

CONTRIBUTED PAPER

Product attributes affecting the substitutability of saiga horn drinks among young adult consumers in Singapore

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Abstract

Globally, illegal and unsustainable wildlife trade can drive biodiversity loss. Understanding which product attributes consumers consider when deciding between products of threatened species or alternatives, is key for conservation interventions. Labeled Discrete Choice Experiments (DCEs) are underutilized in wildlife trade literature but can aid this understanding. In labeled DCEs, the alternatives presented to respondents have specific names (e.g., paracetamol) as opposed to being generic bundles (e.g., option A). We used a labeled DCE to assess young adult preferences toward “cooling water” used to treat fever and heatiness (a traditional Chinese medicine state of illness) in Singapore. One popular cooling water contains saiga horn, made from Critically Endangered *Saiga tatarica* antelope. Data from 639 university-enrolled respondents were analyzed using latent class models. Middle- to high-income Chinese Singaporeans were the respondents most likely to choose saiga horn. Overall, however, respondents significantly preferred lower price products sold in nearby outlets—suggesting that for young adults in Singapore, saiga horn cooling water may be substitutable if its physical and financial availability is reduced.

KEYWORDS

behavior change, consumer research, decision-making, demand reduction, intervention, social marketing, Southeast Asia

1 | INTRODUCTION

The international trade in wildlife composes both legal and illegal markets, as well as sustainably and unsustainably harvested species (‘t Sas-Rolfes, Challender, Hinsley, Veríssimo, & Milner-Gulland, 2019). It is thought to be a multiple billion dollar industry, though

its exact worth is unknown (‘t Sas-Rolfes et al., 2019; World Bank, 2019). In many countries, wildlife trade serves as a source of subsistence and income for rural populations, and can make a non-negligible contribution to national economies (Engler & Parry-Jones, 2007; Robinson et al., 2018). However, unsustainable and illegal wildlife trade are leading to widespread environmental degradation and are recognized as key contributors to global species decline (Ceballos, Ehrlich, & Dirzo, 2017;

Hunter L. Doughty and Nicholas Lim contributed equally to this study.

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McNeely et al., 2009; Nijman, 2010). Southeast Asia, in particular, has been identified as a hub for wildlife trade and consumption, including the use of wildlife products for medicinal purposes (Bush, Baker, & Macdonald, 2014; Nijman, 2010; Phelps & Webb, 2015; Sodhi, Koh, Brook, & Ng, 2004). With continuing rapid economic growth, demand for wildlife products is expected to increase in the region (Nijman, 2010). As such, there is a need to understand and manage regional demand for wildlife products. Recently, conservationists have called for more demand-focused efforts to engender longer-lasting change among consumers and thus better manage wildlife trade (Challender & MacMillan, 2014; Drury, 2011; Verissimo, Challender, & Nijman, 2012). However, effective interventions require foundational consumer research, which is often lacking (Greenfield & Verissimo, 2018).

One consumer group of interest to conservationists is those who use wildlife-based traditional Chinese medicine (TCM). Though many TCM products are sustainable, a number of them are unsustainably or illegally harvested—a source of concern given the popularity of TCM (Cheung et al., 2020). The over-the-counter drug market in Singapore, for instance, was worth 610 million USD in 2019, with a TCM corporation among the highest performing companies in the country (MDF, 2020). The TCM product market in Singapore is expected to continue growing (Euromonitor International, 2017). With this rising market, and a recognition among conservationists that the often-used approach of simply raising awareness does not impact the behavior of many wildlife trade consumers (Thomas-Walters, Verissimo, Gadsby, Roberts, & Smith, 2020), it is important to understand how specific product attributes (e.g., price, proximity) influence preferences for wildlife products compared to alternative products. This knowledge could prove essential for future interventions to reduce the consumption of unsustainable wildlife products.

One species under threat from unsustainable and illegal wildlife trade for TCM is the saiga (*Saiga tatarica*)—a Critically Endangered migratory ungulate from Central Asia (Milner-Gulland et al., 2001; Milner-Gulland et al., 2003). Extensive poaching for saiga horn and meat, along with recent disease outbreaks, has drastically impacted saiga survival (Kock et al., 2018; Milner-Gulland et al., 2003). Saiga horns are used in TCM to treat fever and heatiness and are often marketed as *ling yang* (Bensky, Clavey, & Stöger, 2004; Doughty et al., 2019). Heatiness is a TCM state of illness in which patients are said to have an imbalance in their *yin-yang*, specifically, an excess of *yang* (Ho, Lie, Luk, & Dutta, 2018). Symptoms include but are not limited to: sore throat, headache, congestion, and cough.

