, confirmatory factor analysis and structural equation modeling were used for

12 data analysis. Chinese consumers' subjective norms, personal norms, attitudes toward shellfish

13 and attitudes toward water environment were significant psychological factors influencing their

14 purchase intentions toward sustainable shellfish. Two consumer segments were identified:

15 Sustainable-shellfish-pioneer (47.28%) and the Sustainable-shellfish-conservative (52.72%).

16 These two segments had significant differences in the purchase intentions for specific

17 sustainable shellfish species, the effects of psychological factors on purchase intentions toward

18 shellfish, and socio-demographic distributions (including income, occupation and marriage

19 status). These first hand findings can help global shellfish producers, marketers and policy-

20 makers to develop sustainable development strategies and policies for their shellfish resources

21 when exploiting the huge market.

24

25

1

1. Introduction

China is the largest aquatic food market in the world, and its vast and still expanding consumption brings a great challenge for the sustainability of global water (marine, river and lake) ecosystems that supply this market (FAO, 2016; Fabinyi, 2016; Ministry of Agriculture of the People's Republic of China, 2017; Wang and Somogyi, 2018; Wang et al., 2018). In particular, China's fast-growing consumption of shellfish has a significant effect on the sustainability of shellfish, as shellfish are more susceptible to environmental changes (e.g. a higher risk of microbial contamination) than non-shellfish aquatic products (Burman, 2017; Fabinyi, 2016; Federico, 2016; FAO, 2016; Ministry of Agriculture of the People's Republic of China, 2005, 2017; Pieniak, 2008; Wang and Somogyi, 2018; Whittle, 2015; Xiao, 2015). As such, there is an increased importance to research Chinese consumer behavior with regard to sustainable shellfish.

Consumer-based studies that focus on the sustainability of aquatic products have mostly been conducted in Western countries and paid attention to sustainable fish and seafood as general food types. Wessells et al. (1999) indicated that US consumers' adoption of eco-labeled seafood is significantly influenced by seafood species, knowledge about seafood sustainability, purchase preferences of product forms, seafood purchase budget and gender difference. Jaffry et al., (2004) point out that food labels with information about quality or sustainability assurance, original locations and production modes (e.g. frozen/live or wild/farmed), have significant influences on UK consumers' choices of seafood. Verbeke et al. (2007a) also added that Belgian consumers' perceived the importance of sustainability for fish is negatively linked to their age and positively associated with their perceived effectiveness, subjective knowledge, interest in capture area and fish origin, and expected benefit from more information. Honkanen and Young (2015) indicate that UK consumers' purchase intentions toward sustainable seafood is positively linked to their perceived subjective norm, perceived personal norm and attitudes

related to seafood sustainability. Bronnmann and Asche (2017) point out that eco-labels (e.g. MSC label) significantly increase the probability of German consumers' salmon purchase. Jacobs et al. (2015a, b) indicate that European consumers' perceived personal norm, concern about marine environment and awareness of marine contamination have significant influences on their seafood choice with Jacobs et al. (2018) further stating that initial behavior and attitudes toward information about sustainability have important effects on consumers' purchase intentions for sustainable seafood in Belgium and Portugal.

However, there is still a lack of understanding on consumers' perceptions, attitudes and behaviors toward aquatic product sustainability in China- the world's largest aquatic food market which has different food consumption patterns and customs from western countries (Wang et al., 2016; Wang and Somogyi, 2018). Only two studies could be found to contribute knowledge about Chinese consumer behavior related to aquatic product sustainability. One by Xu et al. (2012) that points out that Chinese consumers have an increased willingness to purchase green-labeled seafood and the strength of the willingness to do so is influenced by the differences of their genders, seafood consumption experiences, favorite seafood consumption locations, and knowledge about green-labels. The other by Fabinyi et al. (2016) indicated that China's middle-class consumers have a limited level of awareness on issues related to aquatic product sustainability. However, and to our knowledge, there is no consumer-based studies that specifically focus on shellfish sustainability although shellfish has a higher susceptibility of harm to environmental changes than non-shellfish aquatic products (Pieniak, 2008; Wang and Somogyi, 2018).

Given the aforementioned knowledge gaps, this study aims to explore the effects of psychological factors and segmentation on Chinese consumers' adoption of sustainable shellfish. The following paragraphs of this section will discuss the theoretical background underpinning it.

76   Steenkamp (1997) indicates a classical classification of three types of driving factors

77 for food choice including person-related factors, properties of the food products and

78 environmental factors. These three types of factors drive consumers throughout their decision-

79 making process for food choice (Verbeke, 2000). The person-related factors are classified into

80 psychological factors (e.g. motives, perceptions, general image and attitudes) and socio-

81 demographic characteristics (e.g. gender, age, occupation, education, marital status and

82 income) (Pilgrim, 1957; Shepherd, 1990; Steenkamp, 1997).

83   This study focus on the effects of person-related factors on Chinese consumers'

84 purchase intention toward sustainable shellfish. Based on previous studies, a construct of four

85 psychological factors was developed to predict consumers' purchase behaviors or intentions

86 related to aquatic product sustainability including subjective norm, perceived consumer

87 effectiveness, personal norm and attitudes toward aquatic products (Honkanen and Young,

88 2015; Jacobs et al., 2015b; Vanhonacker et al., 2013; Verbeke et al., 2007a; Vermeir and

89 Verbeke, 2006; Vermeir and Verbeke, 2008). "Subjective norm" refers to the perceived peer

90 pressure on the consumption behavior pertaining to sustainable aquatic products (Honkanen

91 and Young, 2015). "Perceived consumer effectiveness" represents consumers' belief levels in

92 individual efforts to make a difference in solving the sustainability problems of aquatic

93 products (Honkanen and Young, 2015; Verbeke et al., 2007a). "Personal norm" is the perceived

94 degree of individual obligation in solving the sustainability problems that plague aquatic

95 products (Honkanen and Young, 2015). "Attitudes" refers to the summary affection (positive

96 or negative) of aquatic products by consumers (Jacobs et al., 2015b; Verbeke et al., 2007a). All

97 these factors have been found to have positive influences on consumers' purchase intentions

98 regarding sustainable aquatic products (e.g. sustainable seafood and sustainable fish) in

99 previous studies (Honkanen and Young, 2015; Jacobs et al., 2015b; Verbeke et al., 2007a). As

100 a result, these four psychological factors were used in this study to predict Chinese consumers'

101 purchase intentions toward sustainable shellfish.

102   Furthermore, water (marine, lake and river) contamination has led to increased

103 consumer concerns regarding safety and sustainability issues of aquatic products in China

104 (Fabinyi et al., 2014a, 2014b, 2016; Lin et al., 2015; Xu et al., 2012). Consumers' attitudes and

105 concerns about the water environment have a significant influence on their choices of aquatic

106 products (Jacobs et al., 2015 a, b). Meanwhile, the water environment is viewed as essential

107 for the sustainable development of aquatic products (Chopin et al., 2001; Smith et al., 2010).

108 Therefore, it is reasonable to suggest that Chinese consumers' attitudes toward the water

109 environment may have a significant impact on their intentions to purchase sustainable aquatic

110 products—the sustainable shellfish in this case. As such, a fifth psychological factor was added

111 to the factorial construct to predict consumers' purchase intentions regarding sustainable

112 shellfish in this study.

