Willingness to adopt a more plant-based diet in China and New Zealand: Applying the theories of planned behaviour, meat attachment and food choice motives

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Adoption of a more plant-based diet in China and New Zealand

Four meat attachment factors with significant impacts

Four factors based on the Theory of Planned Behaviour with significant impacts

One food choice motive with significant impacts

Willingness to adopt a more plant-based diet in China and New Zealand: Applying the theories of planned behaviour, meat attachment and food choice motives

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Willingness to adopt a more plant-based diet in China and New Zealand: Applying the theories of planned behaviour, meat attachment and food choice motives

Abstract

The purpose of this study is to explore the significant factors that drive consumers' willingness to adopt a more plant-based diet, in both an Asian developing country (China) and a Western developed country (New Zealand), on the basis of three theories: meat attachment factors, the theory of planned behaviour and food choice motives. The data were collected through online surveys in China (n=604) and New Zealand (n=581). Confirmatory factor analysis and structural equation modelling were used for the data analysis. Consumers' willingness to adopt a more plant-based diet was significantly linked to all the four meat attachment factors (Hedonism, Affinity, Entitlement and Dependence), four factors based on the Theory of Planned Behaviour (Subjective norms, Personal norms, Perceived behavioural control and Attitudes), and one food choice motive (Environmental concern). There were differences between China and New Zealand in the impact of the meat attachment factors and the theory of planned behaviour factors on the willingness to adopt a more plant-based diet.

Keywords

Consumers; plant-based diet; meat attachment; food choice motives; theory of planned behaviour.

1. Introduction

Since 2015, when world leaders committed to fulfilling the seventeen UN Sustainable Development Goals (SDGs) by 2030, the number of sustainability-related studies has been growing continually (Griggs et al., 2013; United Nations, 2020). This is particularly the case in the areas of consumers' eating habits and food production, because at least nine of the SDGs are dependent on global food systems becoming structurally sustainable (NewForesight, 2017). A plant-based diet seems to have a vital role in the process of sustainable development in global food systems, as such a diet is widely accepted to have positive impacts on reducing greenhouse gas emissions and enhancing human health and animal welfare (Faber et al., 2020; Graça et al., 2019; Lang, 2020). These impacts will be helpful for the fulfilment of several SDGs, such as *Good health and well-being, Responsible consumption and production* and *Climate action* (NewForesight, 2017; United Nations, 2020). For this reason, it is increasingly important for food industry stakeholders to have a full understanding of consumer attitudes towards a more plant-based diet, so that they can develop effective marketing strategies and promotion policies to address the opportunities and challenges of this rising dietary trend.

Studies into consumer attitudes towards a plant-based diet have been mostly conducted in Western developed countries, as a result of the concerns of scholars about the high level of per capita meat consumption caused by the meat-rich Western dietary pattern (e.g. above 90kg in North America, and around or above 70kg in Oceania and Europe; in retail weight) (Graça, Calheiros et al., 2015; OECD/FAO, 2019; Wang et al., 2016). Numerous relevant empirical studies have been published in recent years, most using European consumers in their research samples. Many factors have been recognized to have a significant impact on Western consumers' willingness to reduce their meat consumption and adopt a more plant-based diet; these include meat attachment factors (Bryant et al., 2019; Graça, Calheiros et al., 2015, Graça et al., 2019; Lentz et al., 2018), food choice motives (Graça et al., 2019; Vainio, 2019; Van

74 Loo et al., 2017; Verain et al., 2017), planned behaviour (Austgulen et al., 2018; Graça,
75 Calheiros et al., 2015; Lentz et al., 2018; Pohjolainen et al., 2015) and perceptions of a plant-
76 based diet (Bryant et al., 2019; Reipurth et al., 2019; Vainio, 2019; Van Loo et al., 2017).

77 By contrast, there is still a lack of understanding of consumer behaviour towards a more
78 plant-based diet in Asian developing countries, which have different dietary customs and
79 consumption patterns from Western countries (Li, 2007; Wang et al., 2016). Although the
80 average level of per capita meat consumption is low (around 30kg in retail weight), Asia is the
81 continent with the largest total volume of meat consumed (twice that of Europe and North
82 America), and it is experiencing a consistently high growth in meat demand because of the
83 huge population base, the sustained increase in personal income and the Westernization of
84 dietary patterns (OECD/FAO, 2019; OECD, 2020; Wang et al., 2016). From this perspective,
85 Asian developing countries play a role in enhancing the structural sustainability of global food
86 systems that is as important as the role of Western developed countries. However, only a few
87 studies can be found that explore the effects of perceptions, meat attachment and food
88 neophobia on consumers' adoption of a plant-based diet in Asian developing countries such as
89 China, India and Malaysia (Bryant et al., 2019; Mohamed et al., 2017). Onwezen et al. (2021)
90 also indicate the lack of comparison between Western and non-Western countries with regard
91 to consumer adoption of plant-based diets.

92 Given the knowledge gap above, this study examines the significant factors driving
93 consumers' willingness to adopt a more plant-based diet in the largest Asian developing
94 country, China. It is based on three theories related to the adoption of a plant-based diet: *meat*
95 *attachment factors, the theory of planned behaviour* (TPB) and *food choice motives* (FCMs).
96 The study also explores a Western developed country, New Zealand, in order to identify the
97 similarities and differences between the West and the non-West, and between developed and
98 developing countries.

2. Hypotheses and theoretical background

Building upon the theories and relevant empirical findings for consumers' willingness to adopt a more plant-based diet, hypotheses were developed for this study shown in Figure 1. Three theoretical models were involved: *meat attachment factors, TPB* and *FCMs*. This section explains the rationale underpinning the hypotheses.

Insert Figure 1

Graça, Calheiros et al. (2015) developed and confirmed a four-factorial construct of consumers' meat attachment, representing consumers' positive bond with meat consumption: Hedonism (referring to a high meat consumption for the purpose of pleasure), Affinity (attaching a high degree of affinity to meat consumption), Entitlement (representing the feeling of having a right to consume meat) and Dependence (referring to the feeling of dependence on meat consumption). The four-factorial construct was developed and confirmed based on a sample of Portuguese and US consumers (Graça, Calheiros et al., 2015). It was also confirmed, with a good fit, for a sample of New Zealand consumers, by Lentz et al. (2018). Although the measurement items of the meat attachment factors have been used in a survey with Chinese and Indian consumers, they were treated as general meat attachment variables without the four-factorial construct being tested and without an examination of the specific impacts of the four factors on the adoption of a plant-based diet in these two Asian developing countries (Bryant et al., 2019). In general, the previous findings have confirmed the significantly negative impacts of these meat attachment factors on consumers' willingness to adopt a more plant-based diet (Bryant et al., 2019; Graça, Calheiros et al., 2015; Lentz et al., 2018). From this, the following hypotheses were developed:

H1. Meat attachment factors have significantly negative impacts on consumers' willingness to adopt a more plant-based diet.

H1a. Hedonism has a significantly negative impact on consumers' willingness to adopt a more plant-based diet.

H1b. Affinity has a significantly negative impact on consumers' willingness to adopt a more plant-based diet.

H1c. Entitlement has a significantly negative impact on consumers' willingness to adopt a more plant-based diet.

H1d. Dependence has a significantly negative impact on consumers' willingness to adopt a more plant-based diet.