Singapore is a top saiga horn consumer country (CITES, 2018) and an estimated 18% of Chinese Singaporeans consider it a product they use most often when treating fever and heatiness (Doughty et al., 2021). Saiga horn is legal and commonplace within Singapore, and available in several forms (Doughty et al., 2019; Theng, Glikman, & Milner-Gulland, 2018). Whole horns and horn shavings must be prepared at home for consumption, by boiling the shavings with other herbs. Preboiled mixtures are ready-made and sold as “cooling waters” (often served chilled), or dehydrated down into capsules. Cooling waters, in general, are a popular product in Singapore and can be made from herbal or TCM ingredients such as goat horn, chrysanthemum, or ginseng (Doughty et al., 2019). Non-TCM products like isotonic drinks and paracetamol are also consumed to treat heatiness.

In this study, we use a labeled Discrete Choice Experiment (DCE) to understand preferences of young adults studying at the National University of Singapore (NUS) for saiga horn cooling water products compared to several potential substitutes. DCEs are a stated preference valuation method based on the notion that consumer preference is guided by the characteristics of a product (Lancaster, 1966). By analyzing the repeated choices of respondents, it is possible to deduce which product attributes (e.g., price) drive consumer preferences. Labeled DCEs are a specific type of DCE in which the alternatives presented to respondents have specific names (e.g., paracetamol) as opposed to being generic bundles (e.g., option A). This refinement improves the realism and specificity of the DCE, but has been rarely used in conservation. Using a labeled DCE, we aimed to: (a) understand the product attributes that determine consumer preferences; (b) identify the consumer segments in the market with distinct preferences for cooling water products based on socio-demographic characteristics; and (c) determine the level of substitutability of saiga horn cooling water with alternative products. This work is among the first studies to use labeled DCEs in order to understand the effect of varying product attributes on a wildlife product and its alternatives (see Dutton, Hepburn, & Macdonald, 2011; Liu et al., 2016).

2 | METHODS

2.1 | Overview

The DCE questionnaire used in this survey consisted of three sections (Data S1, Supporting Information). The first obtained respondent demographics. Following prior consumer research (Doughty et al., 2019), we asked about

consumer's gender, age, nationality, ethnicity, religion, parental housing type, university field of study, and if applicable, their Chinese dialect. Questions were phrased as neutrally as possible in order to minimize potential social desirability bias (Althubaiti, 2016). For instance, there is no mention of any one particular product, especially saiga horn, in the question text or introductory note. Product types are only listed as answer options to choose from. Similarly, parental housing type was used as a proxy for household income because it was less sensitive for respondents, and respondents may not have known their parent's income level (Data S1). Housing type ranged from one to five room public housing flats (known locally as HDB flats), private condominiums, and landed property.

The second section assessed a respondent's purchasing behavior of TCM cooling water products, namely whether they were recent purchasers of cooling water products—defined as having purchased a cooling water product for themselves in the last 12 months to treat heatiness. Only recent purchasers proceeded to the DCE, ensuring it was completed by actual buyers, as their choices are more relevant to potential intervention designs. In this section we also gauged frequency of recent use and purchase location.

The third survey section was the DCE. To mitigate “hypothetical bias” (i.e., that responses in our hypothetical valuation differ from choices in real life), we used a “cheap talk script” that reminded respondents to behave as if real transactions were taking place (Cummings & Taylor, 1999). A short paragraph describing the purchase scenario was included so that respondents understood the circumstances under which they were expected to make a decision. While saiga horn cooling water is used to treat both heatiness and fever, we asked respondents to make the decision under the scenario of being “heaty,” because past research indicated that saiga horn in cooling water form was purchased more for heatiness than fever (Doughty et al., 2019). This research study was approved by National University of Singapore's Internal Review Board (#S-17-369E) and the data were anonymized.