113   Regarding another type of person-related factor, socio-demographic characteristics and

114 their effects on the adoption of sustainable shellfish were explored through consumer

115 segmentation in this study. Segmentation analysis is often carried out in food consumer studies

116 to identify consumer segments based on their psychological factors (e.g. perceptions and

117 intentions) related to food products (Pieniak et al., 2010; Wang et al., 2018; Wang and

118 Somogyi, 2018). Numerous differences in socio-demographic distributions between those

119 consumer segments are often encountered (Pieniak et al., 2010; Wang et al., 2018; Wang and

120 Somogyi, 2018). Previous studies have indicated different consumer segments based on their

121 interests, perceptions, knowledge, attitudes and behaviors regarding aquatic products, in which

122 the socio-demographic distributions of age, gender, region, income, education, marital status

123 and occupation are recognized to have significant differences between those segments (Pieniak

124 et al., 2010; Verbeke et al., 2007b; Wang et al., 2018; Wang and Somogyi, 2018). Regarding

aquatic product sustainability, a study by Jacobs et al. (2015b) showed that consumer segments have significantly different concerns regarding marine environment, seafood consumptions and socio-demographic characteristics in terms of age, gender and region. This study assumes that there are different Chinese consumer segments within significantly different socio-demographic characteristic and psychological factors will have an impact on the purchase intentions toward sustainable shellfish. Chinese consumers will be segmented based on their purchase intentions toward twelve specific sustainable shellfish species in this study.

A hypothetical model is developed based on the theoretical framework above and as shown in Figure 1. Five psychological factors (subjective norm, perceived consumer effectiveness, personal norm, attitudes toward the water environment and attitudes toward shellfish) are assumed to have significant impacts on Chinese consumers' purchase intentions toward sustainable shellfish. Furthermore, such impacts are assumed to vary between different Chinese consumer segments.

>> Insert Figure 1

2. Methods and materials

2.1. Participants and procedures

Survey data was collected through an online questionnaire (developed in English and translated into Chinese) in three Chinese cities (Beijing, Guangzhou and Chongqing) during December 2016. The three cities were selected as survey locations in order to compare and contrast consumer behaviors with regard to sustainable shellfish among different tiered cities, including the capital city (Beijing), first-tier city (Guangzhou) and second-tier city (Chongqing) that have different development levels in terms of economy, education and other socio-demographic factors (Liu et al., 2011; Wang et al., 2017). An online pilot study was conducted with 32 participants in order to modify the design and language quality of the questionnaire. A Chinese research agency was hired for questionnaire distribution of the online

survey and pilot. The final version of the questionnaire was distributed to a sample panel of the

Chinese research agency, with a quota sampling approach and the following quota stratification

dimensions: age (18-30, 31-40 and above 40), gender (male and female), cities (Beijing,

Guangzhou and Chongqing) and education (Junior college and below and University and

above) (Fabinyi et al., 2016; Wang et al., 2017; Wang and Somogyi, 2018). Participants were

shown survey questions in a random order to increase the validity of the study.

A total of 643 valid responses were received for this survey, 214 from Beijing, 221 from

Guangzhou and 208 from Chongqing (see Table 1). All valid respondents received a money

incentive from the research agency. The results from cross-tabulations with χ2 tests indicated

non-significant differences in socio-demographic distribution (including gender, age, marital

status, income, education, occupation and household size) across the three city subsamples.

>> Insert Table 1

2.2.   Measures

Table 2 shows measures and items used in this study. Subjective norm, perceived

consumer effectiveness, personal norm and purchase intentions toward sustainable shellfish (as

a general food type) were respectively probed, with two items developed from a previous study

on sustainable seafood by Honkanen and Young (2015). Participants were asked to indicate

their degree of agreement with each statement on a seven-point Likert agreement scale, from

strongly disagree to strongly agree (Wang et al., 2017).

Twelve sustainable shellfish species were involved in this study. The shellfish species

included the normal shellfish species commonly consumed by Chinese consumers (e.g.

shrimp/prawn, scallop and fresh-water-crab) and the high-value shellfish species that

experienced a quick growth rate of importation in China recently (e.g. lobster and snow-

crab/king-crab) (Fabinyi et al., 2016; Manzelli, 2017; Whittle, 2015; Xiao, 2015). A similar

design for purchase intention (only using single measurement item) was used to identify

175   participants' purchase intentions toward the twelve sustainable shellfish species: sustainable

176   shrimp/prawn, sustainable fresh-water-crab, sustainable scallop, sustainable crawfish,

177   sustainable oysters, sustainable fresh-water-winkle, sustainable sea-crab, sustainable razor-

178   clam, sustainable lobster, sustainable sea-winkle, sustainable mussels and sustainable snow

179   crab/king crab.

180   Participants' attitudes toward shellfish (as a general food type) and the water (marine,

181   river or lake) environments were respectively measured by two items using seven-point

182   semantic differential scales with bipolar adjectives. The approach was developed from previous

183   studies that examined consumers' attitudes toward seafood, fish and the marine environment

184   (Honkanen and Young, 2015; Jacobs et al., 2015a; Verbeke et al., 2007a).

185   >> Insert Table 2

2.3.   *Data analysis*

187   Data analysis was performed using the statistical software package SPSS 24 and AMOS

188   24. Figure 2 demonstrates the procedures used in the data analysis. First, descriptive analyses

189   (by mean values) were conducted to recognize participants' purchase intentions for the twelve

190   sustainable shellfish species. Second, segmentation analysis was conducted by using purchase

191   intention variables of the twelve sustainable shellfish species as segmentation variables, with a

192   two-step approach: a hierarchical clustering followed by a K-means cluster analysis (Wang et

193   al., 2015b). Cross-tabulation with $\chi 2$ tests were used to identify the significant differences

194   across the consumer segments based on socio-demographics (Wang et al., 2018). Third,

195   confirmatory factor analysis (CFA) was used to examine whether the construct with the five

196   psychological factors regarding sustainable shellfish adoption had a good fit with the sample

197   of this study (Pieniak et al., 2009; Wang et al., 2015a). Fourth, a structural equation model

198   (SEM) was built to examine associations between the psychological factors and the purchase

199   intentions toward sustainable shellfish as a general food type (Pieniak et al., 2009; Roman,

200　2017; Wang et al., 2015a). Path analysis for the total sample and multi-group path analysis for

201　subsamples of the consumer segments were conducted to recognize significant associations

202　(Pieniak et al., 2009; Wang et al., 2015a).

203　>> Insert Figure 2

204　**3. Results**

205　***3.1.　Purchase intentions for specific shellfish species***

206　As shown in Figure 3, mean values of purchase intention variables for the twelve

207　sustainable shellfish species ranged from 4.73 to 5.79. The highest mean value was found for

208　sustainable shrimp/prawn (the only variable with a mean value higher than 5.5), while the

209　lowest mean value was recognized for sustainable mussels (the only variable with a mean value

210　lower than 5).

211　>> Insert Figure 3

212　***3.2.　Consumer segments***

213　The segment analysis resulted in a two-segment solution (Table 3). Segment 1

214　accounted for 47.28% of the total sample. Participants in this segment had strong purchase

215　intentions toward all the twelve sustainable shellfish species, as mean values of all twelve

216　segmentation variables were above or close to 6. As such, Segment 1 was named Sustainable-

217　shellfish- pioneer.

218　Segment 2 accounted for 52.72% of the total sample. Participants in this segment had

219　much weaker purchase intentions toward the twelve sustainable shellfish species than their

220　counterparts in Segment 1, as mean values of eleven segmentation variables were below 5. In

221　particular, the mean value for sustainable mussels was loaded on the negative answer anchor

222　(lower than 4). Therefore, this segment was labelled as Sustainable-shellfish- conservative.