Ajzen (1991) developed the TPB to predict human behaviour, incorporating three factors: Attitudes (i.e. the generally positive or negative attitudes towards a behaviour), Subjective norms (i.e. perceived peer pressures in relation to a behaviour) and Perceived behavioural control (i.e. perceived self-control in relation to performing a behaviour). Scholars have extended the theoretical model with two extra factors for the specific prediction of consumers' environmental and sustainability-related behaviours: Perceived consumer effectiveness (i.e. the degree of consumers' belief in individual efforts to address an environmental or sustainability-related problem) and Personal norms (i.e. perceived individual obligations to address an environmental or sustainability-related problem) (Honkanen & Young, 2015; Vermeir & Verbeke, 2008; Wang & Somogyi, 2019). Previous studies only used the original three-factorial construct of TPB to predict Western consumers' adoption of a plant-based diet (Graça, Calheiros et al., 2015; Lentz et al., 2018), and this study is the first to use the extended five-factorial construct of TPB to predict consumers' willingness to adopt a more plant-based diet in China and New Zealand, as adopting a plant-based diet is widely accepted as sustainability-related and environment-friendly behaviour (Faber et al., 2020; Graça, Calheiros et al., 2015; Lang, 2020). All the five factors have been proved to have a significantly positive impact on consumers' sustainability-related food consumption behaviours, such as the

148 consumption of sustainable seafood or dairy products and a reduction in meat consumption
149 (Graça, Calheiros et al., 2015; Honkanen & Young, 2015; Lentz et al., 2018; Vermeir &
150 Verbeke, 2008; Wang & Somogyi, 2019). Therefore, the following hypotheses were developed:

151 **H2.** The factors of TPB have significantly positive impacts on consumers' willingness
152 to adopt a more plant-based diet.

153 **H2a.** Subjective norms have a significantly positive impact on consumers' willingness
154 to adopt a more plant-based diet.

155 **H2b.** Personal norms have a significantly positive impact on consumers' willingness to
156 adopt a more plant-based diet.

157 **H2c.** Perceived behavioural control has a significantly positive impact on consumers'
158 willingness to adopt a more plant-based diet.

159 **H2d.** Perceived consumer effectiveness has a significantly positive impact on
160 consumers' willingness to adopt a more plant-based diet.

161 **H2e.** Attitudes have a significantly positive impact on consumers' willingness to adopt
162 a more plant-based diet.

163 Steptoe et al. (1995) designed a theoretical model of FCMs with a nine-factorial
164 construct to predict people's daily motives for food choices: Sensory appeal, Health, Mood,
165 Convenience, Natural content, Price, Weight control, Familiarity and Ethical concerns.
166 Scholars have extended the nine-factorial construct of FCM with several extra motivational
167 factors such as Safety concerns, Environmental/Ecological concerns, Political values and
168 Religion (Honkanen & Frewer, 2009; Lindeman & Väänänen, 2000; Wang et al., 2015). These
169 motivational factors have been widely explored in previous studies that have considered their
170 impacts on a wide range of dietary behaviours such as willingness to purchase traditional food
171 and European food, sustainable food concerns and the adoption of e-commerce food shopping
172 (Baudry et al., 2017; Wang et al., 2015; Wang et al., 2020). The current study only involves

two motivation factors, Health concerns and Environmental concerns, as these have been indicated in many relevant studies to be the most important motives driving a reduction in meat consumption and the adoption of a plant-based diet (Austgulen et al., 2018; Slade, 2018; Vainio, 2019; Van Loo et al., 2017; Verain et al., 2017). From this perspective, the following hypotheses were developed:

H3. The selected FCMs have significantly positive impacts on consumers' willingness to adopt a more plant-based diet.

H3a. Health concerns have a significantly positive impact on consumers' willingness to adopt a more plant-based diet.

H3b. Environmental concerns have a significantly positive impact on consumers' willingness to adopt a more plant-based diet.

3. Methods and materials

3.1. Participants and procedures

Quantitative data were collected from November 2019 to March 2020 through online surveys in China and New Zealand. A questionnaire was developed in both English and Chinese. Two local research agencies were hired for the fieldwork data collection in the two countries. A soft launch was conducted in New Zealand (n=41) and China (n=56). The questionnaire was not further revised, because the soft-launch datasets produced acceptable scale reliabilities. The soft-launch datasets were combined with the final datasets for the data analyses of this study. The questionnaire was sent to the registered members of the sample panels owned by the two research agencies, with a quota sampling method using gender (male and female) and age (below and above 40 years of age) as dimensions for quota stratification (Wang & Somogyi, 2019). The New Zealand survey used a regional quota stratification based on the national population distribution among different regions including Auckland, Waikato, Wellington, Canterbury, Otago, Bay of Plenty and others. The Chinese survey used a regional

198 quota stratification with half in a first-tier city (Shanghai) and the other half in a second-tier
199 city (Qingdao). This was based on the fact that first-tier and other-tier cities in China have
200 different development levels in economy, education and other social sectors (Wang & Somogyi,
201 2019).

202 Insert Table 1

203 A total of 1,185 valid responses were obtained, 581 from New Zealand and 604 from
204 China. All respondents giving a valid response received a monetary incentive from the two
205 research agencies. Table 1 indicates the socio-demographic characteristics of the samples. It
206 also shows the meat consumption frequencies of the samples from the two countries. Cross-
207 tabulation with the $\chi 2$ test revealed significant differences in the meat consumption frequencies
208 between the Chinese and the New Zealand respondents ($\chi 2$=30.353, p=0.000). There was a
209 higher percentage of respondents with a medium consumption frequency (one to four times
210 weekly) in China (61.9%) than in New Zealand (50.5%), while New Zealand had higher
211 percentages of low-frequency consumers (less than once a week, 11.8%) and high-frequency
212 consumers (five times or more weekly, 37.7%) than China (6.3% and 31.8%, respectively).

213 ***3.2. Measures***

214 Table 2 shows the measures and items involved in the current study. Each factor was
215 measured with two items. These were selected and developed from the relevant measurement
216 items that had higher factor loadings than the others in the confirmatory or exploratory factor
217 analyses of the previous studies mentioned below.

218 The measurement items for the four meat attachment factors were developed from the
219 original measurement questions used by Graça, Calheiros et al. (2015). A seven-point Likert
220 agreement scale was used to give response categories for the measurement questions, ranging
221 from 1=totally disagree to 7=totally agree (Wang & Somogyi, 2019).

222 The measurement items of the five TPB factors were developed from the measurement
223 questions used by previous studies to predict sustainability-related food shopping behaviours
224 such as reducing meat consumption and purchasing sustainable seafood (Graça, Calheiros et
225 al., 2015; Honkanen & Young, 2015; Wang & Somogyi, 2019). The questions were measured
226 using the same seven-point Likert agreement scale and a seven-point semantic differential scale
227 with bipolar adjectives (specifically for the Attitudes items) (Wang & Somogyi, 2019).
228 The measurement items for the two FCM factors were developed from the measurement
229 questions used in previous FCM-related studies (Lindeman & Väänänen, 2000; Steptoe et al.,
230 1995; Vainio, 2019), and were measured using the seven-point Likert agreement scale.
231 Consumers' willingness to adopt a more plant-based diet was measured by two items
232 derived from a previous study to examine the willingness of Western consumers to reduce their
233 meat consumption, and also used the seven-point Likert agreement scale (Graça, Calheiros et
234 al., 2015).
235 Insert Table 2
236 ***3.3. Data analysis***
237 The statistical software tools SPSS 25 and AMOS 25 were used to perform the data
238 analyses of this study. First, confirmatory factor analysis (CFA) and multi-group CFA were
239 conducted to examine whether the original factorial constructs had a good fit with the sample
240 in this study for the meat attachment factors, the TPB factors and the FCM factors. Secondly,
241 three structural equation models (SEMs) were developed to associate consumers' willingness
242 to adopt a more plant-based diet with the meat attachment factors, TPB factors and FCM factors,
243 respectively. Path analysis and multi-group path analysis were conducted based on the three
244 SEMs, to recognize the statistically significant meat attachment factors, TPB factors and FCM
245 factors that influenced consumers' willingness to adopt a more plant-based diet in the pooled
246 sample from China and New Zealand and the samples from the two countries.

