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Perceived benefits, negative impacts, and willingness-to-pay to improve urban green space

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Abstract

Urban green spaces provide multiple benefits but incur some negative impacts. We employed the contingent valuation method to investigate Hong Kong residents' willingness-to-pay to improve urban green space provision. A questionnaire collected 316 responses from urban-park visitors. It assessed perceptions of positive benefits and negative impacts and influences on willingness-to-pay. Health benefits attracted top scores, followed by environment and ecology. For negative impacts, road safety ranked first, followed by risks and hazards, and health and sanitation concerns. More educated and younger respondents were more willing to pay. One third of respondents, mainly the less educated and older people, registered protest votes for diverse reasons. Logistic regression was used to analyse the probability of positive bids with a socio-demographic model and an extended model incorporating explanatory perception variables. Ordinal regression identified willingness-to-pay determinants. Both statistical tests found perceived environmental and ecological benefits as key willingness-to-pay predictors. The perceived negative impacts of health and sanitation concerns were correlated with willingness-to-pay, indicating a desire to improve and contradicting past studies and expectations. The results highlighted the importance of exploring willingness-to-pay from a rarely studied perspective of valuating the potential improved utility of urban green space through suppressing negative impacts. The findings can inform park and urban management to meet user expectations.

KEYWORDS

contingent valuation method, perceived benefit, perceived negative impact, protest vote, urban green space, willingness-to-pay

1 | INTRODUCTION

Urban green spaces play a substantial role in residential quality of life and environmental well-being. These

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spaces benefit physical and mental health (Grahn & Stigsdotter, 2010; Mitchell & Popham, 2008), environmental quality (Fam et al., 2008; Heidt & Neef, 2008), social relationships (Dinnie et al., 2013; Zhou & Parves Rana, 2012), and the economy (Conway et al., 2010). Governments often provide and maintain urban green spaces as public amenities (Brandli et al., 2014; Dolley, 2020; Phillips, 2020; Smith, 2020), leading to a common belief that such valuable resources are free. Their broad spectrum of intrinsic benefits is often neglected, disregarded, or misunderstood. Furthermore, as non-market goods, urban green space services may be intangible, unobvious, and indirect; that is, they may be viewed as non-priced benefits (Latinopoulos et al., 2016). Thus, their real value to people and society may not be easy to understand and express in economic terms and that has implications for both economic and political geographical understandings of these spaces—something already explored in this journal (Dolley, 2020; Phillips, 2020; Smith, 2020).

Urban green spaces have been increasingly valued using specialised techniques developed by economists for non-market goods. Often adopted are stated preference approaches such as the contingent valuation method. The contingent valuation method typically employs questionnaires to enable people to directly indicate their preferences for certain goods and do so in monetary terms. The monetary values reported by respondents are usually expressed as willingness-to-pay—a maximum monetary value an individual would be prepared to pay for a hypothesised improved scenario. Alternatively, willingness-to-pay could be the minimum amount an individual would be willing to accept as compensation for changes. Contingent valuation method has been widely used in environmental studies in the valuation of nature restoration (Petrolia et al., 2014; Susilo et al., 2017), sustainable energy use (Borchers et al., 2007; Hansla et al., 2008), and biodiversity conservation (Martín-López et al., 2007). A major advantage of contingent valuation method over other valuation techniques is its capacity to assess both use and non-use urban green space values, enabling full capture of urban green space value (Latinopoulos et al., 2016).

Some studies have applied contingent valuation method to urban green space valuation (Chiesura, 2004; Latinopoulos et al., 2016; Lo & Jim, 2010; López-Mosquera & Sánchez, 2011; Saz-Salazar & Rausell-Köster, 2008). Early applications focused on quantitative results and monetary figures or tested the statistical robustness of the valuation method (Breffle et al., 1998; Lorenzo et al., 2000; Tyrväinen & Väänänen, 1998). It became common in later studies to profile respondents' socio-demographic backgrounds. Willingness-to-pay determinants were investigated by linking respondents' socio-demographic characteristics and willingness-to-pay (López-Mosquera & Sánchez, 2011). However, simple willingness-to-pay quantification or analysis of socio-demographic characteristics might not effectively reveal people's preferences for and expectations of urban green spaces (Chen et al., 2014; Hoyos et al., 2015; López-Mosquera & Sánchez, 2011). Instead, underlying psychological processes of intended behaviours may be the crux to improve contingent valuation method estimation and address people's expectations and needs of people in relation to urban green spaces (Hoyos et al., 2015; López-Mosquera & Sánchez, 2013). Chen et al. (2014) also suggested that accounting for perceptions in conventional socio-demographic models would improve the predictive power of willingness-to-pay measures. Therefore, an increasing number of studies have focused on investigating the influence on people's willingness-to-pay of different psychological constructs such as motivation (Lo & Jim, 2010), perceived benefits (Latinopoulos et al., 2016; Song et al., 2015) or satisfaction, and emotional attachment (López-Mosquera & Sánchez, 2011). López-Mosquera and Sánchez (2013), in particular, referred to the attention received by studies theorising the influence of individuals' positions on their willingness-to-pay for perceived benefits. Yet, empirical studies are lacking. A few such studies attempted to determine the predictive power of work considering perceived benefits on willingness-to-pay (Chen et al., 2014; Latinopoulos et al., 2016; López-Mosquera & Sánchez, 2013), and some have shown positive results.