2.2 | DCE design

We used a labeled DCE, which consisted of five labeled alternatives (saiga horn cooling water, herbal cooling water, isotonic drink, paracetamol, and none) and four attributes (price, travel time to store, type of store, and flavor; Figure 1 and Table 1). Each round, the respondent was presented with a different combination of attributes assigned to each alternative, and was asked to select which product they would purchase based on the












	A Antelope horn cooling water	B Herbal cooling water	C Isotonic drinks	D Paracetamol	E None of these
Price	 \$5	 \$5	 \$7	 \$1	
Travel time to store	 35 minutes	 25 minutes	 15 minutes	 5 minutes	
Store	 TCM Family- owned store	 TCM Chain-store			
Flavour		 Ginseng			

FIGURE 1 An example of a choice set from the survey. Alternatives are labeled across the top horizontal axis, while attributes for each alternative are labeled down the left vertical axis. Antelope horn denotes saiga horn

product's traits in that round. For example, in the choice set displayed in Figure 1, the saiga horn option costs 5.00 Singapore dollar (SGD) and is available from a family-owned TCM store 35 min from the respondent, whereas the paracetamol is 1.00 SGD and available from an unnamed store 5 min away. Unnamed stores were used for the non-TCM products (isotonic drinks and paracetamol) because they are sold in various general stores and not in TCM stores.

The four alternatives to saiga horn cooling water represented potential product substitutes. A fifth “none” alternative was added to offer a realistic scenario in which respondents could choose to opt-out if none of the alternatives were satisfactory (Hoyos, 2010; Lancsar & Louviere, 2008). While this results in a loss of efficiency, the presence of the opt-out option is preferable as it better aligns with consumer theory (Hoyos, 2010).

As shown in Figure 1, each alternative consisted of two to four attributes. By limiting the number of possible alternative-attribute combinations to just these options we aimed to reduce cognitive burden on respondents, thereby reducing inconsistencies in consumer choices (Caussade, de Dios, Rizzi, & Hensher, 2005). Price and traveling time to a store were considered generic attributes, implying that they were present in all the alternatives (Table 1). Price is a typical attribute used in DCEs to

TABLE 1 Summary table of attributes and levels used in the final DCE

Attributes	Description	Levels	Rationale for attribute and levels	Hypothesized preference
Price	Price for a standard-sized bottle or a 12-pills pack of paracetamol	\$1, \$3, \$5, \$7	Price range is based on prices of the products from actual stores. Cooling water products tend to cost \$1–\$6 with saiga horn cooling water being the most expensive cooling water available	Lower price—as university students are often on a budget
Travel time	Amount of time spent traveling from the respondent's house to the store to purchase the good	5, 15, 25, 35 min	The large number of stores selling cooling water products (Tan & Freathy, 2011) means that multiple different stores (and thus product selections) are available to consumers in a range of proximities	Shorter travel time—as university students are often pressed for time
Store type ^a	Type of TCM store from which the product is purchased	TCM family-owned store, TCM chain store	Due to their differences in locations and marketing, these two store types might cater to different segments of the population (Tan & Freathy, 2011). A preference for a particular store type might also be used by consumers as a heuristic for the purchase of common products (Hoyer & Brown, 1990; Macdonald & Sharp, 2000)	TCM chain store—due to these stores' positive reputation regarding quality (Tan & Freathy, 2011) and general expectations that young adults would prefer modern stores over more traditional family-owned stores
Flavor ^b	Flavor of the herbal cooling water product	Chrysanthemum, Ginseng	Well-recognized cooling water products that cover a range of prices are often sold in these flavors	Unknown

^aOnly applicable for TCM alternatives (i.e., not paracetamol or isotonic drinks).

^bOnly applicable for herbal cooling water.

measure willingness to pay. Traveling time was included as an attribute as convenience often impacts consumer decisions (Farquhar & Rowley, 2009). Store type and flavor were alternative-specific attributes, meaning they were applicable only to certain alternatives (see Carlsson, Frykblom, & Lagerkvist, 2007 for an example). TCM alternatives (saiga horn and herbal cooling water products) included the attribute of store type because the way TCM stores are operated might affect consumer choices (Tan & Freathy, 2011). Further, since there are many herbal flavors available in real markets, flavor was added to the herbal cooling water alternative to minimize assumptions made by the respondents.

Both price and travel time were made up of four linear levels (Table 1). The price range (\$1–7) was determined through on-site observations of TCM stores and substitutes. For travel time, a range of 5–35 min was used because family-owned TCM stores tend to be situated in housing estates where respondents live, whereas TCM chain stores and pharmacies are commonly situated in high-traffic areas, though they also exist in housing estates. TCM family-owned stores and TCM chain stores

were used to represent cooling water products from the different business models. Flavor also had two levels—chrysanthemum and ginseng—which are commonly available and recognizable cooling herbal alternatives to saiga horn.