247 ## 4. Results

248 ### *4.1. Confirmatory factor analysis for meat attachment factors*

249 Table 3 shows the CFA results and correlation matrix for the four-factorial construct of
250 meat attachment factors, based on the pooled sample from China and New Zealand. The values
251 of the goodness-of-fit indices were acceptable, with the CFI and GFI values higher than 0.9,
252 and the RMSEA value lower than 0.08 (Pieniak et al., 2009). The standardized factor loadings
253 of the eight measurement items were all above the acceptable limit of 0.5 (Hair et al., 2014;
254 Wu, 2009). The CR values of the four factors were higher than the threshold of 0.7 for
255 satisfactory scales. The AVE values of three of the factors, Hedonism, Affinity and Entitlement,
256 were above the squared correlation coefficients with the other factors (Pieniak et al., 2009). No
257 severe multi-collinearity (above 0.8) was recognized among these three factors (Pieniak et al.,
258 2009). In this way, discriminant validity was established with these three factors for the
259 construct (Pieniak et al., 2009; Voorhees et al., 2016). Regarding the multi-group CFA results,
260 the values of goodness-of-fit indices for all the restricted models were within the acceptable
261 limits.

262 However, the factor Dependence had severe multi-collinearity with Entitlement and
263 Hedonism. Further, its AVE value did not exceed the squared correlation coefficients of these
264 two factors. From that perspective, discriminant validity was not established for the factor
265 Dependence (Pieniak et al., 2009; Voorhees et al., 2016). The item DE1 was included as an
266 observed variable of Dependence in the further analyses, because it had a higher factor loading
267 than DE2 and had no multi-collinearity issues within other three meat attachment factors (see
268 the correlation matrix in Table 3) (Wang & Somogyi, 2018). DE2 was therefore removed from
269 further analyses in this study.

270 Insert Table 3

4.2. Confirmatory factor analysis for TPB factors

Table 4 shows the CFA results and correlation matrix for the five-factorial construct of TPB factors based on the pooled sample from China and New Zealand. The values of the goodness-of-fit indices were acceptable, with the CFI and GFI values higher than 0.9 and the RMSEA value lower than 0.08 (Pieniak et al., 2009). Discriminant validity was established with three of the factors for the TPB construct (Subjective norms, Personal norms and Attitudes) as a result of their high values for CR and factor loadings, the absence of severe multi-collinearity with each other, and AVE values that were higher than their squared mutual correlation coefficients (Pieniak et al., 2009; Voorhees et al., 2016). Regarding the multi-group CFA results, the values of goodness-of-fit indices for all the restricted models were within acceptable limits.

By contrast, discriminant validity was not established with the two factors Perceived behavioural control and Perceived consumer effectiveness, as they had low CR values (below 0.7), low factor loadings for items PB2 and PC1 (below 0.5), and an AVE value of Perceived consumer effectiveness lower than its squared mutual correlation coefficient with Personal norms (Pieniak et al., 2009; Voorhees et al., 2016). For this reason, items PB2 and PC1 were removed from further analyses. PB1 and PC2 were kept as observed variables for Perceived behavioural control and Perceived consumer effectiveness in the further analyses of this study (Wang & Somogyi, 2018).

Insert Table 4

4.3. Confirmatory factor analysis for FCM factors

Table 5 shows the CFA results and correlation matrix for the two-factorial construct of FCM factors based on the pooled sample from China and New Zealand. Although the CFI and GFI values were within the acceptable limit, the RMSEA value was outside what is acceptable and was higher than 0.08 (Pieniak et al., 2009; Voorhees et al., 2016). Regarding the multi-

group CFA results, the values of CFI and GFI for all the restricted models were within the acceptable limits; while the values of RMSEA for two restricted models were outside the acceptable limits. For this reason, the two-factorial FCM construct did not fit well with this study sample. This might be because this study only involved the two most important FCM factors related to the adoption of a plant-based diet and ignored the other FCM factors affecting people's daily food choices in the original FCM factorial construct, such as Sensory appeal, Convenience, and Price (Steptoe et al., 1995; Vainio, 2019).

Discriminant validity was not established with the two FCM factors, as they had low CR values (below 0.7) and AVE values lower than the squared correlation coefficient between them (Pieniak et al., 2009; Voorhees et al., 2016). The items HC1 and EC1 were used as observed variables for Health concerns and Environmental concerns in the further analyses of this study because they had higher factor loadings than HC2 and EC2 (Wang & Somogyi, 2018).

Insert Table 5

4.4. Structural equation modelling and validation

As shown in Figure 2, three SEMs were developed to associate the meat attachment factors (Model 1), the TPB factors (Model 2) and the FCM factors (Model 3) with consumers' willingness to adopt a more plant-based diet. The two observed variables of the willingness to adopt a more plant-based diet had good internal reliabilities, with a high Cronbach's α value of 0.826 (Wang et al., 2015).

Insert Figure 2

Insert Figure 3

All three SEMs performed well for the path analysis with the pooled sample from New Zealand and China, having values for the goodness-of-fit indices all within acceptable limits, the CFI and GFI values above 0.9 and the RMSEA values below 0.08 (see Figure 3) (Pieniak et al., 2009). Meanwhile they also performed well for the multi-group path analysis for the

samples for each of China and New Zealand, as the values of goodness-of-fit indices for all the restricted models based on these were within the acceptable limits; Model 1: 0.946 to 0.994 for CFI, 0.943 to 0.987 for GFI, 0.028 to 0.062 for RMSEA; Model 2: 0.964 to 0.989 for CFI, 0.952 to 0.981 for GFI, 0.035 to 0.052 for RMSEA; Model 3: 0.964 to 1.000 for CFI, 0.978 to 0.999 for GFI, 0 to 0.057 for RMSEA. The acceptable values of the goodness-of-fit indices for the multi-group path analyses underpin the decision to pool the datasets from China and New Zealand in order to detect significant paths from the meat attachment factors, the TPB factors and the FCM factors to consumers' willingness to adopt a more plant-based diet in a more generalized way, ignoring the distinctions between developing and developed countries, and East and West (Pieniak et al., 2009; Wang et al., 2015). The acceptable values of the goodness-of-fit indices also validate that the three SEMs perform as expected for either the pooled sample or the samples of the two countries (Pieniak et al., 2009). Following prior work, the RMSEA value is considered a better and sufficient indicator for justifying the data pooling and the model-validation examination comparing to other goodness-of-fit indices (Marsh & Balla, 1994; Olsen et al., 2007; Wu, 2009).

Figure 3 summarizes the significant paths from the path analyses and the multi-group path analyses based on all the three SEMs, with standardized regression weights. Regarding the meat attachment factors, all the four factors (Hedonism, Affinity, Entitlement and Dependence (DE1)) had significantly negative impacts on the willingness to adopt a more plant-based diet in the pooled sample or in one or both of the samples of the two countries. Entitlement was not found to have a significant path in the Chinese sample, while Hedonism was not found to have a significant path in the New Zealand sample. In this way, **H1a-d** were supported. Besides, the findings indicate the much higher absolute values on the standardized regression weights of Affinity and Dependence (DE1) in the New Zealand model than that in the Chinese model. In other words, these two meat attachment factors had more significant

346 influences on the willingness to adopt a more plant-based diet in the New Zealand sample than
347 that in the Chinese sample.