223　>> Insert Table 3

224 >> Insert Table 4

225 As shown in Table 4, cross-tabulations with χ2 tests revealed statistically significant

226 differences in socio-demographic distributions of income, marital status and occupation

227 between the two segments. The Sustainable-shellfish-pioneer segment had a higher percentage

228 of participants with a high monthly income (≥10001 RMB), a high level of occupation (e.g.

229 managing employee) or who were married than that of the Sustainable-shellfish-conservative

230 segment. In contrast, the Sustainable-shellfish-conservative segment had a higher percentage

231 of participants with a low monthly income (0-5000 RMB), a low- or medium-level occupation

232 (e.g. salaried employee, student and worker), or who were unmarried (e.g. single or had a

233 partner). No significant difference was found for other socio-demographic distributions

234 (including city, gender, age and household size) between the two segments.

235 ### *3.3. Confirmatory factor analysis*

236 Table 5 shows results of the CFA for the construct with the five psychological factors

237 toward sustainable shellfish purchase (as a general food type). The construct performed well

238 in the CFA, as the values of goodness-of-fit-indices were acceptable: above 0.9 for CFI and

239 below 0.08 for RMSEA (Pieniak et al., 2009; Wang et al., 2015a). As shown in Table 6,

240 correlation coefficients between the variables of psychological factors were all below 0.7;

241 therefore, severe multi-collinearity was not the case in this study (Pieniak et al., 2009).

242 Standardized factor loadings of the observed items ranged from 0.774 to 0.974. The AVE

243 scores of the five variables of psychological factors were all higher than their squared

244 correlation coefficients with each other. All composite reliability (CR) measures were higher

245 than 0.8. As such, discriminant validity was established with the five psychological factors on

246 the construct for the data in this study (Voorhees et al., 2016).

247 >> Insert Table 5

248 >> Insert Table 6

3.4.   Structural equation modeling

250   Figure 4 shows a SEM that associates the psychological factors with the purchase
251 intention toward sustainable shellfish. It includes six latent variables and twelve observed
252 variables. The observed variables of purchase intention toward sustainable shellfish had a good
253 internal reliability with a high Cronbach α score of 0.891 (Wang et al., 2015a; Žeželj et al.,
254 2012). The SEM performed well for both the path analysis for the total sample and the multi-
255 group path analysis for the subsamples of the two consumer segments (see Table 3 and 4). The
256 RMSEA and CFI values all reached an acceptable fit (below 0.08 for RMSEA and above 0.9
257 for CFI) for the model of path analysis and restricted models of the multi-group path analysis
258 (see Figure 5) (Pieniak et al., 2009; Wang et al., 2015a).

259 >> Insert Figure 4

260 >> Insert Figure 5

261   Figure 5 shows statistically significant paths from the path analysis and the multi-group
262 path analysis. The intention to purchase sustainable shellfish had a positive association with
263 subjective norm, personal norm and the attitudes toward shellfish in models for both the total
264 sample and the two subsamples. In other words, those Chinese participants who felt a high peer
265 pressure, had a strong moral obligation to protect shellfish resources and sustainability, and/or
266 had a positive attitude toward shellfish will be more willing to purchase sustainable shellfish.
267 Furthermore, the findings indicated the highest score on the standardized regression weight of
268 personal norm among the three significant psychological factors in the model of the total
269 sample. Regarding the models for the two consumer segments, the Sustainable-shellfish-
270 pioneer segment had an obviously higher score on the regression weight of personal norm than
271 that of the Sustainable-shellfish-conservative segment while the Sustainable-shellfish-

272 conservative segment had an obviously higher score on the regression weight of subjective

273 norm than that of the Sustainable-shellfish- pioneer segment. In addition, the purchase

274 intention also had a positive relationship with the attitudes toward the water environment in the

275 model of the Sustainable-shellfish-conservative segment. As such, participants who had

276 positive attitudes toward the water environment were more likely to purchase sustainable

277 shellfish in this segment. Such a significant path was not found in the models for the total

278 sample and the subsample of the Sustainable-shellfish-pioneer segment. Moreover, perceived

279 consumer effectiveness had no significant relationship with the purchase intention for all the

280 models of the total sample and the two subsamples.

281 **4. Discussion**

282 This is the first study to present information regarding consumers' psychological factors

283 in relation to sustainable shellfish purchases in China—the largest aquatic product market in

284 the world. Regarding the psychological factors, Chinese consumers' attitudes toward shellfish,

285 subjective norm and personal norm are significantly linked to their purchase intentions toward

286 sustainable shellfish. However, there is no significant association between the purchase

287 intention and their perceived effectiveness for the sustainability of shellfish. These findings in

288 our Chinese sample bear strong similarities to former findings in studies related to the effects

289 of consumers' psychological factors regarding sustainable aquatic products in Western

290 countries (e.g. UK and Belgium) (Honkanen and Young, 2015; Jacobs et al., 2015b; Verbeke

291 et al., 2007). This indicates that the effects of consumers' psychological factors on purchase of

292 sustainable aquatic products surpass cultural differences, even between East and West.

293 Subjective norm and personal norm have strongly positive influences on Chinese

294 consumers' purchase intentions toward sustainable shellfish. In this perspective, policy-makers

295 should make effective policies including universal education/promotion campaigns

296 highlighting the moral obligation to eat sustainable shellfish or other aquatic products. Such

297 actions would be of benefit to the sustainable development of the world's shellfish resources

298 (or even non-shellfish aquatic products) that supply this huge market. Furthermore, Honkanen

299 and Young (2015) suggests that using celebrities is an effective approach to enhancing

300 consumers' subjective norm in relation to purchasing sustainable seafood. This is confirmed

301 by an example of the decrease in consumption of some endangered aquatic products (e.g.

302 shark's fin) in China, caused by a series of public-benefit activities in which a Chinese super

303 basketball star participated (Fabinyi and Liu, 2014a, b). In contrast, although researchers

304 indicate the more important role of personal norm (confirmed by the highest score on the

305 standardized regression weight of personal normal in the SEM of the total sample, see Figure

306 4) in leading sustainable consumption behavior, no direct approach has been suggested to

307 enhance consumers' personal norm in relateion to purchasing sustainable aquatic products in

308 previous studies (Honkanen and Young, 2015; Schwartz, 1977). An indirect approach is

309 suggested to enhance the personal norm through activating the subjective norm related to

310 purchasing sustainable seafood by Honkanen and Young (2015).

311   Attitude toward shellfish is positively linked to the intention to purchase sustainable

312 shellfish by Chinese consumers. This corresponds with the positive role of consumers' attitudes

313 in influencing their seafood consumption behavior with regard to sustainability (Honkanen and

314 Young, 2015; Jacobs et al., 2015b; Verbeke et al., 2007). Furthermore, the findings of this

315 study provide the first look at Chinese consumers' purchase intentions for specific sustainable

316 shellfish species. Their favorite species is sustainable shrimp/prawn while their least favorite

317 species is sustainable mussels. These findings bear a similarity to Chinese consumers' general

318 attitudes toward specific shellfish species, which indicate a more positive attitude toward

319 shrimp/prawn than mussels (Wang and Somogyi, 2018). This again confirms the significant

320 impact of general attitudes toward shellfish on the purchase intention toward sustainable

321 shellfish in the SEM of this study. Therefore, it is recommended that sustainable promotions

322 focus on those shellfish species with more positive general attitudes by Chinese consumers in

323 order to enhance their acceptability in the market.