The full set of the DCE consisted of 12 question rounds, which were split into two blocks (Blocks 1 and 2) with six question rounds each. Blocking was performed in Ngene 1.2.1 to minimize the correlation within each block (ChoiceMetrics, 2012). Each recent purchaser was randomly assigned to just one of the two blocks to complete in order to reduce respondent fatigue.

2.3 | Data collection

We focused this research on young adults because our prior consumer research showed that saiga horn cooling water was preferred by those aged 18–34 years old significantly more than by older adults (Doughty et al., 2019). We recognize the bias in surveying university-enrolled students, particularly from one campus (albeit a large

university which draws from a wide range of Singaporean society), but we were unable to expand the study based on time and funding constraints.

A pilot study was first used to trial the survey and obtain Bayesian priors for a D-efficient DCE design. Based on the attributes and levels (Table 1), the design for the pilot study was generated using Ngene (ChoiceMetrics, 2012). As the store type and flavor attributes were categorical, these were dummy coded in Ngene. The pilot study was conducted among 30 NUS students in January 2018 using both paper and online surveys. Data collected from the pilot study were analyzed using a multinomial logit (MNL) model in NLOGIT Version 6.0. The Bayesian priors from the pilot study were used to generate a D-efficient Bayesian design in Ngene for the final DCE design (ChoiceMetrics, 2012), which had a d-error of 0.01.

The final survey was conducted in 13 lecture classes held at the university between February to March 2018 across various subjects (all non-conservation-specific; Data S1). Students in the lectures were invited in-person by NL to participate in the survey and were offered the option of either completing the form on paper immediately or carrying out the survey online later.

2.4 | Data analysis

Students' field of study was coded using the University faculty level (e.g., the Faculty of Science) since using finer resolution, for example, degree, resulted in low counts for several categories. All categorical sociodemographic variables were dummy coded in R (R Core Team, 2017) for use in later models. A multinomial logit model (MNL) was initially run in NLOGIT based on the utility function for each alternative. An MNL assumes homogeneity in preferences among the sample. We then extended this analysis using a latent class model (LCM), which assumes a consumer market with heterogeneous preferences that can be divided into several unobserved (latent) consumer segments based on sociodemographic variables. To determine the sociodemographic variables to be included in the LCM, different combinations of the variables were included in an LCM in NLOGIT (as informed by Doughty et al., 2019). The sociodemographic variables were chosen based on proportion of consumer segment membership and statistical significance of different attributes. After the sociodemographic variables which best explained the data had been chosen, LCMs with two to five consumer market segments were specified. To identify the optimal number of consumer segments for the LCM, three statistical criteria were used to select the model with the most

explanatory power: Akaike's information criterion (AIC), AIC3 (a modified AIC with increased penalization factor of three), and Bayesian information criterion (BIC).

3 | RESULTS

3.1 | Descriptive results

A total of 639 valid questionnaires were collected (Data S2). Incomplete questionnaires were excluded. Ninety-eight percent of respondents were aged 18–25 years old, and females comprised 60% of the sample. Most respondents were Singaporean (88%), followed by Malaysian (4%) and Chinese (3%). Of the Singaporean, 87% were Chinese Singaporean, followed by Indian Singaporean and Malay Singaporean at 5 and 3%, respectively. Among Chinese Singaporeans, 45% identified as Hokkien, 16% as Teochew, and 15% as Cantonese. Most subject faculties in NUS were represented, with 32% from the Faculty of Arts and Social Sciences, and 29% from the Faculty of Science. A summary of respondent demographics is available in Data S3.