348 Looking at the TPB factors, Personal norms, Attitudes and Perceived behavioural
349 control (PB1) had significant impacts on the willingness to adopt a more plant-based diet in
350 either the pooled sample or the sample from one of the two countries. Therefore, **H2b, c** and **e**
351 were supported. By contrast, Perceived consumer effectiveness (PC2) had no significant impact
352 for any of the samples. From this, **H2d** was not supported. In addition, Subjective norms had a
353 significantly negative impact on the willingness to adopt a more plant-based diet in the New
354 Zealand sample. This significant path was not found in the pooled sample or the Chinese
355 sample. For this reason, **H2a** was partly supported. Moreover, the findings indicate the much
356 higher value on the standardized regression weights of Attitudes in the New Zealand model
357 than that in the Chinese model, and the much higher value of Perceived behavioural control
358 (PB1) in the Chinese model than the New Zealand model. In other words, Attitudes had a more
359 significant influence on the willingness to adopt a more plant-based in the New Zealand sample;
360 while Perceived behavioural control had a more significant influence on that in the Chinese
361 sample. Personal norm has the highest values of the standardized regression weights among
362 the five TPB factors for either the pooled sample or the samples of two countries.

363 For the FCM factors, Environmental concerns (EC1) had a significantly positive impact
364 on the willingness to adopt a more plant-based diet in both the pooled sample and the samples
365 of the two countries, while Health concerns (HC1) had no significant impact in any of those
366 samples. Therefore, **H3b** was supported, while **H3a** was not.

367 ## 5. Discussion and conclusions

368 ### *5.1. Meat attachment and the plant-based diet in China and New Zealand*

369 This is the first study to test the factorial constructs of the meat attachment factors by
370 using a pooled sample from a Western developed country (New Zealand) and an Asian

developing country (China). The result of the CFA and multi-group CFA confirmed that the original four-factorial construct (Hedonism, Affinity, Entitlement and Dependence) developed by Graça, Calheiros et al. (2015) fits well with the pooled data and the samples of two countries in this study. Meanwhile the SEM involving the four meat attachment factors and consumers' willingness to adopt a more plant-based diet performed well in the path analysis for the pooled sample and the multi-group path analysis for the samples of the two countries. All these results indicate the high reliability of the meat attachment factors as an instrument to explore consumers' links to meat consumption, whether in the East or the West, and whether in a developing or a developed country. All the four meat attachment factors were found to have significantly negative impacts on consumers' willingness to adopt a more plant-based diet. This is in line with the previous findings showing that the meat attachment factors represent a positive bond between consumers and eating meat, and therefore have negative influences on consumers' adoption of a more plant-based diet (Bryant et al., 2019; Graça, Calheiros et al., 2015; Lentz et al., 2018). In particular, the findings are consistent with the validation of the meat attachment factorial construct and its high explanatory power for the adoption of meat reduction behaviour in New Zealand found in a previous study by Lentz et al. (2018).

The current study is also the first to recognize the different impacts of those meat attachment factors on consumers' willingness to adopt a more plant-based diet in China and New Zealand. Affinity has a more significant influence on the consumer adoption of a more plant-based diet in New Zealand than that in China. This might reflect the lack of public regulation, education and awareness of animal welfare in developing countries in contrast to developed countries, which may result in a weaker sense of the affinity in respect of animals among Chinese consumers than among their counterparts in New Zealand (Phillips et al., 2012; Rahman et al., 2005).

Entitlement and Dependence are also more important determinants of the willingness to adopt a more plant-based diet in New Zealand than in China. This may be caused by the much higher meat consumption in daily meals and dietary tradition in New Zealand than in Asian developing countries like China. Chinese cuisine is one of the 'Three Grand Cuisines' in the world (together with French and Turkish cuisines) and has significant influence on the dietary consumption patterns and cultures of China itself and its surrounding countries such as East Asian and Southeast Asian countries, with a long history of agricultural civilisation and dietary patterns including more plant-based foods (Li, 2007; Wang et al., 2016). Regarding New Zealand, more than 70% of the population are of European ethnicity (Stats NZ, 2020). Western cuisine belongs to the 'French Grand Cuisine' and has significant influences on the dietary cultures and consumption patterns on Europe and its colonized regions such as Oceania and America, with a long history of nomadic civilisation and a dietary consumption pattern of more meat-and-dairy-based foods (Graça, Oliveira et al., 2015; Li, 2007; Wang et al., 2016; Wolf, 2010). This different dietary tradition may result in a stronger sense of entitlement and dependence attached to eating meat among New Zealand consumers relative to their counterparts in China.

Chinese consumers are more likely to refuse a more plant-based diet based on how important they perceive meat to be as a source of pleasure (Hedonism) compared to New Zealand consumers. Diets high in animal products and fat are culturally and strongly viewed as pleasurable (Macdiarmid et al., 2016; Pohjolainen et al., 2015; Popkin, 2006). Our findings might be a reflection of the declining marginal utility of this meat eating pleasure (Greene & Baron, 2001; Steiner, 2011). Eating meat is more likely to bring pleasure to consumers who historically lacked daily meat consumption (e.g. consumers in China and other developing countries) (OECD/FAO, 2019; OECD, 2020). This is less likely with their counterparts who

419 historically had high daily meat consumption (e.g. consumers in Oceania, Europe and North
420 America)(OECD/FAO, 2019; OECD, 2020).

421 This may be caused by the gradually Westernized food consumption pattern (e.g. more
422 meat and dairy intake) in China; which Westernized food and eating styles are considered with
423 symbolic values such as fashionable and upscale, and being emotional pleasure by Chinese
424 consumers (Wang et al., 2015; Wang et al., 2016; Curtis et al., 2007; Zhou & Hui, 2003).

425 ***5.2. TPB and the plant-based diet in China and New Zealand***

426 Regarding the TPB factors, this study is the first to implement the five-factorial
427 construct to predict consumers' willingness to purchase a more plant-based diet by considering
428 Attitudes, Subjective norms, Perceived behavioural control, Perceived consumer effectiveness,
429 and Personal norms (Ajzen, 1991; Honkanen & Young, 2015; Vermeir & Verbeke, 2008;
430 Wang & Somogyi, 2019). This factorial construct performed well in the (multi-group) CFA
431 and the (multi-group) path analyses based on our samples from China and New Zealand. This
432 indicates that the five-factorial TPB is a highly reliable construct as an instrument to explore
433 consumers' adoption of a more plant-based diet.

434 Personal norms, Attitudes and Perceived behavioural control have significantly positive
435 impacts on consumers' willingness to adopt a more plant-based diet in both China and New
436 Zealand. This is in line with the significantly positive influences of these three factors on
437 consumers' adoption of plant-based eating and other sustainable eating behaviours (Graça,
438 Calheiros et al., 2015; Honkanen & Young, 2015; Lentz et al., 2018; Vermeir & Verbeke, 2008;
439 Wang & Somogyi, 2019).

440 Personal norm is the strongest TPB predictor of the willingness to adopt a more plant-
441 based diet in both China and New Zealand. From this perspective, individual obligation plays
442 the most important role in the reduction of meat consumption both in the East and the West.
443 This is an important addition to the findings of previous relevant studies which only utilise the

three original TPB factors to predict the willingness to adopt a more plant-based meat (Graça, Calheiros et al., 2015; Lentz et al., 2018).