324   This study is also one of the first to examine the impacts of consumers' attitudes toward

325 the water (marine, lake and river) environment on their intentions to purchase sustainable

326 aquatic products. The findings indicate the significantly positive impact on the purchase

327 intentions toward sustainable shellfish by the Chinese consumer segment which has a relatively

328 conservative choice behavior with regard to sustainable shellfish. This corresponds to the

329 increased consumer concerns regarding safety and sustainability issues of aquatic products

330 caused by frequent water contamination and food safety events currently appearing in China

331 (Fabinyi et al., 2014a, 2014b, 2016; Lin et al., 2015; Xu et al., 2012) and the important role of

332 water environment for the sustainable development of aquatic products (Chopin et al., 2001;

333 Smith et al., 2010). Therefore, global shellfish marketers and exporters should develop

334 promotions and food labels to highlight their shellfish production from clean and safe water

335 when exploiting the Chinese market.

336   This study is the first one to provide knowledge about consumer segments and their

337 purchases of sustainable shellfish in China. Two consumer segments are recognized for

338 sustainable shellfish purchase in China: the Sustainable-shellfish-pioneer segment (with a high

339 monthly income, a high level of occupation and/or who are married) and the Sustainable-

340 shellfish- conservative segment (with a low monthly income, a low- or medium-level

341 occupation and/or who are unmarried). The significant difference in marital status between

342 these two segments is in line with the previous findings that married consumers are more

343 willing to purchase sustainable food products, as they are more frequently involved in family

344 food purchases and care more about health issues related to family members, compared to

345 unmarred consumers (Robinson and Smith, 2002). Meanwhile, those Chinese consumers with

346 a high level of monthly income and/or position are more willing to purchase sustainable

347 shellfish products. This is in line with the previous findings that high- and middle-class

348 consumers are more likely to pursue the satisfaction of high-level needs (e.g. sustainability and

349 ethnic satisfaction) pertaining to shellfish consumption in China (Wang and Somogyi, 2018).

350   There are differences in the effects of psychological factors on the purchase of

351 sustainable shellfish between the two Chinese consumer segments. Personal norm has a more

352 significant influence on the purchase intention toward sustainable shellfish in the Sustainable-

353 shellfish-pioneer segment than in the Sustainable-shellfish-conservative segment. In contrast,

354 subjective norm has a more significant influence on the purchase intention in the Sustainable-

355 shellfish- conservative segment than in the Sustainable-shellfish-pioneer segment. In addition,

356 the attitudes toward the water environment has a significant influence on the purchase intention

357 in the Sustainable-shellfish-conservative segment, but such a significant influence does not

358 appear in the Sustainable-shellfish-pioneer segment. The theory of "Maslow's hierarchy of

359 needs" might explain this psychological difference toward sustainable shellfish purchases

360 between the two segments. The high- and middle-class consumers (the Sustainable-shellfish-

361 pioneer segment) are more likely to seek satisfaction of their high-level needs, such as self-

362 actualization (personal norm), while the low-class consumers (the Sustainable-shellfish-

363 conservative segment) are more likely to seek satisfaction of low-level needs, such as

364 love/belonging (subjective norm) and safety (water environment) (Maslow, 1943; Wang and

365 Somogyi, 2018). Furthermore, the theory may also explain the hardness of enhancement of

366 consumers' personal norm in relation to purchasing sustainable (aquatic) products mentioned

367 in previous studies; high-level needs (e.g. personal norm) are much more difficult to satisfy

368 than low-level needs (e.g. subjective norm) (Honkanen and Young, 2015; Maslow, 1943;

369 Schwartz, 1977; Wang and Somogyi, 2018). Therefore, shellfish policy-makers and marketers

370 should focus on the Sustainable-shellfish-pioneer segment for promotions of sustainable

371 shellfish products due to the strong willingness to satisfy the high-level need—personal

norm—by this segment and the potential influence of subjective norm from this segment on the Sustainable-shellfish-pioneer segment in China.

There are also differences in purchase intentions for specific sustainable shellfish species between the two Chinese consumer segments. As such, shellfish policy-makers and marketers should select suitable shellfish species for different Chinese consumer segments in promotions related to shellfish sustainability. Consumers in the Sustainable-shellfish-pioneer segment have a strong willingness to purchase all the twelve sustainable shellfish species. Shellfish policy-makers and marketers could promote all their sustainable shellfish species to this segment. For those consumers in the Sustainable-shellfish-conservative segment, shellfish policy-makers and marketers should only promote sustainable shellfish species which are more likely to be accepted by this consumer segment (e.g. sustainable shrimp/prawn and sustainable fresh-water-crab) due to the low desire to purchase most of the sustainable shellfish species by this segment.

Nevertheless, this study does have limitations. It only focuses on Chinese consumers' person-related factors and purchase intentions toward sustainable shellfish. It is recommended for future relevant studies to also involve other types of factors that might have influences on Chinese consumers' adoption of sustainable shellfish such as the properties of the food products and environmental factors. Furthermore, our study only involves twelve shellfish species, including the normal shellfish species commonly consumed by Chinese consumers and the high-value shellfish species experiencing a quick growth rate of importation in China recently. It is necessary for future relevant studies to also focus on or involve other sustainable shellfish species (e.g. sustainable clam).

397 **5. Conclusions**

398   China's massive and ever so increasing demand in aquatic products has had a significant

399 effect on the sustainability of global water ecosystems that supply this market. By using cluster

400 analysis and quantitative-modeling method, this study provides an understanding of the

401 important psychological factors and consumer segments influencing Chinese consumers'

402 adoption of sustainable shellfish. The first-hand findings have significance for future consumer

403 studies related to aquatic product sustainability and can assist global shellfish producers,

404 marketers and policy-makers to better understand Chinese consumers' behaviors regarding

405 shellfish sustainability. This should assist these stakeholders when developing sustainable

406 development strategies and policies for their shellfish when exploiting the huge market.

410   **References**

411 Bronnmann, J., Asche, F., 2017. Sustainable seafood from aquaculture and wild fisheries:

412   Insights from a discrete choice experiment in Germany. Ecol. Econ. *142*, 113-119.

413 Burman, A., 2017. Shrimp surging in popularity on Chinese seafood market. http://www.food-

414   exhibitions.com/Market-Insights/China/Shrimp-surging-popularity-Chinese-seafood-

415   market (accessed 17.07.30).

416 Chopin, T., Buschmann, A. H., Halling, C., Troell, M., Kautsky, N., Neori, A., Neefus, C.,

417   2001. Integrating seaweeds into marine aquaculture systems: a key toward

418   sustainability. J. Phycol. *37*, 975-986.

419 Fabinyi, M. , Liu, N., 2014a. Seafood banquets in Beijing: consumer perspectives and

420   implications for environmental sustainability. Conserv. Soc. *12*, 218-228.

421 Fabinyi, M. , Liu, N., 2014b. Social trust and luxury seafood banquets in contemporary Beijing.

422   Asian Anthropol. 13, 92-105.

423 Fabinyi, M., Liu, N., Song, Q., Li, R., 2016. Aquatic product consumption patterns and

424   perceptions among the Chinese middle class. Region. Stud. Mar. Sci. *7*, 1-9.

425 Fabinyi, M., 2016. Sustainable seafood consumption in China. Mar. Policy *74*, 85-87.

426 FAO, 2016. The State of World Fisheries and Aquaculture 2016. Food and Agriculture

427   Organization of the United Nations, Rome.

428 Federico, 2016. Luxury Seafood Industry in China: high-end seafood products enjoy a wave of

429   popularity. http://daxueconsulting.com/luxury-seafood-industry-in-china/ (accessed

430   17.07.30).

431 Honkanen, P., Young, J. A., 2015. What determines British consumers' motivation to buy

432   sustainable seafood?. Br. Food J. *117*, 1289-1302.