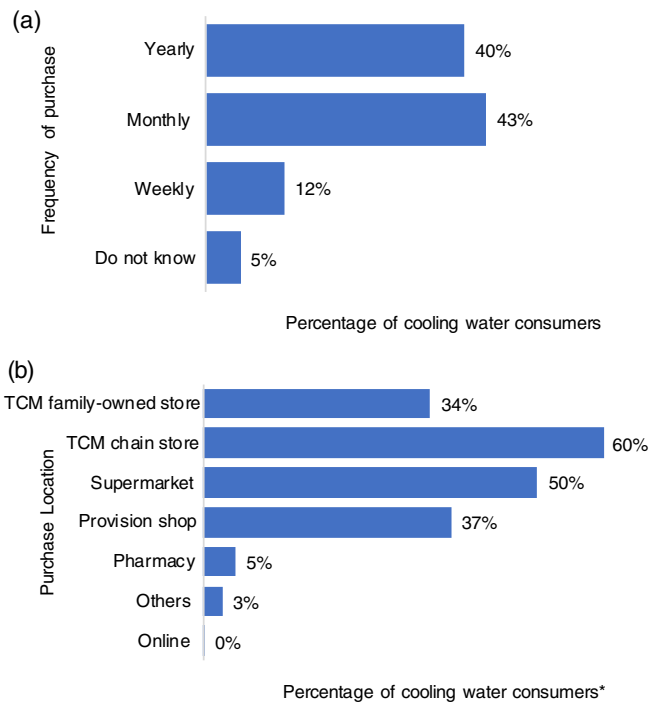


FIGURE 2 (a) Frequency of purchase of cooling water products among self-reported cooling water consumers. “Yearly” indicates purchasing about once a year, and so on. (b) Location of purchase of cooling water products among self-reported cooling water consumers. *For this question respondents could select more than one option

Three-hundred respondents (47%) reported purchasing cooling water products in the past 12 months and thus completed the DCE—providing 1800 complete choice sets for the analysis. Respondents most commonly indicated buying cooling water products approximately once a month, though this was closely followed by buying cooling water once a year (Figure 2a). Cooling water products were most frequently purchased from TCM chain stores and then supermarkets (Figure 2b).

3.2 | DCE results

The best performing LCM was segmented based on the variables of cooling water consumption, identifying as Buddhist, and the Chinese dialect groups of Hokkiens and Teochews (Tables 2 and 3). As expected, both price and time were negative and statistically significant across

the MNL and LCM estimates, indicating a preference for lower-priced and less distant options (both $p < .001$; Table 3). However, respondents did not exhibit a preference for the type of TCM store they purchased cooling water from (Table 3).

The AIC was minimized at five consumer segments, whereas AIC3 and BIC values were minimized at four segments (Table 2). Given that the AIC3 and BIC are more conservative, thus pointing toward simpler models, we chose the model with four segments to explain the heterogeneity in the market. The four consumer segments comprised 12.3, 34.8, 28.4, and 24.5% of the sample population.

Overall, most respondents preferred herbal cooling waters to saiga cooling water, with paracetamol being the preferred option in the remaining segment. LCM Segment 1 stands out for preferring paracetamol over saiga horn cooling water ($p < .001$), while avoiding isotonic

TABLE 2 Summary of information criteria used to select for the number of consumer market segments in the latent class model (LCM)

Number of segments	Number of parameters	Log-likelihood	AIC	BIC	AIC3
MNL	8	−2507.4	5030.8	5076.5	5038.8
2 segment LCM	21	−2310.7	4663.3	4783.4	4684.3
3 segment LCM	34	−2117.9	4303.7	4498.2	4337.7
4 segment LCM	47	−2041.9	4177.8	4446.6	4224.8
5 segment LCM	60	−2027.5	4175.1	4518.2	4235.1

Note: Bold numbers indicate best performance.

Abbreviation: MNL, multinomial logit.

TABLE 3 Multinomial logit (MNL) and latent class model (LCM) estimates of utility function for each attribute, with standard errors in parentheses (95% confidence intervals)