Apart from the perceived benefits of urban green spaces, perceived negative impacts were commonly enlisted as explanatory variables. For instance, several studies explored the effects of perceived negative impacts on urban green space use (Maruthaveeran & van den Bosh, 2015). Blöbaum and Hunecke (2005) suggested that perceived impacts of the fear of danger and crime could reduce the frequency of

Key insights

Hong Kong has exceptionally high development and population densities and a grave lack of public green spaces in built-up areas. This study employed the contingent valuation method to investigate Hong Kong residents' willingness-to-pay for improved urban green space provision. We evaluated the influence of perceived benefits and negative impacts of urban green space on that willingness-to-pay. Findings highlighted the importance of exploring willingness-to-pay from a rarely studied perspective that has wider implications for park and urban management.

urban green space use despite its widely promoted benefits. Nevertheless, studies on urban green space valuation have yet to reveal the links between perceived negative impacts and willingness-to-pay. Both benefits and negative impacts should be considered to assess comprehensively the influence of perception on willingness-to-pay. To address the gap in knowledge about the relationship between perception and willingness-to-pay, this study builds upon and extends existing socio-demographic models by incorporating perceived benefits and perceived negative impacts as willingness-to-pay predictors.

In contingent valuation method studies, respondents could choose to state a zero bid in addition to expressing their willingness-to-pay. To analyse responses with zero bids, debriefing questions were commonly included in the questionnaire to solicit their reason for unwillingness to pay (Boyle & Bergstrom, 2001; Freeman et al., 2014). It is essential to distinguish between protest bids and genuine zero bids; that is, answers based on respondents genuinely thinking the proposed scenario has no value. A two-step approach had previously been adopted to analyse positive and protest bids in relation to the willingness-to-pay amount (Bernath & Roschewitz, 2008). The first step explored the probability of positive and protest bids and differentiated the two types of voters. The second step investigated the willingness-to-pay amount among positive voters. In this study, we assessed willingness-to-pay, reasons for protest votes, perceived benefits, and negative impacts of respondents, and performed willingness-to-pay analysis to identify determinants of positive and protest voters. Specifically, we investigated the perceptions of Hong Kong residents towards urban green space and the relationships among socio-demographic factors, perceived benefits and negative impacts, and the willingness-to-pay amount of positive votes.

2 | LITERATURE REVIEW

2.1 | Determinants of positive and protest bids

Some willingness-to-pay environmental studies have explored the determinants that distinguish positive and protest voters (Acquah, 2011; Bernath & Roschewitz, 2008; Chen & Qi, 2018; Kostakis & Sardianou, 2012; Latinopoulos et al., 2016). In urban green space studies, Bernath and Roschewitz (2008) employed logistic regression to explore the probability of respondents in a city forest park in Zurich providing a protest vote and examined the characteristics of protest voters. They concluded that socio-demographic characteristics showed no significant influence on protest votes, yet walkers had a tendency to state a protest vote greater than that expressed by cyclists. Latinopoulos et al. (2016) examined the willingness-to-pay of citizens in Thessaloniki city, Greece, to support an urban green space project. They found that a few explanatory variables significantly influenced acceptance or rejection of the proposed development—that is, a positive bid or a zero bid, including income, home distance, and the advantages and disadvantages of urban green space development. Alternatively, in their study of an urban forest park in China, Chen and Qi (2018) indicated that socio-demographic characteristics of residents could not distinguish positive and protest bidders.

2.2 | Influence of socio-demographic factors on willingness-to-pay

Socio-demographic factors, including age, education level, and income, are the primary and most fundamental predictors of willingness-to-pay and have been widely assessed in the literature (Halkos et al., 2022; Latinopoulos et al., 2016; Song et al., 2015; Tian et al., 2020; Vecchiato & Tempesta, 2013). However, these studies render mixed results. Tian et al. (2020) examined citizens' willingness-to-pay in three Chinese cities and concluded that those with higher socio-economic status visited urban green spaces more frequently and reported greater willingness-to-pay than did those with lower socio-economic status. Song et al. (2015) explored the motivation and willingness-to-pay of citizens for urban green space conservation in Jinan, China and found that income and education level were positive determinants of willingness-to-pay, and age had no significant effect. Alternatively, Vecchiato and Tempesta's (2013) urban green space study in Venice identified a significant negative relationship between respondents' age and willingness-to-pay but not for other socio-demographic variables. The authors argued that the perceived value of urban green space—reflected by willingness-to-pay—was proportional to the remaining years that a respondent might enjoy the urban green space benefits. In contrast, Latinopoulos et al. (2016) identified partially similar results to the above studies, with age showing a negative influence on willingness-to-pay, and income and education level positive relationships with willingness-to-pay. Evidently, the results related to socio-demographic variables were not conclusive, where the heterogeneity of responses between societies may play a role, and that also reflects the need for more in-depth assessment of predictors.

2.3 | Influence of perceived benefits on willingness-to-pay

Some studies employed perceived benefits as a willingness-to-pay predictor. Chen et al. (2014) identified

a strong relationship between the perceived overall benefits of the ecosystem and willingness-to-pay for a riparian meadow restoration project in Belgium. The benefits were measured based on people's perception of various ecosystem services and the overall perceived benefits. Latinopoulos et al. (2016) examined the influence of positive and negative impacts of urban green space development in Greece. Positive impacts were measured in different domains, including tourism, recreation, microclimate, air quality, or aesthetics, for example. Negative impacts were represented by problems such as littering, noise pollution, and increased crowding. Latinopoulos et al. concluded that the project's positive impacts would lead to increased willingness-to-pay, whereas the negative impacts brought the opposite effect. López-Mosquera and Sánchez (2013) used a structural equation model to study the relationships among perceived benefits, place attachment, and willingness-to-pay in two urban green spaces in Spain. The results showed a direct connection between perceived benefits and willingness-to-pay, but the relationship was not significant. However, positive relationships were found when the path was mediated by affective attachment and place identity. In terms of recreational features, Chen and Qi (2018) revealed that users of an urban forest park in Fuzhou city, China, showed greater willingness-to-pay with their higher level of perception of benefits from and satisfaction of the park's facilities and services. These studies all analysed perceived benefit as a single construct to reflect urban green spaces' overall benefits. Given the multiple perspectives on benefits and negative impacts identified in urban green space studies, we employed a systematic approach and incorporated multiple benefits and negative impacts constructs into the model.