433 Hu, Y., Yuan, C., Yu, K., Qu, Y., Chen, S., Wang, X. , Kimura, I., 2014. An online survey

434   study of consumer preferences on aquatic products in China: current seafood

435   consumption patterns and trends. Fish. Aquacult. J. *5*, 1-6.

436 Jacobs, S., Sioen, I., De Henauw, S., Rosseel, Y., Calis, T., Tediosi, A., Verbeke, W., 2015a.

437   Marine environmental contamination: public awareness, concern and perceived

438   effectiveness in five European countries. Environ. Res. *143*, 4-10.

439 Jacobs, S., Sioen, I., Pieniak, Z., De Henauw, S., Maulvault, A. L., Reuver, M., Verbeke, W.,

440   2015b. Consumers' health risk–benefit perception of seafood and attitude toward the

441   marine environment: Insights from five European countries. Environ. Res. *143*, 11-19.

442 Jacobs, S., Sioen, I., Marques, A., & Verbeke, W. (2018). Consumer response to health and

443   environmental sustainability information regarding seafood consumption. *Environ.*

444   *Res. 161*, 492-504.

445 Jaffry, S., Pickering, H., Ghulam, Y., Whitmarsh, D., Wattage, P., 2004. Consumer choices for

446   quality and sustainability labelled seafood products in the UK. Food Policy *29*, 215-

447   228.

448 Lin, C., Liu, Z. S., Tan, C. Y., Guo, Y. P., Li, L., Ren, H. L., Zhou, Y., 2015. Contamination

449   of commercially available seafood by key diarrhetic shellfish poisons along the coast

450   of China. Environ. Sci. Pollut. Res. 22, 1545-1553.

451 Liu, S., Smith, J. R., Liesch, P. W., Gallois, C., Ren, Y., Daly, S, 2011. Through the lenses of

452   culture: Chinese consumers' intentions to purchase imported products. J. Cross-Cult.

453   Psychol. 42, 1237-1250.

454 Manzelli, A., 2017. The king of the sea? how China's king-sized appetite ss sinking the global

455   fishing   industry.   http://www.globalanimal.org/2017/05/01/the-king-of-the-sea-how-

456   chinas-king-sized-appetite-is-sinking-the-global-fishing-industry/(accessed 17.07.30).

457 Maslow, A. H. 1943. A theory of human motivation. Sychol. Rev. 50(4), 370–396.

458 Ministry of Agriculture of the People's Republic of China, 2005. China Fishery Statistical

459   Yearbook 2017. China Agriculture Press, Beijing.

460 Ministry of Agriculture of the People's Republic of China, 2017. China Fishery Statistical

461   Yearbook 2017. China Agriculture Press, Beijing.

462 Pieniak, Z., 2008. Information and health-related beliefs as determinants of fish consumption.

463   Doctoral dissertation. Ghent University, Gent.

464 Pieniak, Z., Verbeke, W., Vanhonacker, F., Guerrero, L., Hersleth, M., 2009. Association

465   between traditional food consumption and motives for food choice in six European

466   countries. Appetite 53, 101-108.

467 Pieniak, Z., Verbeke, W., Olsen, S. O., Hansen, K. B., Brunsø, K., 2010. Health-related

468   attitudes as a basis for segmenting European fish consumers. Food Policy *35*, 448-455.

469 Pilgrim, F. J., 1957. The components of food acceptance and their measurement. Am. J. Clin.

470   Nutr. 5(2), 171-175.

471 Robinson, R. and Smith, C. 2002. Psychosocial and demographic variables associated with

472   consumer intention to purchase sustainably produced foods as defined by the Midwest

473   Food Alliance. *J. Nutr. Educ. Behav.* 34(6), 316-325.

474 Roman, A. V. (2017). Institutionalizing sustainability: A structural equation model of

475   sustainable procurement in US public agencies. J. Clean. Prod. 143, 1048-1059.

476 Smith, M. D., Roheim, C. A., Crowder, L. B., Halpern, B. S., Turnipseed, M., Anderson, J. L.,

477   Liguori, L. A., 2010. Sustainability and global seafood. Science *327*, 784-786.

478 Schwartz, S.H., 1977. Normative influences on altruism1. *Adv. Exp. Soc. Psychol.* 10, 221-279.

479

480 Shepherd, R., 1990. Overview of factors infuencing food choice, in: Ashwell, M. (Eds.), Why

481   we Eat What we Eat, ed. M. Ashwell. British Nutrition Foundation, Lodon, pp. 12-30.

482 Steenkamp, J. B. E., 1997. Dynamics in consumer behavior with respect to agricultural and

483   food products. In: Wierenga, B., Van Tilburg, A., Grunert, K., Steenkamp, J. B. E.,

484   Wedel, M. (Eds.), Agricultural marketing and consumer behaviour in a changing world

485   . Kluwer Academic publishers, Dordrecht, pp. 143–188.

486 Vanhonacker, F., Van Loo, E. J., Gellynck, X., Verbeke, W. 2013. Flemish consumer attitudes

487   towards more sustainable food choices. Appetite 62, 7-16.

488 Verbeke, W., 2000. Influences on the consumer decision-making process towards fresh meat-

489   Insights from Belgium and implications. Br. Food J. *102*(7), 522-538.

490 Verbeke, W., Vanhonacker, F., Sioen, I., Van Camp, J., De Henauw, S., 2007a. Perceived

491   importance of sustainability and ethics related to fish: A consumer behavior

492   perspective. AMBIO *36,* 580-585.

493 Verbeke, W., Vermeir, I., Brunsø, K., 2007b. Consumer evaluation of fish quality as basis for

494   fish market segmentation. Food. Qual. Prefer. *18*, 651-661.

495 Vermeir, I., Verbeke, W. 2006. Sustainable food consumption: Exploring the consumer

496   "attitude–behavioral intention" gap. J. Agric. Environ. Ethics 19(2), 169-194.

497 Vermeir, I., Verbeke, W. 2008. Sustainable food consumption among young adults in Belgium:

498   Theory of planned behaviour and the role of confidence and values. Ecol. Econ. 64(3),

499   542-553.

500 Voorhees, C. M., Brady, M. K., Calantone, R., Ramirez, E., 2016. Discriminant validity testing

501   in marketing: an analysis, causes for concern, and proposed remedies. J. Acad. Market.

502   Sci. 44, 119-134.

503 Wang, O., De Steur, H., Gellynck, X., Verbeke, W., 2015a. Motives for consumer choice of

504   traditional food and European food in China. Appetite 87, 143- 151.

505 Wang, O., Gellynck, X., Verbeke, W., 2015b. General image of and beliefs about European

506   food in two Chinese cities: Shanghai and Xi'an. Br. Food J. 117, 1581-1595.

507 Wang, O., Gellynck, X.,Verbeke, W., 2016. Perceptions of Chinese traditional food and

508   European food among Chinese consumers. Br. Food J. *118*, 2855-2872.

509 Wang, O., Gellynck, X., Verbeke, W., 2017. Chinese consumers and European beer:

510   Associations between attribute importance, socio-demographics, and consumption.

511   Appetite *108*, 416-424.

512 Wang, O., Somogyi, S., 2018. Chinese consumers and shellfish: Associations between

513   perception, quality, attitude and consumption. Food. Qual. Prefer. 66, 52-63.

514 Wang, O., Somogyi, S., Ablett, R. 2018. General image, perceptions and consumer segments

515   of luxury seafood in China: a case study for lobster. Br. Food J. 120 (5).

516 Wessells, C. R., Johnston, R. J., Donath, H., 1999. Assessing consumer preferences for

517   ecolabeled seafood: the influence of species, certifier, and household attributes. Am. J.