Product attributes	MNL	LCM Segment 1 (12.3%)	LCM Segment 2 (34.8%)	LCM Segment 3 (28.4%)	LCM Segment 4 (24.5%)
Price	−0.232 (0.013)***	−0.204 (0.077)***	−0.276 (0.034)***	−0.340 (0.036)***	−0.465 (0.052)***
Time to store	−0.045 (0.003)***	−0.080 (0.017)***	−0.044 (0.007)***	−0.063 (0.008)***	−0.123 (0.015)***
TCM store (Chain Store)	0.098 (0.064)	0.467 (0.315)	0.106 (0.099)	0.017 (0.146)	−0.180 (0.216)
Herbal flavor (Ginseng)	−0.350 (0.104)***	0.446 (0.479)	−0.862 (0.195)***	−0.436 (0.246)*	−0.217 (0.310)
Herbal cooling water ^a	0.510 (0.079)***	−0.352 (0.449)	0.654 (0.141)***	0.908 (0.199)***	0.507 (0.289)*
Isotonic drink ^a	−0.963 (0.099)***	−1.559 (0.625)**	−3.271 (0.468)***	0.468 (0.276)*	−1.778 (0.447)***
Paracetamol ^a	−0.918 (0.099)***	1.873 (0.335)***	−3.302 (0.488)***	−1.212 (0.350)***	−2.860 (0.686)***
None	−1.996 (0.121)***	−2.922 (0.862)***	−5.461 (0.642)***	−3.356 (0.428)***	−2.246 (0.388)***
Segmentation variables					
Cooling water consumer		1.019 (0.473)**	−0.437 (0.385)	0.885 (0.424)**	
Buddhist religion		−0.001 (0.002)	0.508 (0.335)	−0.002 (0.001)*	
Teochew Chinese dialect		−0.303 (0.354)	0.044 (0.25)	−0.831 (0.359)**	
Hokkien Chinese dialect		0.303 (0.354)	−0.045 (0.249)	0.831 (0.359)**	

Note: Segmentation variables are also shown, with Segment 4 as the reference. Significance levels are indicated by asterisks (* $p < .05$; ** $p < .01$; *** $p < .001$).

^aOne of the four labeled “alternatives” in the DCE; reference level is saiga horn cooling water.

drinks and being neutral regarding herbal cooling water and its flavors. Segment 2 showed a preference for herbal cooling water over saiga horn cooling water ($p < .001$), but avoided isotonic drinks or paracetamol ($p < .001$). Similar to Segment 2, Segment 3 also preferred herbal cooling water over saiga horn cooling water ($p < .001$). These two Segments differed in their preference for isotonic drinks: in Segment 3 the preference for isotonic drinks was not significantly different from saiga horn cooling water. The final segment, Segment 4, also had a preference for herbal over saiga cooling water ($p < .05$) while avoiding isotonic drinks and paracetamol (both $p < .001$). Lastly, all four segments showed a preference for taking one of the offered treatments over the “None” alternative (all $p < .001$; Table 3).

Based on the LCM model, the socioeconomic memberships of the four segments were investigated. Members of Segments 1 and 3 could be differentiated from Segment 4 by being more likely to report having consumed cooling water (Table 3; both $p < .01$). Members of Segment 3 were significantly more likely to identify as Hokkien Chinese and less likely to identify as Teochew Chinese, or to be Buddhist, compared to Segment 4 (both $p < 0.01$). None of the variables investigated were found to be a significant predictor of membership of Segment 2.

4 | DISCUSSION

Across all consumer segments, saiga horn cooling water was substitutable with other product alternatives, in particular herbal cooling water, but also paracetamol. Price and travel time significantly affected consumer choices, with cheaper more accessible alternatives being preferred as expected. Four consumer market segments, each with different preferences, were identified. This study is among the first to apply a labeled DCE to understanding consumer preferences for wildlife products. This method shows potential for helping elicit more realistic information about the factors consumers are internally weighing when they decide between potentially substitutable product types.

4.1 | Contextualizing consumer preferences

We found a negative coefficient for price in most of the population, indicating a preference for lower priced products. While this may seem intuitive, price is often used by consumers as a cue for quality (Kardes, Cronley, Kellaris, & Posavac, 2004; Rao & Monroe, 1989). In recent research, online posts created by social media

users in Singapore included discussion of cheap saiga horn products being fake (Doughty et al., 2020), suggesting that at least for some Singaporean consumers, a higher price *does* indicate quality or authenticity of saiga horn products. The price-quality relationship also has been found in other TCM products; for example, bear bile consumers in China preferred higher-priced products under certain conditions, which was attributed to price being a signal of perceived quality (Dutton et al., 2011). Since price and travel time significantly affected our consumers' selection of cooling products, then, at least in this context, it is likely that many of our consumers are more interested in obtaining a suitable product that fits their needs rather than specifically using saiga horn. Here it is important to note that our sample, being made up of university students, may be more focused on low prices than the average Singaporean consumer. Additionally, our respondents appear to stand in contrast to high-fidelity saiga horn users who definitively want to use saiga horn (Doughty, Milner-Gulland, et al., 2021) and thus possibly have a higher price-threshold and a higher tolerance to the opportunity cost resulting from longer travel time.