3 | METHODS

3.1 | Research and questionnaire design

The questionnaire is a commonly employed survey instrument of data collection in contingent valuation method studies (Nielsen-Pincus et al., 2017). The method allows the measurement of the value that people place on non-market environmental goods and enables researchers to gauge people's attitudes and perceptions. Therefore, a questionnaire was adopted as the tool for data collection in this study. We obtained ethics clearance from the Human Research Ethics Committee of the University of Hong Kong with reference number EA1803001.

We divided the questionnaire into three parts. The first part assessed the perceived benefits and negative impacts of urban green space. The second allowed respondents to report their willingness-to-pay and the reasons for protest votes. The last part collected information about respondents' socio-demographic characteristics, including age, income, and education level.

Concerning the first part, five groups of perceived urban green space benefits were selected, each with eight to 15 items: thermal environment benefits (A1–A10), environmental and ecological benefits (B1–B15), outdoor recreation and general health benefits (C1–C8), specific health benefits (D1–D10), and social benefits (E1–E10). They were designated with reference to both existing studies on urban green space benefits (Brown et al., 2014; De Ridder et al., 2004; Madureira et al., 2015; Young, 2007), and Hong Kong's unique approach to urban green space provision. Similarly, we included three groups of perceived negative impacts of urban green space, namely risks and hazards (F1–F9), road safety concerns (G1–G6), and health and sanitation concerns (H1–H8). All items in this first part of the questionnaire were measured according to a Likert scale of 1–5 from "strongly disagree" to "strongly agree."

The second part focused on the contingent valuation method and drew on three common value elicitation formats used in the literature, including dichotomous bidding, open-ended questions, and payment cards. Dichotomous bidding is readily comprehensible by respondents, who are asked to indicate whether they accept a partially random amount provided by the researcher. However, the method suffers from drawbacks, including the need for a large sample size over 1,000, starting point bias, and limited information about the respondents' actual preferred values (Boyle & Bishop, 1988; Ready et al., 1995). The open-ended question method has superior performance in detecting and understanding the willingness-to-pay variations (Lo & Jim, 2010). However, it is difficult for respondents to assign a monetary value to a non-market good such as urban green space, which may lead to underestimation (Boyle et al., 1996; Chen et al., 2014). The payment card method combines the dichotomous and open-ended approaches to address their respective weaknesses without compromising their strengths (Lo & Jim, 2010; Song et al., 2015). Extensively applied in contingent valuation method studies on urban green space (Bernath & Roschewitz, 2008; Lo & Jim, 2010; Song et al., 2015; Tyrväinen, 2001), the payment card approach was adopted in the present study.

In applying the payment card approach, a scenario about urban green space improvement was first presented to respondents:

> Currently, citywide and systematic works specializing in improving the benefits and

> reducing the negative impacts of urban green space in Hong Kong is lacking. Please assume that the government and non-governmental organizations would develop and implement a new greening enhancement programme by introducing a series of maintenance work to improve the environmental quality and facilities of urban green space across Hong Kong. For instance, the improvements include introducing more native vegetation and pest control—for instance, mosquitos—in all neighbourhoods in the next five years. Current thermal or environmental urban green space benefits would be enhanced. At the same time, negative urban green space impacts related to health and sanitation would be ameliorated. Would you be willing to pay for this programme as a voluntary contribution to show your support? Before making a choice, please also take into account (1) your financial status (that is, household income and expenditure), and (2) your preference for benefits and perception of negative impacts.

For respondents who were willing to pay, a list of bid amounts was presented: ≤ HKD199, 200–299, 300–399, 400–499, and ≥ 500 per year (the officially pegged exchange rate is USD1.0 = HKD7.8). Respondents would choose the maximum amount they were willing to pay. Bid values were determined based on an urban green space study in Hong Kong (Lo & Jim, 2010) and considered recent changes in consumer price and regular expenses in Hong Kong. Respondents were asked to choose only one option from the list. Respondents who expressed unwillingness to pay were given a list of reasons to explore their intention in the following terms: "I do not use green space," "No need to improve the greening," "Users of green space should pay," "The government should pay with tax revenue," "I cannot afford," and "Other reason." This question could distinguish protest votes from true zero bids, which indicated that the respondents perceived no value in the proposed scenario; that is, respondents expressing "no need to improve greening" or similar responses.

3.2 | Questionnaire administration and data analysis

The questionnaire was administered at urban parks in Hong Kong. Target respondents were 18 years or older. We sampled five urban parks with similar characteristics and conditions in Hong Kong Island, Kowloon, and the New Territories—the three main regions. A roughly similar number of questionnaires were collected in each park. University student assistants were briefed and trained by researchers to assist. The questionnaire was conducted face-to-face, as recommended for the contingent valuation method (Arrow et al., 1993). Student assistants guided respondents through the questionnaire and explained any misunderstandings. Convenient sampling was adopted, and one in five individuals intercepted in each designated urban green space was invited to answer the questions. The participation was entirely voluntary, with no provision of reward. From a total of 468 potential participants, 152 were either rejected or incomplete, yielding a response rate of 67.5%.

Cronbach's alpha tests were carried out to confirm the reliability of the perceived benefits and negative impacts factors, and a standard threshold of 0.7 was taken as reference as suggested by Nunnally and Bernstein (1994). Data analysis was conducted in two stages using the statistical tool SPSS 25.0. In the first stage, stepwise logistic regression identified the determinants of positive and protest voters. Positive bids were coded as 1, and protest votes as 0. We tested two models in this part: a socio-demographic model and an extended model. The socio-demographic model first assessed education level, age, and income based on models used in previous studies. Perceived benefits and perceived negative impacts were then added to the first model to establish the extended model and investigate the influence and predictive power of the two new variables. The second stage of the analysis explored the predictors of the willingness-to-pay amount of positive voters. We classified the willingness-to-pay results reported by respondents into five categories and coded them in ascending order. The step ≤ HKD199 was coded as 1 and ≥ HKD500 as 5. We used ordinal regression analysis to examine the relationships between socio-demographic variables, perceived benefits, perceived negative impacts, and the ranked willingness-to-pay categories. We applied the Hosmer and Lemeshow goodness-of-fit test to assess the fitness of the two models by comparing the observed event rates with the expected event rates. Regarding the accuracy of the dependent variables, the classification accuracies of the two models measuring the data's prediction accuracy were computed.