518   Agr. Econ. *81*, 1084-1089.

519 Whittle, P., 2015. Maine lobster is booming in China. http://uk.businessinsider.com/maine-

520   lobster-is-booming-in-china-2015-2?r=US&IR=T (accessed 15.08.30).

521 Xiao, L., 2015. Lobster exports to China rise. http://usa.chinadaily.com.cn/world/2015-

522   01/29/content_19433889.htm (accessed 15.08.30).

523 Xu, P., Zeng, Y., Fong, Q., Lone, T., Liu, Y., 2012. Chinese consumers' willingness to pay for

524   green-and eco-labeled seafood. Food Control *28*, 74-82.

525

(The number of words: 741)

Table 1 Socio-demographic distribution of the sample

		Total sample	Beijing	Guangzhou	Chongqing
Sample size (n=)		643	214	221	208
Gender					
	Male	49.9%	50.0%	50.2%	49.5%
	Female	50.1%	50.0%	49.8%	50.5%
Marital status					
	Married	71.5%	72.4%	69.2%	73.1%
	No, but has a partner	12.9%	13.1%	12.2%	13.5%
	Single	15.6%	14.5%	18.6%	13.5%
Age					
	18-30	36.7%	36.9%	37.6%	35.6%
	31-40	33.0%	32.2%	33.9%	32.7%
	≥41	30.3%	30.8%	28.5%	31.7%
Personal income (RMB, monthly)	0-5000	40.4%	41.1%	38.0%	42.3%
	5001-10000	40.9%	41.6%	41.2%	39.9%
	≥10001	18.7%	17.3%	20.8%	17.8%
Education					
	Junior college and below	45.9%	44.9%	52.0%	40.4%
	University and above	54.1%	55.1%	48.0%	59.6%
Occupation					
	Managing employee	32.7%	28.0%	33.9%	36.1%
	Salaried employee	41.8%	48.1%	40.3%	37.0%
	Worker	9.5%	12.1%	7.7%	8.7%
	Student	7.0%	6.5%	6.3%	8.2%
	Self-employed	5.4%	2.8%	8.6%	4.8%
	Other	3.6%	2.3%	3.2%	5.3%
Household size					
	1-2	12.8%	12.6%	13.6%	12.0%
	3	53.5%	56.5%	52.9%	51.0%
	4	17.6%	17.3%	16.7%	17.8%
	≥5	16.5%	13.6%	16.7%	19.2%

Table 2 Measurement items in the study

Code	Factor (latent variable) and measurement item
SN	**Subjective norm**
SN1	Most of my friends or colleagues think that I should buy sustainable shellfish.
SN2	Most of my family members think I should buy sustainable shellfish.
PCE	**Perceived consumer effectiveness**
PCE1	One person alone can do very little about sustainability of shellfish stocks (R).
PCE2	One person's positive efforts concerning the sustainability of shellfish stocks is useless if others don't want to Contribute (R).
PN	**Personal norm**
PN1	I feel a moral obligation to protect the shellfish stocks.
PN2	I feel that I should protect the shellfish stocks.
ATW	**Attitudes toward the water (marine, river or lake) environment**
ATW1	Unhappy/happy
ATW2	Dull/Excited
A	**Attitude toward shellfish (as a general concept)**
A1	Unhappy/happy
A2	Dull/Excited
PIS	**Purchase intention toward sustainable shellfish (as a general concept)**
PIS1	I'm going to buy sustainable shellfish.
PIS2	I will try to buy sustainable shellfish.

Table 3 Sizes and mean scores of consumer segments based on their purchase intentions toward the twelve sustainable shellfish species

Sustainable shellfish species	Segment 1 Sustainable-shellfish-pioneer	Segment 2 Sustainable-shellfish-conservative	F	p-Value
Sustainable lobster	6.28	4.56	475.304	0.000
Sustainable crawfish	6.11	4.47	285.742	0.000
Sustainable shrimp/prawn	6.41	5.23	238.724	0.000
Sustainable fresh-water-crab	6.3	4.76	344.245	0.000
Sustainable sea-crab	6.23	4.43	498.893	0.000
Sustainable snow-crab/king-crab	5.95	4.16	399.036	0.000
Sustainable scallop	6.28	4.68	432.390	0.000
Sustainable razor-clam	6.01	4.2	449.852	0.000
Sustainable mussels	5.71	3.85	410.702	0.000
Sustainable oysters	6.27	4.43	491.514	0.000
Sustainable fresh-water-winkle	6.05	4.3	386.043	0.000
Sustainable sea-winkle	6.05	4.14	519.333	0.000
Segment size	304	339		
Share of the total sample (n=643)	47.28%	52.72%		

Table 4 Socio-demographics of the two consumer segments based on their purchase intentions toward the twelve sustainable shellfish species

	Segment 1	Segment 2
	Sustainable-shellfish- pioneer	Sustainable-shellfish- conservative
	(n=304)	(n=339)
City		
Beijing	33.9%	32.7%
Guangzhou	33.6%	35.1%
Chongqing	32.6%	32.2%
Gender		
Male	53.9%	46.3%
Female	46.1%	53.7%
Income**		
0-5000	34.9%	45.4%
5001-10000	41.4%	40.4%
≥10001	23.7%	14.2%
Marital status*		
Single	11.2%	19.5%
No, but has a partner	12.5%	13.3%
Married	76.3%	67.3%
Educational level		
Junior college and below	45.1%	46.6%
University and above	54.9%	53.4%
Occupation***		
Managing employee	40.1%	26.0%
Salaried employee	35.5%	47.5%
Student	4.6%	9.1%
Worker	8.9%	10%
Self-employed	6.9%	4.1%
Others	3.9%	3.2%
Age		
18-30	34.2%	38.9%
31-40	34.2%	31.9%
≥41	31.6%	29.2%
Household size		
1-2	11.5%	13.6%
3	54.9%	52.2%
4	16.8%	17.7%
≥5	16.8%	16.5%

*Note: ***= p<0.001; **= p<0.01; *= p<0.05.*

Table 5. Results of the CFA based on the construct of motives for Chinese consumers' choice of sustainable shellfish

Latent and observed variable	Standardized factor loading	Composite reliability	Average variance extracted (AVE)
Subjective norm		0.854	0.745
SN1	0.858		
SN2	0.868		
Perceived consumer effectiveness		0.810	0.681
PCE1	0.774		
PCE2	0.874		
Personal norm		0.803	0.671
PN1	0.803		
PN2	0.835		
Attitudes toward the water environment		0.952	0.909
ATW1	0.932		
ATW2	0.974		
Attitude toward shellfish		0.882	0.789
A1	0.858		
A4	0.918		

Note: For the codes of measurement items (e.g. SN1 and SN2) please see Table 2; Goodness-of-fit indices: RMSEA=0.010, CFI=1.000, Chi-square=26.660, DF=25, p= 0.373.