Regarding purchase location, past research indicates that modern TCM chain stores have an established reputation and are perceived to stock higher quality merchandise—criteria that ranked among the top factors influencing store patronage (Tan & Freathy, 2011). Contrary to this finding and general expectations that younger demographics would prefer more modern establishments, our results show that respondents did not exhibit such a preference. This further indicates that product selection for our respondents was less tied to intrinsic product or store preferences, and more tied to obtaining a suitable treatment that was affordable and convenient.

While almost half of respondents were regular purchasers of cooling water, over 80% of respondents reported purchasing the products about once a month or once a year. Given that cooling waters are generally used to treat a state of feeling unwell, it makes sense that most people would not be consuming them on a more frequent basis. Herbal cooling water was more or equally preferred to saiga horn cooling water across consumer segments, which is supported by research showing that even consumers with a high fidelity to saiga horn also purchase traditional herbal products to treat heatiness and fever (Doughty, Milner-Gulland, et al., 2021). Among individual respondents who may have a preference for saiga horn cooling water, it is likely that their preference is linked to familial preferences, as past research shows saiga horn use, and TCM usage in general, is strongly tied to family influence (Chang & Basnyat, 2014; Doughty, Oliver, Verissimo, Lee, & Milner-Gulland, 2021) and the

effect of home environment on individuals' preferences and behavior in general is well evidenced (Glanz, Rimer, & Lewis, 2002). This familial influence may be exacerbated in our target audience where it is likely that many respondents still live at home or have only recently moved out.

Across the consumer segments, we did not see a strong preference *against* saiga horn (i.e., it being one of the least chosen products). This could be due to overall positive societal perceptions of saiga horn (Doughty, Oliver, et al., 2021), or to the lack of knowledge in Singapore regarding the saiga's conservation status and the impacts of poaching for their horns on saiga populations (Doughty et al., 2019; Theng et al., 2018). The effectiveness of conservation messaging on saiga horn consumption among this Singaporean demographic has not been tested, but in general simple "awareness raising" has been repeatedly shown as ineffective in provoking many pro-environmental behaviors (Heberlein, 2012; Thomas-Walters et al., 2020). This DCE was carried out prior to an online intervention targeting saiga horn consumption among middle-aged Chinese Singaporean women, where tailored exposés of the provenance of saiga horn products were used to elicit a specific social normative response (Doughty et al., 2020). The intervention did significantly impact some consumers but temporal change in high-fidelity consumers was nonsignificant (Doughty, Milner-Gulland, et al., 2021). A similarly socially framed approach may have an impact on our demographic too, but it would likely need to be amended since tailoring intervention approaches and messaging to a specific target audience is key to increasing the likelihood of intervention success (Dillman, Smyth, & Christian, 2014; Greenfield & Verissimo, 2018).

Given our sample's preferences for low prices and proximity, conservationists wishing to target saiga horn consumption in this demographic may wish to consider an industry- or policy-level intervention in which saiga horn products are taxed, for instance, rather than a consumer-focused intervention. A tax-based intervention might increase the price of saiga horn cooling water beyond young consumers' willingness to pay or prompt companies to reduce the amount of saiga horn in cooling water products in order to maintain the price point. It could also reduce the number of locations selling saiga horn if companies are no longer garnering a worthwhile profit from sales, thus decreasing the average proximity of consumers to stores selling saiga horn which decreases convenience. Taxes have been used successfully elsewhere to shift behavior, such as to reduce tobacco use, despite tobacco being considered a price-inelastic product (Chaloupka, 2010; Jha, Chaloupka, Corrao, & Jacob, 2006). Tax increases or cuts are not always

effective though (Andreyeva, Long, & Brownell, 2010), and heterogeneous consumer markets will naturally respond differently to changes in product attributes. Thus, more extensive research is needed to ascertain whether taxes have applicability specifically to saiga horn consumers across the young adult market in Singapore, or whether there are other industry- or policy-level interventions that may work better.