4 | RESULTS

4.1 | Descriptive statistics

In Table 1, male and female respondents had nearly equal representation. Older respondents were the majority, with the 31–50 group accounting for 44.9% of all respondents.

TABLE 1 Key demographic characteristics of the 316 randomly chosen questionnaire-survey respondents

Gender	*n*	%	Age group	*n*	%
Male	161	51	≤ 20	24	7.6
Female	155	49	21–30	57	18
			31–50	142	44.9
			51–70	77	24.4
Household income (HKD)[a]			≥ 71	16	5.1
< 10,000	19	6			
10,000–20,000	55	17.4	**Education level**		
20,000–40,000	106	33.5	Primary or lower	48	15.1
40,000–60,000	56	17.7	Secondary	125	39.6
> 60,000	17	5.4	Tertiary or above	143	45.3
Other (no regular income: Student, pending employment, retired)	23	7.3			
No response	40	12.7			
			Total (*N*)	**316**	**100**

[a]Officially pegged exchange rate: USD1.00 = HKD7.80.

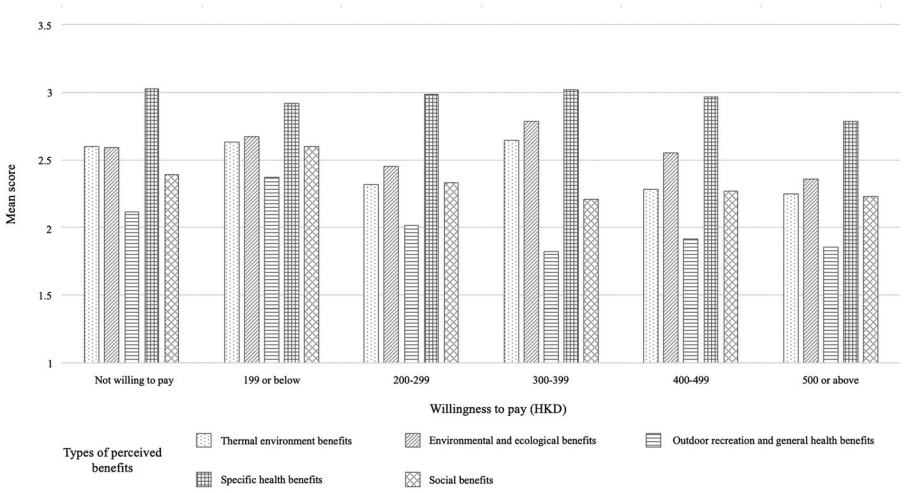

FIGURE 1 Mean score of perceived benefits by respondents' willingness-to-pay

Respondents with household incomes of HKD20,000 40,000 per month were the largest group (33.5%), followed by HKD40,000–60,000 (17.7%) and HKD10,000–20,000 (17.4%). Close to half of the respondents had received an undergraduate or higher level of education and a similar proportion had secondary education (39.6%).

4.2 | Willingness-to-pay and reasons for protest votes

Approximately one third of respondents indicated an unwillingness to pay to improve a neighbourhood urban green space (Figure 1). Another one third of the respondents were willing to pay ≤ HKD199. Approximately 25% of respondents were willing to pay HKD200–499, and very few respondents (5.7%) were willing to pay a larger amount of ≥ HKD500.

For respondents who intended not to pay, a follow-up question was asked seeking their reasons for the choice. All such respondents provided a non-payment reason. They were all protest voters, and no true zero bids were found (Figure 2). One third of the protest voters stated that the government should shoulder the expenses of urban green space improvement. A similar proportion of respondents indicated that they could not afford such an expense. Merely 1.9% of the respondents chose "other reasons" and mentioned that they were poor. Only a small proportion of the respondents refused to pay because they reckoned that only urban green space users

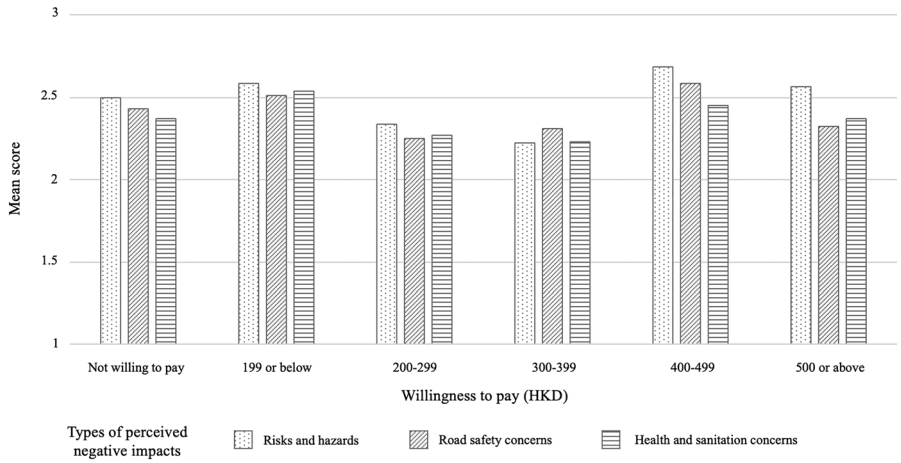

FIGURE 2 Mean score of perceived negative impacts by respondents' willingness-to-pay

should pay (8.65%), they did not use urban green space (11.54%), or they did not perceive the need to improve the urban green space (8.65%).