Table 6. Correlation matrix of latent variables based on the construct of motives for Chinese consumers' choice of sustainable shellfish

Latent variable	1	2	3	4	5
1. Subjective norm	1				
2. Perceived consumer effectiveness	-0.218***	1			
3. Personal norm	0.641***	- 0.367***	1		
4. Attitudes toward the water environment	0.192***	-0.037	0.156**	1	
5. Attitude toward shellfish	0.432***	-0.166***	0.359***	0.312***	1

*Note: ***= p<0.001; **= p<0.01; *= p<0.05.*

(The number of words: 163)

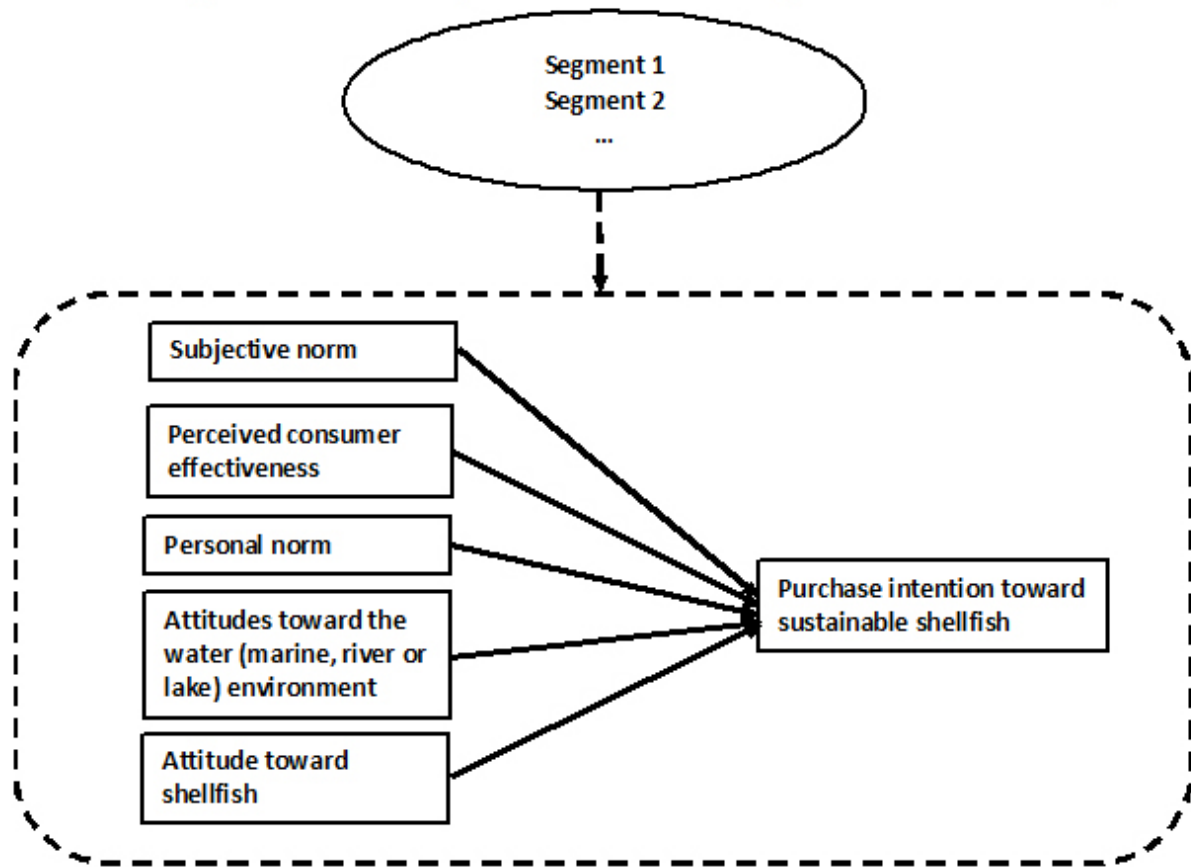Consumer segments based on their purchase intentions toward specific sustainable shellfish species
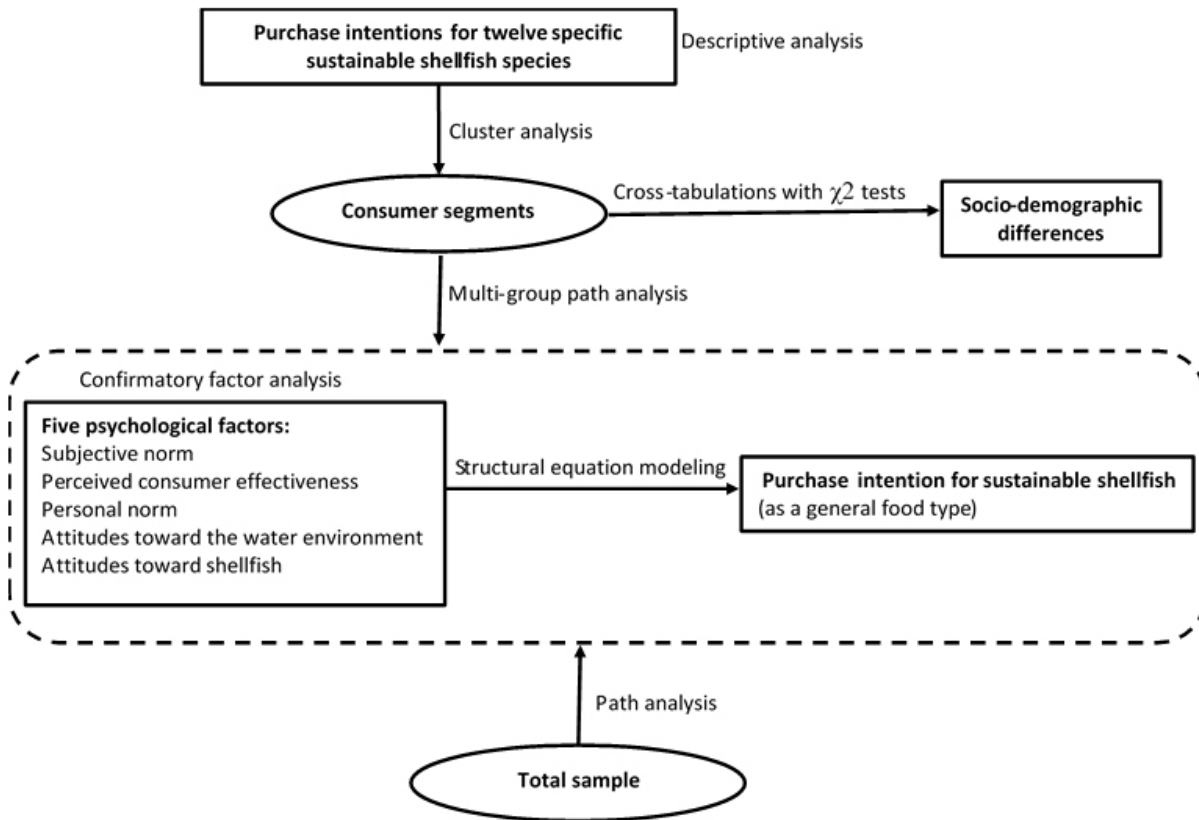
Segment 1
Segment 2
...