Attitude is the second strongest TPB predictor of the willingness to adopt a more plant-based diet in New Zealand. When only considering the original three-factorial TPB construct, attitude is the strongest predictor for that in New Zealand. This is in line with the previously relevant findings based on the Western consumer samples (e.g. New Zealand, US and Portugal) by Graça, Calheiros et al. (2015) and Lentz et al. (2018). However, attitude is a much weaker TPB predictor of the willingness to adopt a more plant-based diet in China (the weakest among the significant TPB factors in the Chinese model, see Figure3). This is also an important addition to the findings from previous Western-based studies, and indicates the importance of differentiation between Western developed and Asian developing countries (e.g. New Zealand versus China) when developing strategies for the promotion of plant-based eating. Effective strategies in Western countries (e.g. enhancing consumers' positive attitudes towards plant-based eating) may fail in Asian developing countries.

Perceived behavioural control is a weaker predictor than the attitude for the willingness to adopt a more plant-based diet in New Zealand. This is also in line with the previously relevant findings based on Western settings (Graça, Calheiros et al., 2015; Lentz et al., 2018). While our findings show that perceived behavioural control is a stronger predictor for the willingness to adopt a more plant-based diet in China than in New Zealand, and a stronger predictor for that than the attitude in the Chinese sample. This may be caused by the different dietary consumption patterns and traditions between the East and the West (e.g. meaty versus more plant-based) (Graça, Oliveira et al., 2015; Li, 2007; Wang et al., 2016; Wolf, 2010). With the dietary tradition and consumption pattern of less meat, Chinese consumers are more likely than their counterparts in New Zealand to control themselves in order to reduce meat intake.

Subjective norm has no significant influence on the willingness to adopt a more plant-based diet in the pooled sample. This corresponds with the non-significant impact of Subjective norms on the adoption of a plant-based diet found by previous studies (Graça, Calheiros et al., 2015; Lentz et al., 2018). While Subjective norm has a significantly negative impact on the willingness to adopt a more plant-based diet in the New Zealand sample, this significant influence does not appear in the Chinese sample. This might be caused by the more frequent promotion and exposure to information about plant-based diets that enhance consumers' subjective norms in Western developed countries, as a result of strong concerns about the high level of meat consumption in the Western dietary pattern, in comparison with that in Asian developing countries (Faber et al., 2020; Graça, Calheiros et al., 2015; Vainio, 2019; Wang et al., 2016). The negative impact of subjective norms may reflect that typical consumers (mostly meat eaters) resist the peer pressure to reduce meat consumption - their basic dietary demand and habit. However, subjective norm plays a significant and positive role in the adoption of other sustainable eating behaviour like consumers' purchase intentions towards sustainable seafood and dairy products (Honkanen & Young, 2015; Vermeir & Verbeke, 2008; Wang & Somogyi, 2019). From this perspective, it subjective norms should still be considered as a useful tool to promote plant-based diets among typical consumers. Further, vegetarians and vegans could play a positive role in the normalisation of plant-based diets and show other consumers how tasty, easy and pleasurable it is to eat more plant-based foods .

5.3. FCMs and the plant-based diet in China and New Zealand

Turning to the FCM factors, Environmental concerns have a significantly positive impact on the willingness to adopt a more plant-based diet in both the pooled sample and the samples of the two countries. This confirms the findings from previous relevant studies (Austgulen et al., 2018; Slade, 2018; Vainio, 2019; Van Loo et al., 2017; Verain et al., 2017).

492 It also corresponds with the widely accepted role of plant-based eating in enhancing
493 environmental sustainability in food systems (Faber et al., 2020; Graça et al., 2019; Lang, 2020).
494 Health concerns are not significantly linked to the willingness to adopt a more plant-
495 based diet in the samples of this study. This is in contradiction to the significant impact of
496 health concerns on the reduction in meat consumption and the adoption of plant-based eating
497 found in previous studies (Lang, 2020; Vainio, 2019; Verain et al., 2017). The finding in this
498 study is reasonable because the health effects of reducing meat consumption are still
499 controversial. Although many scholars indicate that there are potential health issues caused by
500 eating meat, such as diabetes and cardiovascular diseases, their peers argue for the importance
501 for human health of dietary diversity including eating meat in moderation (e.g. Haddad et al.,
502 2016; Lander et al., 2019; Lynch et al., 2018; Pohjolainen et al., 2015; Ruel, 2003; Rowarth,
503 2020). For this reason, typical consumers (mostly meat eaters) might not treat a plant-based
504 diet as an option for improving their health, in particular if they agree with the role of meat
505 moderation for health. Hence, an effective promotion strategy for the reduction of meat
506 consumption would accurately and clearly inform consumers about optimal daily meat intake
507 for good health, in order to help them avoid unnecessary meat consumption.

508 ***5.4. Limitations and recommendations***

509 Nevertheless, this study has observed limitations. Firstly, considering our limited
510 research budget, the Chinese survey only collected the data from a second-tier city Qingdao
511 and a first-tier city Shanghai. Given the nature of our surveys, i.e. a web-based questionnaire
512 and with the quota sampling method using gender and age as dimensions for quota stratification,
513 our sample did not fully represent the demographic characteristics of the two Chinese cities.
514 Future relevant studies could include more Chinese cities and regions due to the possibility of
515 diversified consumer attitudes towards plant-based diet across different geographic regions in
516 China.

517 Secondly, like previous relevant studies (e.g. Graça, Calheiros et al., 2015; Van Loo et
518 al., 2017), this study focuses on the general consumers' adoption of plant-based diet and we
519 did not specifically recognize vegan and vegetarian participants in the surveys. It is highly
520 recommended that future studies can explore the differences and similarities of the adoption of
521 plant-based diet among vegan, vegetarian and omnivorous consumers.

522 Thirdly, the meat attachment factors, TPB and FCM factorial constructs were
523 developed from the previous well-structured theories related to the consumer adoption of plant-
524 based and/or sustainability-related diets (e.g. Austgulen et al., 2018; Graça, Calheiros et al.,
525 2015; Honkanen & Young, 2015; Lentz et al., 2018; Slade, 2018; Vainio, 2019; Vermeir &
526 Verbeke, 2008; Verain et al., 2017). As such, we followed a standardized protocol to examine
527 the validation of the three factorial constructs with our sample by conducting the (multi-group)
528 CFAs (Graça, Calheiros et al., 2015; Lentz et al., 2018; Pieniak et al., 2009; Suhr, 2006). While
529 as the acceptable values of goodness-of-fit indices and the relatively simple factorial constructs,
530 particularly for the two-factor FCM construct, we implemented a scale purification strategy to
531 remove the items with low factor-loadings from the constructs (Wieland et al., 2017). It is
532 recommended for future similar studies that involve more complicated factorial constructs to
533 conduct exploratory factor analysis for a further analysis of the factorial constructs.

534 Fourthly, this study consider China and New Zealand as Asian and Western countries
535 based on their dietary cultures and consumption patterns. As the origin of one of the 'Three
536 Grand Cuisines', China is a typical East Asian country like Japan and South Korea (Graça,
537 Oliveira et al., 2015; Li, 2007; Wang et al., 2016; Wolf, 2010). However, China does not fully
538 represent other Asian regions' dietary consumption patterns and cultures. With a majority
539 European ethnic group in the national population, New Zealand can be considered as a Western
540 country (Li, 2007; Stats NZ, 2020; Wang et al., 2016; Wolf, 2010). However contemporary
541 New Zealand might not fully represent a traditional Western dietary consumption pattern due

to the impact of other ethnic groups such as Māori, Pacific peoples, and more recent migrants from non-Western nations.