4.3 | Perceived benefits and perceived negative impacts

The mean scores of the five groups of perceived benefits ranged from 2.06 to 2.79, showing that respondents generally did not rate perceived benefits highly (Table 2). Specific health benefits received the highest rating (2.79), followed by environmental and ecological benefits (2.37). The respondents perceived the benefits of outdoor recreation and general health as the least important.

Road safety concerns were the highest-rated perceived negative benefit among respondents (2.49) (Table 3). However, the remaining two groups of negative impacts, namely risks and hazards, and health and sanitation concerns, received similar mean scores of 2.45 and 2.35. The Cronbach's alpha coefficients of the five constructs of perceived benefits ranged from 0.862 to 0.918, and the three perceived negative impacts from 0.862 to 0.908, indicating good reliability of all variables (Table 3).

4.4 | Logistic regression analysis

Apart from the reasons stated directly by protest voters, logistic regression was performed to examine the differences between positive and protest voters (Table 4). We employed education level, age, and income as predictors of protest and positive votes in the socio-demographic model. Education level positively enhanced the intention of respondents to pay for the improvement of the urban green space, yet the result was only marginally significant ($p = 0.05$). In contrast, age had a significant negative influence on the respondents' intention to pay ($p < 0.05$). The effect of income was not significant. In short, more educated and younger respondents were more likely to be willing to pay, whereas less educated and older respondents had a higher tendency to report a protest vote.

Perceived benefits and perceived negative impacts were included as additional predictors in the extended model (Table 4). Consistent with the previous model, education level and age were positively and negatively related to the respondents' intention to pay, respectively; income was again not significant. Contrasting with the first model, education level was statistically significant ($p < 0.05$). Among the perception constructs, the perceived environmental and ecological benefits group offered the only significant predictors. Respondents perceiving a higher level of environmental and ecological benefits displayed a higher probability of willingness-to-pay for urban green space improvement.

The Hosmer and Lemeshow goodness-of-fit result in both models yielded p values over 0.05, indicating that they do not differ significantly from the observed data to represent good model fit. The classification accuracy values of the socio-demographic model and the extended model were 68.7% and 68.0%, respectively, indicating close to no difference. The chi-square value changed from 17.973 in the socio-demographic model to 26.945 in the extended model, and both statistics were significant. The increased χ^2 indicated a better prediction of the outcome by the extended model with the additional predictors. The Nagelkerke R^2 values for the two models were 0.077 and 0.114, respectively. The improved R^2 value of the extended model showed its higher predictive and explanatory power with reference to the total variance.

4.5 | Ordinal regression analysis

The relationships of perceived benefits, perceived negative impacts, and socio-demographic variables with

TABLE 2 Summary of scores of respondents' perceived benefits of urban green space

Items	Score (%)					Mean	Standard deviation	Cronbach's α
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree			
Thermal environment benefits:								0.877
A1. Offer evapotranspiration to cool urban air temperature	0.0	5.7	26.3	50.9	17.1	2.21	0.788	
A2. Provide cool shading in hot sunny weather	0.0	1.3	17.1	54.1	27.5	1.92	0.702	
A3. Reduce air-conditioning energy consumption	0.3	6.0	23.1	50.6	19.9	2.16	0.822	
A4. Reduce heat-induced health problems	0.3	5.1	24.7	52.2	17.7	2.18	0.790	
A5. Green roof can lower building surface and indoor temperature	0.0	4.4	25.6	52.2	17.7	2.17	0.765	
A6. Green wall can lower building surface and indoor temperature	0.3	3.8	26.3	50.9	18.7	2.16	0.778	
A7. Ameliorate urban heat island effect	0.6	2.2	38.3	42.4	16.5	2.28	0.785	
A8. Urban parks can create cool island effect	0.6	3.8	40.2	42.7	12.7	2.37	0.776	
A9. Urban parks' cool island effect can extend to adjoining areas	0.9	7.3	41.5	37.7	12.7	2.46	0.841	
A10. Ameliorate climate change impacts	0.6	2.5	32.0	49.7	15.2	2.24	0.758	
						2.215		
Environmental and ecological benefits:								0.889
B1. Absorb carbon dioxide and mitigate greenhouse effect	0.0	3.2	18.0	51.3	27.5	1.97	0.764	
B2. Remove air pollutants to improve air quality	0.0	6.3	20.6	45.6	27.5	2.06	0.856	
B3. Abate noise pollution	1.9	8.9	34.5	38.6	16.1	2.42	0.927	
B4. Reduce road glare and improve road safety	0.9	10.1	34.2	39.6	15.2	2.42	0.900	
B5. Provide natural fragrant smell	1.3	5.7	30.7	44.0	18.4	2.28	0.871	
B6. Offer natural seasonal changes	0.6	5.7	29.7	44.3	19.6	2.23	0.852	
B7. Absorb and retain rainwater	0.9	5.7	33.5	47.2	12.7	2.35	0.809	
B8. Reduce release of rainwater into drainage system	0.6	8.5	44.0	35.8	11.1	2.52	0.826	
B9. Reduce investments in stormwater drainage infrastructure	1.9	11.4	44.6	30.4	11.7	2.61	0.903	
B10. Reduce the likelihood of urban flooding	0.6	9.2	42.7	34.8	12.7	2.50	0.853	

(Continues)

TABLE 2 (Continued)