Subjective norm

Perceived consumer effectiveness

Personal norm

Attitudes toward the water (marine, river or lake) environment

Attitude toward shellfish

Purchase intention toward sustainable shellfish

Figure 1 Hypothetical model of this study
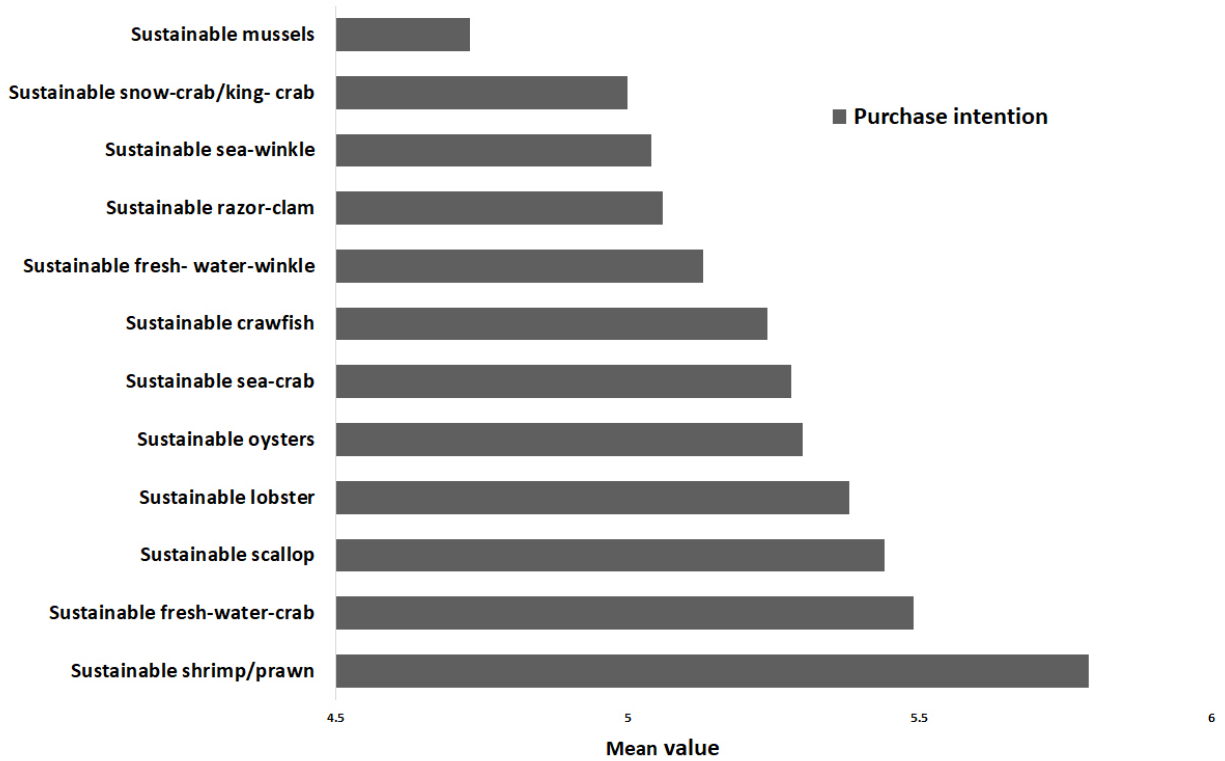
Figure 2 Procedure of data analysis in this study

Figure 3 Mean values of Chinese consumers' purchase intentions toward twelve sustainable shellfish species
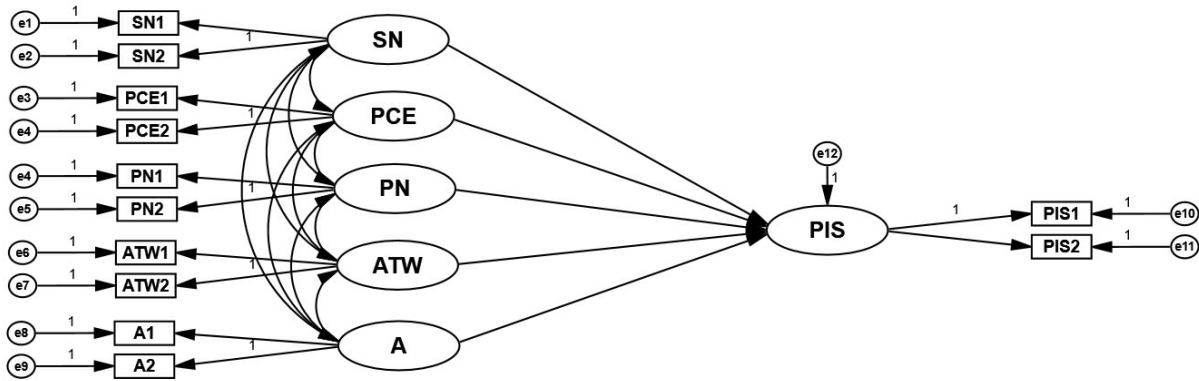
Figure 4 Structural equation model for the (multi-group) path analysis in this study
Note: for the codes of measurement items and their latent variables (e.g. SN, SN1 and SN2) please refer to Table 2; e1-e12: error variables.
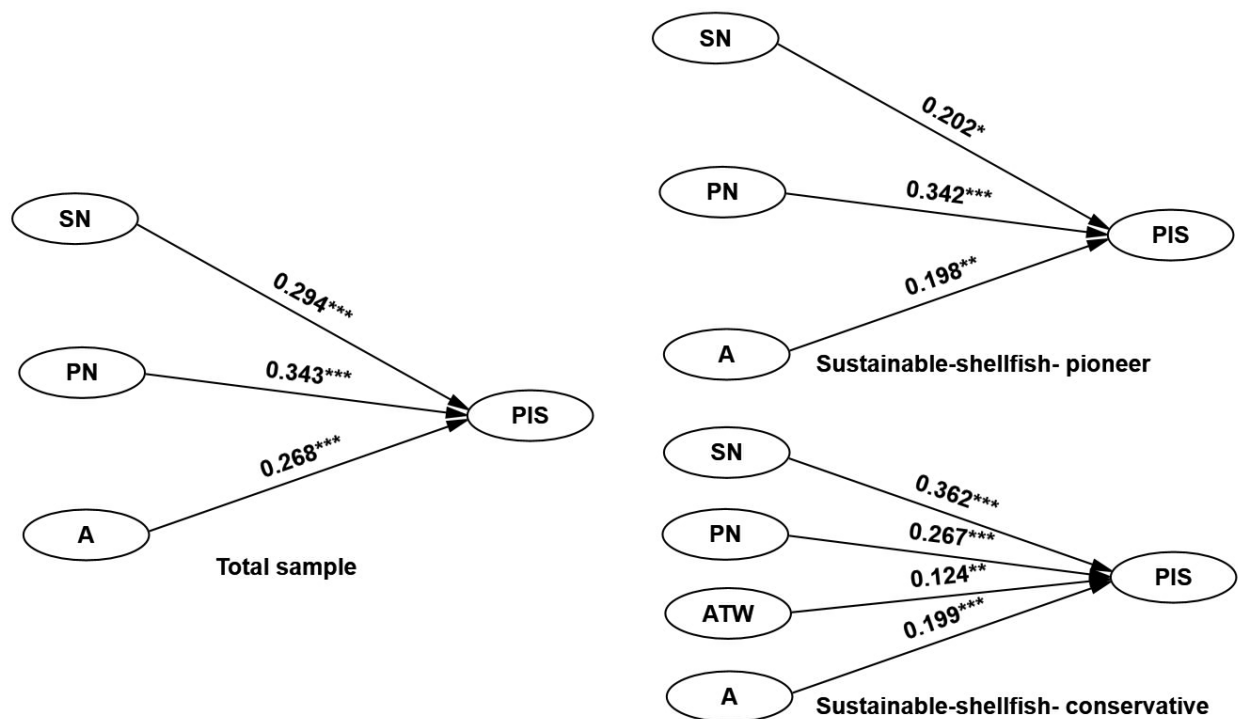
Figure 5 Significant paths of the path analysis for the total sample and the multi-group path analysis for the sub-samples of the two consumer segments (see Table 3 and 4): standardized regression weights

Note: for the codes of latent variables (e.g. SN, PCE and ATW) please refer to Table 2; ***= p<0.001; **= p<0.01; *= p<0.05; Goodness-of-fit indices for the path analysis of total sample: RMSEA=0.021, CFI=0.998, Chi-square=49.628, DF=39, p=0.118; Goodness-of-fit indices for the multi-group path analysis of sub-samples of the two consumer segments (unconstrained model): RMSEA=0.000, CFI=1.000, Chi-square=70.969, DF=78, p=0.701.