Fifthly, this study use ta quantitative approach to explore the significant factors driving consumers' willingness to adopt a more plant-based diet based on the three previous theories. However, since we are still at the stage of initial explorations regarding dietary shift towards a more plant-based diet (particularly in a non-Western setting), qualitative approaches are highly recommended for future relevant studies in order to explore the domain and contribute knowledge from new angles. For example, a recent qualitative study by Kemper & White (2021) explores young consumers' adoption of a flexitarian diet.

Sixthly, in the Introduction section, the per capita meat consumption figures of North America, Europe, Oceania and Asia are expressed in retail weight (OECD/FAO, 2019; OECD, 2020). The actual per capita meat consumption is less as the retail weight includes inedible parts such as bones. However, we could not find relevant materials that indicate the per capita meat consumption based on only edible components of meat.

Seventhly, the questionnaire was translated from English into Chinese by the first author of this study who has significant experience in similar questionnaire translation work. He is bilingual and a native mandarin speaker. However, the translation may be further modified for future use in relevant studies by back-translation with multiple bilingual scholars or professional language translators.

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728

Table 1 Socio-demographics of the sample in this study

		China	New Zealand
Sample size (n=)		604	581
Gender			
	Male	50.3%	49.9%
	Female	49.7%	50.1%
Age			
	Range	18-70	18-79
	Mean	36.56	39.17
	18-40	58.1%	58.2%
	≥41	41.9%	41.8%
Residential area			
	Shanghai	50%	NA
	Qingdao	50%	NA
	Auckland	NA	34.6%
	Wellington	NA	17.9%
	Canterbury	NA	17.7%
	Waikato	NA	11.0%
	Otago	NA	7.6%
	Bay of Plenty	NA	4.8%
	Other New Zealand's regions	NA	6.4%
Meat consumption frequency			
	Never	0.2%	3.4%
	Less than once per week	6.1%	8.4%
	Once or twice per week	25.0%	19.3%
	Three or four time per week	36.9%	31.2%
	Five times or more per week	31.8%	37.7%

Note: NA= Not applicable.

Table 2 Measurements of the study in English and Chinese

Code	Factor and measurement items
	Meat attachment factors
HE	**Hedonism**
HE1	I love meals with meat. 我热爱肉类餐食。
HE2	I'm a big fan of meat. 我是肉类的忠实粉丝。
AF	**Affinity**
AF1	By eating meat I'm reminded of the death and suffering of animals (R). 吃肉能让我联想到动物的死亡和所受的折磨。
AF2	I feel bad when I think of eating meat (R). 一想到吃肉，我就会有很不好的感觉。
EN	**Entitlement**
EN1	According to our position in the food chain, we have the right to eat meat. 基于我们在食物链所处的位置，我们有权去吃肉。
EN2	Eating meat is a natural and undisputable practice. 吃肉是一种自然并且无可争议的客观存在。
DE	**Dependence**
DE1	I don't picture myself without eating meat regularly. 我难以想象我在日常生活中不能吃肉该怎么办。
DE2	Meat is irreplaceable in my daily diet. 肉类在我的日常饮食中是不可替代的。
	Food choice motives It is important to me that the food I eat on a typical day… 这对我很重要，那就是 我日常生活中的餐食…
HC	**Health concern**
HC1	Keeps me healthy. 让我保持健康。
HC2	Contains a lot of vitamins and minerals. 富含维生素和矿物质。
EC	**Environmental concern**
EC1	Has been prepared in an environmentally friendly way. 是以一种环保的方式做的。
EC2	Has been produced in a way which has not disrupted the balance of nature. 产自一种不破坏自然平衡的方式。

Note: R=Reverse-scored items.

Table 2 (Continued)

Code	Factor and measurement items
	The Theory of Planned Behaviour towards a more plant-based diet
SN	**Subjective norm**
SN1	Most of my friends or colleagues think that I should eat less meat. 大部分我的朋友或同事们认为我应该吃更少的肉类。
SN2	Most of my family members think I should reduce meat consumption. 大部分我的家人认为我应该减少肉类的消费量。
PN	**Personal norm**
PN1	I feel a moral obligation to eat less meat in order to reduce the negative influence of meat production on environment. 我觉得有道德上的责任去吃更少的肉类，从而减少肉类生产对环境的负面影响。
PN2	It is important that people should reduce meat consumption to protect environment. 那很重要，就是人们应该通过减少肉类的消费量去保护环境。
PB	**Perceived behavioural control**
PB1	I am confident that if I am willing to, I can reduce my daily meat consumption. 我有信心，只要我愿意，我就可以减少我日常肉类的消费量。
PB2	The decision to reduce my daily meat consumption is under my complete control. 我完全能够自主决定去减少我日常肉类的消费量。
PC	**Perceived consumer effectiveness**
PC1	By reducing daily meat consumption, one person alone can have very little influence on environmental sustainability (R). 通过减少日常肉类的消费量，个人对环境可持续性的影响非常小。
PC2	One person's positive efforts to reduce meat consumption for environmental sustainability is useless if others don't want to contribute (R). 如果他人不想参与，一个人通过减少肉消费量去促进环境可持续性的积极努力基本上是没有用的。
A	**Attitudes** When I think about reducing my daily meat consumption, I feel … 当我想到减少我日常肉类的消费时，我感觉…
A1	Unhappy/Happy 不开心/开心
A2	Dull/Excited 无趣/兴奋
	Willingness to adopt a more plan-based diet
W	**Willingness to adopt**
W1	I am willing to reduce my daily meat consumption. 我愿意减少我日常肉类的消费量。
W2	I am willing to try a more plant-based diet. 我愿意尝试以更多植物为主的饮食方式。

Note: R=Reverse-scored items.

Table 3 Results of the CFA and correlation matrix of the meat attachment factors on the pooled sample from China and New Zealand (n=1185)

Factor and item	Standardized factor loading	Composite reliability (CR)	Average variance extracted (AVE)
Hedonism		0.876	0.779
HE1	0.882		
HE2	0.883		
Affinity		0.789	0.654
AF1	0.713		
AF2	0.894		
Entitlement		0.707	0.549
EN1	0.673		
EN2	0.803		
Dependence		0.773	0.630
DE1	0.800		
DE2	0.787		

Correlation matrix	**1**	**2**	**3**	**4**	**5**	**6**
1. Dependence	1					
2. Entitlement	**0.803**	1				
3. Affinity	0.572	0.590	1			
4. Hedonism	**0.905**	0.732	0.544	1		
5. DE2	0.787	0.632	0.450	0.712	1	
6. DE1	0.800	0.642	0.457	0.724	0.629	1

Note: For the codes of variables, please see Table 2; Goodness-of-fit indices: RMSEA=0.048, CFI=0.992, Chi-square=51.943, DF=14, p=0.000.

Table 4 Results of the CFA and correlation matrix of the factors of Theory of Planed Behaviour on the pooled sample from China and New Zealand (n=1185)

Factor and item	Standardized factor loading	Composite reliability (CR)	Average variance extracted (AVE)
Subjective norm		0.827	0.705
SN1	0.824		
SN2	0.855		
Personal norm		0.815	0.688
PN1	0.843		
PN2	0.816		
Perceived behavioural control		0.604	0.477
PB1	0.910		
PB2	0.355		
Perceived consumer effectiveness		0.594	0.443
PC1	0.449		
PC2	0.827		
Attitudes		0.906	0.829
A1	0.883		
A2	0.937		

Correlation matrix	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Attitudes	1								
2. Perceived consumer effectiveness	0.143	1							
3. Perceived behavioural control	0.554	-0.006	1						
4. Personal norm	0.678	0.162	0.604	1					
5. Subjective norm	0.344	0.071	0.232	0.562	1				
6. PC1	0.064	0.449	-0.003	0.073	0.032	1			
7. PC2	0.118	0.827	-0.005	0.134	0.059	0.371	1		
8. PB1	0.504	-0.006	0.910	0.550	0.211	-0.003	-0.005	1	
11. PB2	0.197	-0.002	0.355	0.215	0.083	-0.001	-0.002	0.323	1

Note: For the codes of variables, please see Table 2; Goodness-of-fit indices: RMSEA=0.045, CFI=0.987, Chi-square=84.860, DF=25, p=0.000.