Items	Score (%)					Mean	Standard deviation	Cronbach's α
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree			
B11. Recharge groundwater	0.6	7.3	41.8	38.3	12.0	2.46	0.821	
B12. Reduce soil erosion	0.3	8.5	33.5	42.1	15.5	2.36	0.856	
B13. Allow more wildlife to dwell in cities	1.3	11.1	32.3	40.8	14.6	2.44	0.915	
B14. Provide diverse habitats to protect endangered species	1.6	12.7	31.3	43.0	11.4	2.50	0.910	
B15. Raise urban biodiversity	0.6	9.8	33.5	42.1	13.9	2.41	0.870	
						2.37		
Outdoor recreation and general health benefits:								0.862
C1. Provide passive recreational venues	0.0	2.2	19.6	52.5	25.6	1.98	0.737	
C2. Offer visual delights	0.0	3.2	18.0	52.5	26.3	1.98	0.756	
C3. Encourage outdoor activities	0.0	2.8	14.6	56.0	26.6	1.94	0.723	
C4. Improve general health conditions	0.3	2.5	16.1	52.8	28.2	1.94	0.756	
C5. Reduce anxiety, frustration, and irritability	0.3	2.5	17.1	51.6	28.5	1.95	0.764	
C6. Reduce mental stress and improve mental health	0.9	2.8	16.1	50.9	29.1	1.96	0.807	
C7. Reduce obesity	4.7	11.7	26.9	40.8	15.8	2.49	1.043	
C8. Instil creativity and inventiveness	1.3	5.4	25.6	49.1	18.7	2.22	0.853	
						2.06		
Specific health benefits:								0.918
D1. Green view of hospital ward can accelerate patient recovery	1.9	5.1	33.2	49.4	10.4	2.39	0.814	
D2. Green view of hospital ward can reduce the need for nursing care	5.7	13.9	40.5	31.6	8.2	2.77	0.982	
D3. Green view of hospital ward reduce demands for pain relief medication	5.4	16.1	38.3	33.2	7.0	2.80	0.974	
D4. Green view of hospital ward can lower overall medical costs	7.0	19.0	41.1	25.9	7.0	2.93	1.002	
D5. Pregnant women with frequent contact with nature have fewer underweight babies	8.2	14.6	46.5	22.5	8.2	2.92	1.013	
D6. Pregnant women with frequent contact with nature have babies with a larger head circumference	10.1	19.6	46.8	17.7	5.7	3.11	0.999	
D7. Pregnant women with frequent contact with nature have more full-term births	8.9	15.2	46.8	23.7	5.4	2.98	0.981	
	3.8	8.9	33.5	42.1	11.7	2.51	0.944	

TABLE 2 (Continued)

Items	Score (%)					Mean	Standard deviation	Cronbach's α
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree			
D8. Urban greening can reduce morbidity								
D9. Urban greening can reduce mortality	5.1	10.8	39.6	34.8	9.8	2.66	0.970	
D10. Lower income people with frequent contact with nature can reduce mortality	5.7	13.3	42.7	30.7	7.6	2.79	0.964	
						2.79		
Social benefits:								0.883
E1. Green space area can improve quality of environment and life	0.9	3.5	26.3	52.2	17.1	2.19	0.790	
E2. Green space quality can improve quality of environment and life	0.6	3.8	25.3	50.9	19.3	2.16	0.796	
E3. Urban greening can facilitate social networking and mutual support	1.9	7.9	31.0	45.6	13.6	2.39	0.886	
E4. Urban greening has a calming effect of reducing outbursts of anger and violence	1.3	9.5	26.9	46.5	15.8	2.34	0.899	
E5. Urban greening can promote constructive reasoning to resolve conflicts	3.2	13.3	34.8	38.3	10.4	2.60	0.952	
E6. Urban greening can foster social cohesion and harmony	1.3	8.5	31.6	46.2	12.3	2.40	0.858	
E7. Heritage trees can symbolise a city's history and cultural identity	1.6	7.0	24.1	49.1	18.4	2.24	0.888	
E8. Meritorious urban greening can improve a city's image	0.9	3.2	21.8	51.3	22.8	2.08	0.808	
E9. Meritorious urban greening can make cities liveable and sustainable	0.6	6.3	22.2	49.4	21.5	2.15	0.852	
E10. Urban greening can bring appreciable returns to its public expenditures	1.9	10.8	28.5	42.4	16.5	2.39	0.948	
						2.29		

All items follow the Likert scale of 1 to 5 from strongly disagree to strongly agree.

willingness-to-pay amount were assessed by ordinal regression (Table 5). The p value of 0.933 for the goodness-of-fit test indicated that the observed data fitted the model well. Concerning the test of parallel lines, the insignificant result ($p = 0.992$) supported the assumption of proportional odds. A positive relationship was identified between perceived environmental and ecological benefits and willingness-to-pay amount ($p < 0.01$). Moreover, perceived negative impacts on health and sanitation concerns were also positively and significantly correlated with willingness-to-pay amount ($p < 0.05$). For socio-demographic variables, only education level

TABLE 3 Summary of scores of respondents' perceived negative impacts of urban green space

Items	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean (%)	Standard deviation	Cronbach's α
Risks and hazards:								0.862
F1. Some plants can emit air pollutants, such as BVOC (biogenic volatile organic compounds)	4.1	15.5	45.3	33.5	1.6	2.87	0.839	
F2. Roadside trees can hamper dispersion of air pollutants	4.4	13.0	36.4	40.8	5.4	2.70	0.919	
F3. Some plants have poisonous leaves or fruits	1.6	5.1	25.6	55.7	12.0	2.28	0.802	
F4. Some plants have sharp thorns or protrusions to hurt people	1.6	7.0	22.5	52.5	16.5	2.25	0.867	
F5. Some tree branches are prone to breakage to hurt people	1.6	6.0	24.4	52.5	15.5	2.26	0.847	
F6. Some trees are often toppled by strong wind to hurt people	1.3	6.0	26.6	51.3	14.9	2.28	0.834	
F7. Poorly managed trees are susceptible to failure to hurt people	0.6	6.0	22.8	50.6	19.9	2.17	0.836	
F8. Dense vegetation can reduce visibility and induce feeling of fear	2.2	18.4	28.2	41.8	9.5	2.62	0.964	
F9. Poorly managed parks can provide a seedbed for criminals	2.2	16.8	29.7	40.2	11.1	2.59	0.967	
						2.45		
Road safety concerns:								0.897
G1. Roadside trees can obstruct visibility to induce road safety problems	1.9	11.7	32.3	40.8	13.3	2.48	0.931	
G2. Roadside trees can block traffic signs and street lighting to induce road safety problems	1.9	12.7	26.3	45.3	13.9	2.43	0.946	
G3. Roadside trees can extend their branches to hinder vehicular traffic	1.3	12.0	30.4	44.6	11.7	2.47	0.896	
G4. Roadside trees can reduce pavement width and cause inconvenience to pedestrians	3.2	13.9	29.1	43.7	10.1	2.56	0.959	
G5. Some trees can deposit slippery fruits that may trip pedestrians	2.5	11.4	30.4	45.9	9.8	2.51	0.910	
G6. Some tree roots can crack and heave the pavement to endanger pedestrians	1.6	12.3	31.3	42.4	12.3	2.48	0.917	
						2.49		