Prior research suggests that past behavior is often a strong predictor of future behavior, which is why psychographic variables, like decision criteria, are increasingly used in consumer segmentation for wildlife products (Verissimo, Vieira, Monteiro, Hancock, & Nuno, 2020). Taken together with the results of Doughty et al. (2019) and Doughty, Milner-Gulland, et al. (2021), our results suggest preference structures may differ not only between consumers and nonconsumers of a product like saiga cooling water, but also between casual consumers and consumers with a higher fidelity. This hints at the need for more detailed information on consumption habits for effective consumer segmentation. Regarding the religion of respondents, one respondent segment that did *not* prefer saiga horn was also significantly less likely to be Buddhist, which aligns with research indicating saiga horn use is associated with identifying as Buddhist (Doughty et al., 2019). Lastly, Chinese dialect impacted a respondent's likelihood of being in this same non-saiga preferring segment (i.e., members were likely to be Hokkien but not Teochew). The Chinese Singaporean population is composed of individuals descending from migrants of multiple Chinese provinces, hence multiple dialect identities, but what this identity means to individuals with respect to their purchase choices is unknown, as linguistic identity among this population is complex and continually evolving (Lim, Chen, & Hiramoto, 2021).

4.2 | Methodological considerations

A labeled DCE was appropriate for this study because it allowed us to better examine the trade-offs made between saiga horn cooling water and its substitutes, and to successfully identify distinct consumer segments based on their stated purchasing preferences. To date though, most choice experiments studying wildlife products have used unlabeled designs (e.g., Hanley, Sheremet, Bozzola, & MacMillan, 2018; Moro et al., 2013; Shairp, Verissimo, Fraser, Challender, & MacMillan, 2016) or were focused on both users and nonusers of the product in question (Dutton et al., 2011; Liu et al., 2016). In an unlabeled DCE the options presented to a consumer are generic (e.g., A, B, C) and therefore do not describe a specific brand or product (e.g., paracetamol, saiga horn). These

designs have been found to be less realistic in some contexts as they fail to capture attributes of the products that are not generalizable (De Bekker-Grob et al., 2010; Thong, Solgaard, Haider, Roth, & Ravn-Jensen, 2018). In addition to labeling, we also chose to only allow recent purchasers of cooling water to complete the DCE. This ensured that the DCE results were more reflective of actual buyers and thus more relevant to future demand reduction efforts. Additionally, we used latent class modeling to understand the different preference structures of respondent subgroups. Taken together, these methodological decisions make this research more likely to yield actionable insights that can inform conservation practice.

This work is focused on students studying at the National University of Singapore. We chose this demographic group because past research identified young adults as the most likely demographic to purchase saiga horn in the form of cooling water (Doughty et al., 2019). Additionally, though no specific education level was statistically associated with saiga horn use in that study, the most common education level for saiga horn users in aged 18–35 years old age was “pre-university or university” level (81%), indicating that our sampling of university-enrolled students is an apt target group for understanding preferences around saiga horn cooling water. Given the inherent selection bias of only surveying university-enrolled respondents, though, as well as our sample composition not representing the gender and ethnic composition of the national population in Singapore (Department of Statistics Singapore, 2017), our results cannot be extrapolated to the entire Singaporean population of young adults. However, this sample does provide useful insight into university-enrolled individuals throughout the country, which likely represents the consumers with the highest purchasing power of the future.

5 | CONCLUSION

Poaching for horn continues to impact wild saiga populations despite extensive international and saiga range-state efforts (CMS, 2017). However, with a thorough understanding of saiga horn consumers, conservationists can work to stem unsustainable demand. Using a labeled DCE, our results found that saiga horn cooling water was less preferred to other products and that consumers were most influenced by product price and store proximity. While there were limits in the scope of our sample our results suggest that from the perspective of one particular group of young adult consumers in Singapore, saiga horn cooling water is substitutable. This research can inform and guide future work to understand

and influence consumers of saiga horn products toward more sustainable alternatives.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

AUTHOR CONTRIBUTIONS

Hunter L. Doughty, L. Roman Carrasco, E. J. Milner-Gulland, and Diogo Veríssimo conceptualized the work. Nicholas Lim led, and was supported by Hunter L. Doughty, Nicholas Lim, L. Roman Carrasco, and Diogo Veríssimo, the final study design, pilot, and data collection. Nicholas Lim led the analysis and initial manuscript draft and was supported by L. Roman Carrasco and Diogo Veríssimo. Further and final manuscript versions were led by Hunter L. Doughty and supported by Nicholas Lim, L. Roman Carrasco, E. J. Milner-Gulland, and Diogo Veríssimo.

DATA AVAILABILITY STATEMENT

All data are available in the Supporting Information (Data S2).

ETHICS STATEMENT

This research study was approved by National University of Singapore's Internal Review Board (#S-17-369E) and the data were anonymized.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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