Table 5 Results of the CFA and correlation matrix of the food choice motives on the pooled sample from China and New Zealand (n=1185)

Factor and item	Standardized factor loading	Composite reliability (CR)	Average variance extracted (AVE)
Health concern		0.670	0.504
HC1	0.756		
HC2	0.662		
Environmental concern		0.588	0.419
EC1	0.716		
EC2	0.571		

Correlation matrix	**1**	**2**	**3**	**4**	**5**	**6**
1. Environmental concern	1					
2. Health concern	0.747	1				
3. EC2	0.571	0.426	1			
4. EC1	0.716	0.534	0.409	1		
5. HC2	0.494	0.662	0.282	0.354	1	
6. HC1	0.564	0.756	0.322	0.404	0.500	1

Note: For the codes of variables, please see Table 2; Goodness-of-fit indices: RMSEA=0.154, CFI=0.968, Chi-square=29.258, DF=1, p=0.000.

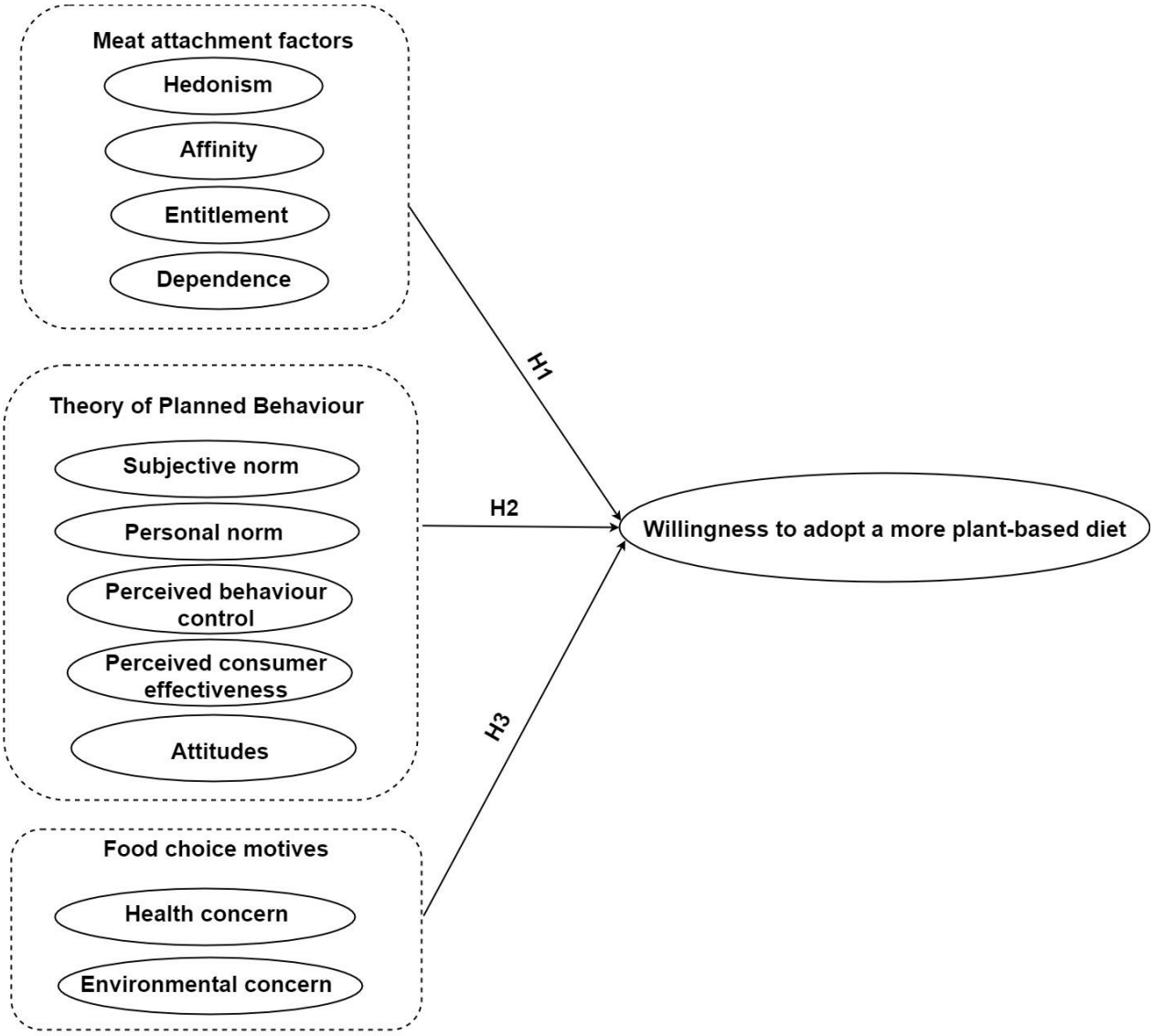

Figure 1 Hypothetical framework in this study

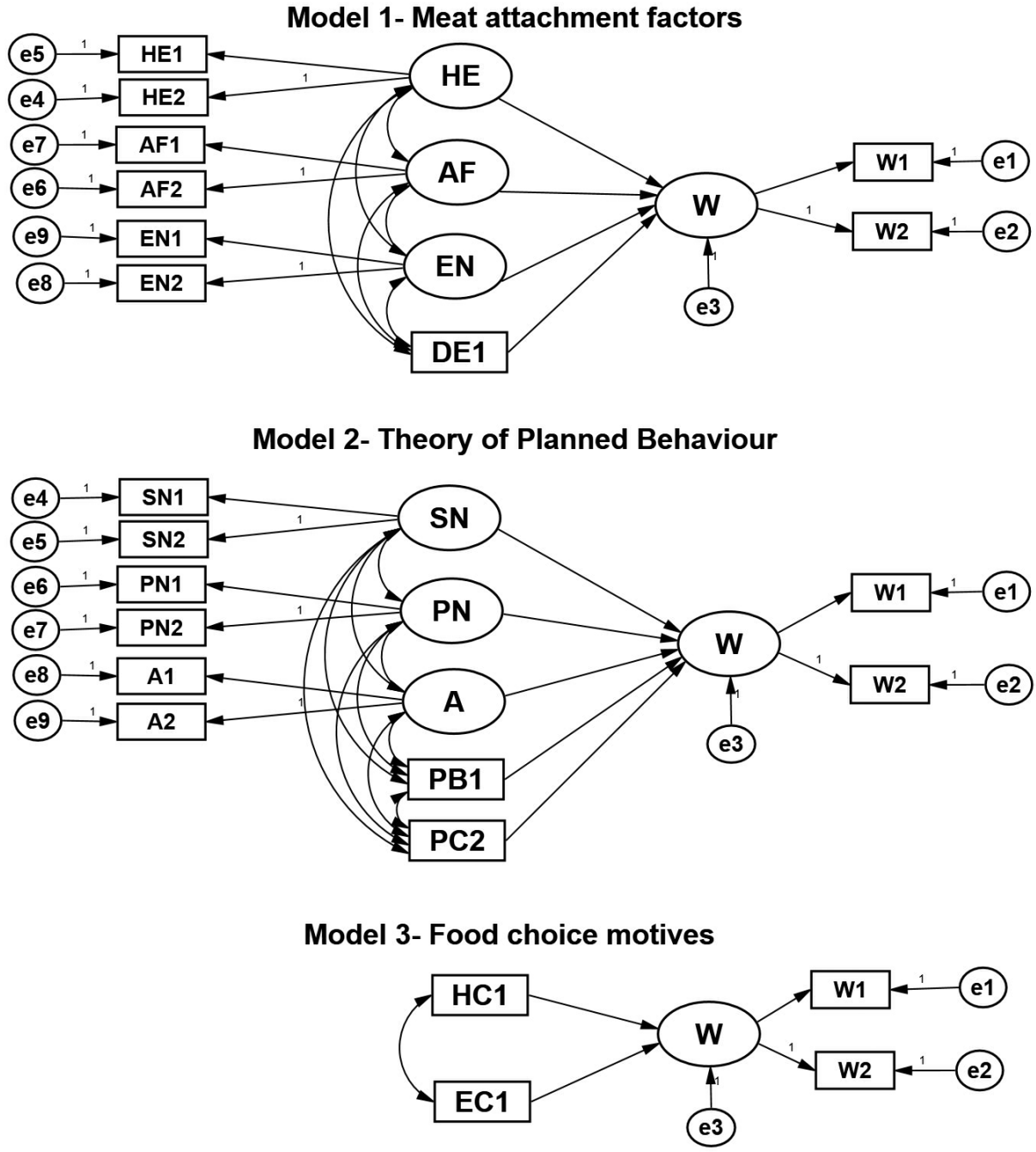

Figure 2 Structural equation models to associate consumers' willingness to adopt a more plant-based diet respectively with their food choice motives, meat attachment factors and the factors of Theory of Planned Behaviour

Note: For the codes of variables, please refer to Table 2; e1-e9: error variables.

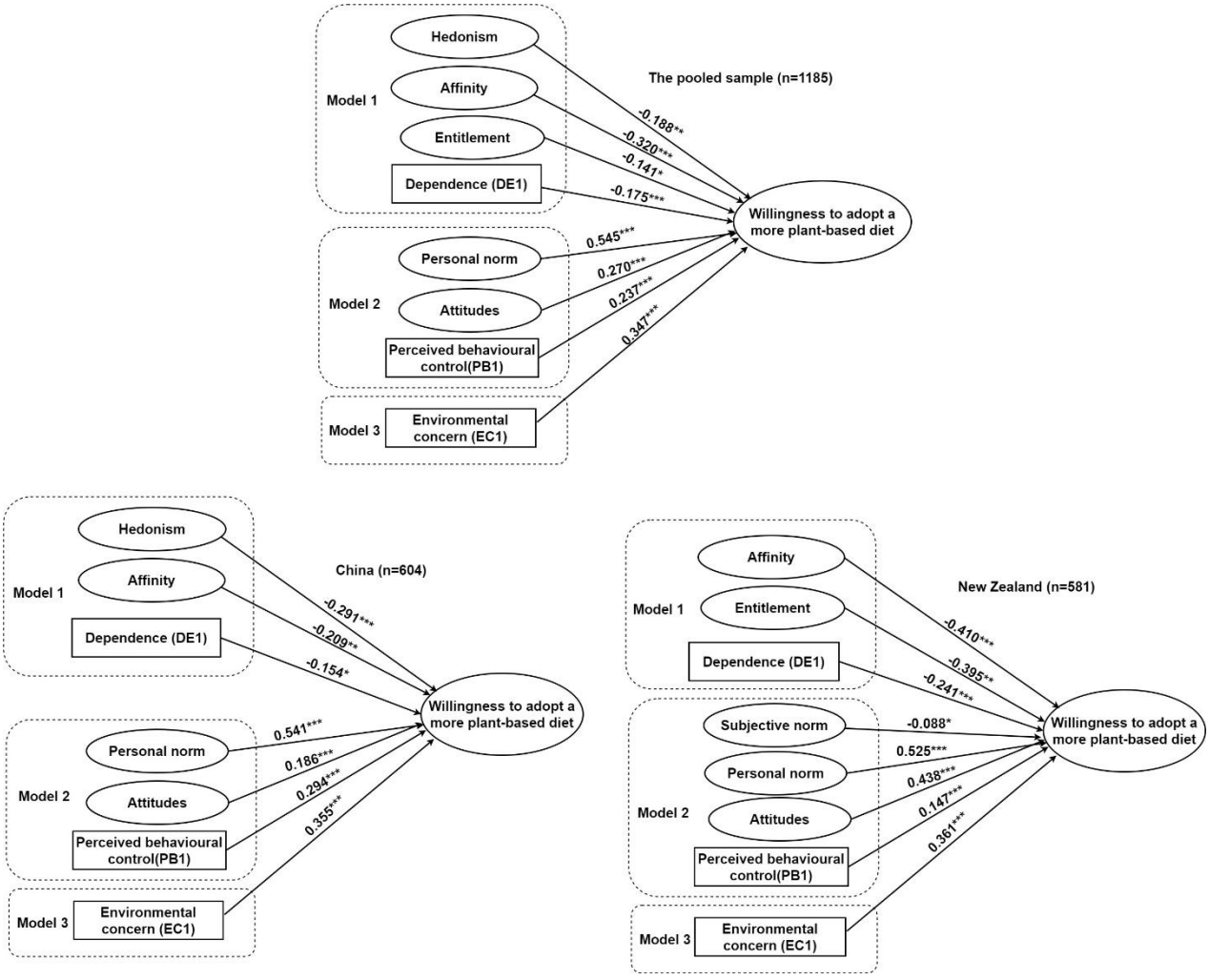

Figure 3 Summarized significant paths of the path analyses for the pooled sample from China and New Zealand and the multi-group path analyses between the Chinese and New Zealand samples based the structural equation models in Figure 2: standardized regression weights