TABLE 3 (Continued)

Items	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Mean (%)	Standard deviation	Cronbach's α
Health and sanitation concerns:								0.908
H1. Urban green spaces can provide mosquito breeding grounds	0.6	6.6	20.3	54.7	17.7	2.18	0.821	
H2. Urban green spaces can bring insect bites	1.3	7.9	19.0	55.1	16.8	2.22	0.862	
H3. Urban green spaces can cause spread of infectious diseases	1.9	13.9	25.0	48.1	11.1	2.47	0.931	
H4. Urban trees can attract birds to spread bird flu	1.6	9.5	24.7	49.7	14.6	2.34	0.896	
H5. Urban trees can attract birds to leave dirty droppings	0.9	6.3	20.6	53.5	18.7	2.17	0.838	
H6. Urban green spaces can attract dangerous wasp nests	0.6	9.5	34.2	42.4	13.3	2.42	0.860	
H7. Urban green spaces can produce pollens to cause hay fever	0.9	9.8	37.0	40.8	11.4	2.48	0.856	
H8. Urban green spaces can produce tiny fibres to cause allergy	0.9	11.1	38.9	39.6	9.5	2.54	0.848	
						2.35		
All items follow the Likert scale of 1 to 5 from strongly disagree to strongly agree								

showed a positive influence on willingness-to-pay amount ($p < 0.01$). The Nagelkerke R^2 value for the regression test was 0.111.

5 | DISCUSSION

Mean willingness-to-pay to recover a possible loss of an urban green space as reported by Lo and Jim (2010) in one study in Hong Kong was HKD77.43. The most commonly selected range of willingness-to-pay in the present study was HKD199 or below, indicating a roughly similar range. However, up to 85% of respondents provided positive bids in the study of Lo and Jim (2010), which is considerably higher than in the present study at approximately 67%. Notably, the most common reason for protest reported by respondents in the present study was similar to that identified by Lo and Jim (2010), in which respondents indicated that the government should pay and be responsible for urban green space improvements. Affordability was another essential factor for protest votes in the present study but one not as important as in the past. Unexpectedly, there were more high-income respondents in the present study than in the past; therefore, affordability may not be strictly related to income. Spending priorities or a lower preference for public good could explain this phenomenon. Although urban green space may be valuable to people, some people may prioritise spending money on other areas, leading to a lack of personal budget for urban green space. Thus, the affordability limitation may not always imply low income. Higher-income people may choose other recreational pursuits than visiting public urban green space, reducing their willingness to support the less patronised urban green space venues. Notably, the context of the two studies was not identical. Yet, the willingness-to-pay

TABLE 4 Logistic regression model of respondents' positive and protest votes ($N = 316$)

	Socio-demographic model				Extended model			
	B	**SE**	**Significance**	**Odds ratio**	***B***	**SE**	**Significance**	**Odds ratio**
(constant)	0.884	0.810	0.275	2.420	0.294	1.251	0.814	1.341
Socio-demographic variables								
Education level	0.376	0.192	0.050	1.456	0.457	0.205	0.026	1.579
Age	−0.346	0.151	0.022	0.707	−0.327	0.155	0.035	0.721
Income	0.014	0.073	0.849	1.014	0.020	0.075	0.792	1.020
Perceived benefits								
Thermal environment					−0.405	0.319	0.205	0.667
Environmental and ecological					0.746	0.345	0.031	2.109
Recreation and general health					−0.090	0.275	0.743	0.914
Specific health					−0.381	0.201	0.058	0.683
Social					0.178	0.244	0.467	1.194
Perceived negative impacts								
Risk and hazards					−0.256	0.276	0.353	0.774
Road safety concerns					0.257	0.218	0.238	1.293
Health and sanitation concerns					0.158	0.216	0.466	1.171
Model testing								
Nagelkerke R^2	0.077				0.114			
Model χ^2	17.973, df = 3, $p < 0.001$				26.945, df = 11, $p < 0.01$			
Hosmer and Lemeshow test	7.848, df = 7, $p > 0.05$				9.217, df = 8, $p > 0.05$			
Classification accuracy	68.70%				68.00%			

for urban green space throughout the years generally has not improved, if not worsened, given the increased zero bids and a similar range of willingness-to-pay amount.

More educated respondents showed a higher probability of stating positive bids and greater willingness-to-pay among positive bids. Such relationships were consistent with Latinopoulos et al. (2016) and Song et al. (2015). On the other hand, age negatively influenced the tendency to report positive bids. This finding was similar to that established by Latinopoulos et al. (2016) and Vecchiato and Tempesta (2013), except that those two studies investigated the willingness-to-pay amount instead of the probability of a positive bid. By obtaining results consistent with other studies, our findings showed that the key socio-demographic variables continued to provide a limited explanation of the intention to pay.