*Note: ***= p<0.001; **= p<0.01; *= p<0.05; Goodness-of-fit indices for the path analysis of the pooled sample based on Model 1: RMSEA=0.035, CFI=0.995, GFI=0.992, Chi-square=44.219, DF=18, p=0.001; Goodness-of-fit indices for the multi-group path analysis between China and New Zealand based on Model 1 (unconstrained model): RMSEA=0.028, CFI=0.994, GFI=0.987, Chi-square=68.954, DF=36, p=0.001; Goodness-of-fit indices for the path analysis of the pooled sample based on Model 2: RMSEA=0.046, CFI=0.991,GFI=0.987, Chi-square=77.312, DF=22, p=0.000; Goodness-of-fit indices for the multi-group path analysis between China and New Zealand based on Model 2 (unconstrained model): RMSEA=0.037, CFI=0.989, GFI=0.981, Chi-square=114.321, DF=44, p=0.000; Goodness-of-fit indices for the path analysis of the pooled sample based on Model 3: RMSEA=0.038, CFI=0.999, GFI=0.999, Chi-square=2.671, DF=1, p=0.102; Goodness-of-fit indices for the multi-group path analysis between China and New Zealand based on Model 3 (unconstrained model): RMSEA=0.008, CFI=1.000,GFI=0.999, Chi-square=2.16, DF=2, p=0.34.*

Dr. Ou Wang: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Writing - original draft.

Prof. Frank Scrimgeour: Funding acquisition, Resources, Validation, Writing - review & editing.