The positive relationship between health and sanitation concerns and willingness-to-pay was particularly interesting. Results reported by Latinopoulos et al. (2016) suggested that the negative impacts of urban green space, including noise, crime, traffic, and littering, could reduce willingness-to-pay. On the other hand, our results suggested that when people perceived greater concerns about health and sanitation issues, they would be willing to pay more in the hope of bringing improvements. When used to assess the increase in well-being brought by improvements of an environmental good, willingness-to-pay is the monetary amount that an individual would give up to attain an increased level of utility (Venkatachalam, 2004). Past studies commonly explored the increase in utility from a relatively positive and value-added perspective. The adopted predictors were often positive, including functions, characteristics, or benefits of urban green space that would positively enhance urban green space value. However, our study provided an alternative to this conventional approach. The construct of perceived negative impacts can be used to assess the improvement of urban green space and increased level of utility by eliminating some inherently negative characteristics or problems of urban green space, which might have reduced urban green space value in the first place. This specific finding demonstrated that improvements made to solve a more serious problem perceived by respondents would cause a greater enhancement in the perceived utility level and, subsequently, the willingness-to-pay amount. For urban green space management and policymaking in Hong Kong, this finding implies

TABLE 5 Ordinal regression analysis of the relationship between willingness-to-pay (the dependent variable) and socio-demographic variables, perceived benefits, and perceived negative impacts ($N = 212$)

	B	SE	Wald	Significance	95% Confidence interval (lower, upper)
Socio-demographic variables					
Education level	0.600	0.184	10.665	0.001	(0.240, 0.961)
Age	−0.083	0.129	0.418	0.518	(−0.335, 0.169)
Income	0.091	0.063	2.055	0.152	(−0.033, 0.215)
Perceived benefits					
Thermal environment	−0.526	0.274	3.683	0.055	(−1.063, 0.011)
Environmental and ecological	0.786	0.303	6.737	0.009	(0.192, 1.379)
Recreation and general health	−0.089	0.240	0.136	0.712	(−0.559, 0.382)
Specific health	−0.277	0.170	2.647	0.104	(−0.61, 0.057)
Social	−0.172	0.209	0.674	0.412	(−0.582, 0.238)
Perceived negative impacts					
Risk and hazards	−0.123	0.238	0.267	0.605	(−0.59, 0.344)
Road safety concerns	0.152	0.185	0.669	0.413	(−0.212, 0.515)
Health and sanitation concerns	0.398	0.185	4.607	0.032	(0.035, 0.761)
Model testing					
Test of parallel lines	16.72, df = 33, $p = 0.992$				
Goodness-of-fit	1105.29, df = 1177, $p = 0.933$				
Nagelkerke R^2	0.111				

that urban green space development should focus on providing additional and improved positive features. Moreover, it should address the potential drawbacks concerning the expectations and demands of people on health and sanitation.

The promotional effect of perceived benefits on willingness-to-pay has been demonstrated in past studies (Latinopoulos et al., 2016; Song et al., 2015). In the present study, we took an additional step to differentiate the influences of various types of benefits. We found that perceived environmental and ecological benefits could determine crucially the increased probability of positive bids and willingness-to-pay amount. Our approach tested individual constructs of beneficial and negative impacts to reveal the interactions of specific features with willingness-to-pay, which might have been overlooked in the past when it was analysed as a single construct. Out of expectation, health and social benefits which were commonly identified and highlighted in studies on urban green space were found to be insignificant in predicting people's willingness-to-pay. This result implies that people are generally emphasising more on the nature-based aspects of urban green spaces in Hong Kong than the more human-oriented aspects. Such a stance could be attributed to the limited availability of nature-endowed spaces in Hong Kong's urban areas. The results provide clues about how and what particular aspects urban green space should be further developed and improved.

From a theoretical perspective, incorporating perceived benefits and perceived negative impacts as predictors into the conventional socio-demographic model was a successful attempt. The increase in the χ^2 and Nagelkerke R^2 in the extended logistic model indicated improved model fitness and predictive power. Chen et al. (2014) adopted a similar logistic model to assess willingness-to-pay for meadow restoration. The resulting R^2 values of their models were approximately 0.1–0.25, slightly higher than the present study. However, the perceived benefits and negative impacts constructs were newly developed and subjected to limited prior empirical tests. Therefore, the slight discrepancy in R^2 compared to the past study is acceptable and reasonable. From a broader perspective, this result demonstrated that psychological variables, in addition to traditionally adopted variables on park use and socio-demographics, could be used to predict and explain willingness-to-pay. Future studies may build upon the present models to investigate additional types of perceived benefits and negative impacts and provide more empirical evidence on the influence of these variables.

6 | CONCLUSION

This study assessed willingness-to-pay and the reasons for protest votes of individuals in Hong Kong regarding improvements in urban green space, and the relationship with perceived benefits and perceived negative impacts. Logistic and ordinal regression showed that some constructs of perceived benefits and negative impacts influenced both the probability of positive bids and willingness-to-pay level. Perceived environmental and ecological benefits were strong predictors in both analyses. The positive relationship between perceived health and sanitation concerns suggests that the willingness-to-pay for urban green space could be explored to alleviate negative impacts. The extended model with additional constructs showed improvements compared to past socio-demographic models, confirming the influence of perception and potentially other psychological variables on willingness-to-pay. Overall, then, this study has provided valuable information for the government in terms of the future development and management of urban green spaces in Hong Kong on multiple fronts. They include the changing trend in willingness-to-pay of Hong Kong citizens, the perceived importance of different benefits and impacts of urban green space, and thus the possible strategy to enhance people's enjoyment in urban green spaces with reference to such perceptions.

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CONFLICT OF INTEREST

The authors declare no known competing financial interests and personal relationships, directly or indirectly, that could have appeared to influence the work reported in this paper.

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Ethics approval of this study was given by the Human Research Ethics Committee of the University of Hong Kong on 15 March 2018 with reference number EA1803001.

DATA AVAILABILITY STATEMENT

Enquiries about availability of the research data can be directed to the corresponding author.

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