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Exploring public perceptions and support for green infrastructure funding mechanisms: a study of the Oxford–Cambridge Arc, England

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The uptake of green infrastructure is challenged by a lack of access to financing. Studies have investigated individuals' economic valuation of green infrastructure but understanding public perceptions of a range of potential funding mechanisms is a fundamental step in developing funding measures. Using data collected from a sample of residents in the Oxford–Cambridge Arc, England, this study addresses a gap in our understanding of public perceptions of green infrastructure funding by investigating support for several funding mechanisms, and the extent to which support is associated with attitudinal, contextual and personal capability variables. Results indicate that respondents prefer the funding of small and large-scale infrastructure to be covered by developers, with most opposition being levelled at those involving additional financial obligations from citizens. Altruistic-biospheric values, pro-environmental behaviour and trust in the government significantly affected support. These findings provide valuable insight to policymakers attempting to introduce sustainable green infrastructure funding streams.

Keywords: green infrastructure; public perceptions; funding mechanisms

1. Introduction

Green infrastructure refers to a network of natural and semi-natural features designed to deliver ecosystem services (European Environment Agency 2014). It can contribute to achieving climate change adaptation and mitigation goals (Foster, Lowe, and Winkelman 2011), and can address issues related to flooding, air quality, biodiversity and health and wellbeing (Connop *et al*. 2016). Despite the benefits, there are barriers to its widespread adoption, such as a need for better access to financing (Brown and Mijic 2019).

Local authorities are beginning to examine whether they can effectively fund green infrastructure by drawing on combinations of public, private and community funding sources (Mell 2017). However, the introduction of new funding mechanisms comes with its own set of challenges. Citizens may be wary of bearing the burden of the costs through measures such as increases in taxes or fees, particularly where any benefits are intangible or unquantifiable (Zuniga-Teran *et al*. 2019). They may also be

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cautious of the use of other measures, such as debt-financing which can pose additional financial risks to the community, as their taxes and fees would be used to meet the financial obligations (Bigger and Millington 2019). Concerns are also increasingly expressed as to whether infrastructure is being provided for the good of the people, or if the people simply provide funding through taxes for the benefit of institutional investors (O'Brien, O'Neill, and Pike 2019).

The work reported below explores public support for a variety of green infrastructure funding mechanisms to better understand both the distribution of support across a range of mechanisms and the underpinning motivations for support. Improved appreciation of these features of green infrastructure funding can inform the design of more acceptable and sustainable financing mechanisms. The first objective of the study is to investigate public stakeholders' willingness to support a variety of mechanisms used to fund green infrastructure, which differ with respect to the source of the funding and the stakeholder group responsible for contributing the funds. Since green infrastructure provision and benefits can vary on different spatial scales, we investigate support for mechanisms used to fund small-scale neighbourhood level green infrastructure and larger regional green infrastructure.

Research in this area has mostly focused on understanding individuals' willingness to pay for green infrastructure and its services. While these studies provide an insight into the values placed on green infrastructure and associated ecosystem services, research conducted on non-market economic valuation tends to have different aims than studies that investigate stakeholders' preferences (Ferreira *et al*. 2021). If an individual is unwilling to pay through a particular mechanism, it does not indicate that they are opposed to attempts to raise funds for an infrastructure option, but they may have different perceptions and preferences for the most appropriate way to fund it (Yusuf *et al*. 2015). It is valuable to investigate individual preferences for a range of mechanisms to better understand their perceptions of how the infrastructure should be funded and by whom. Understanding public perceptions in this regard is key to developing sustainable infrastructure financing policies.

There is also an emerging stream of literature that investigates stakeholders' preferences related to green infrastructure, which focus on their perceptions of green infrastructure's benefits (Miller and Montalto 2019) and value (van Vliet and Hammond 2021), the challenges faced in its implementation (Rall, Kabisch, and Hansen 2015, Bissonnette *et al*. 2018) its design (Tsantopoulos *et al*. 2018) and who should be responsible for its implementation (Ferreira *et al*. 2021). However, there is little evidence of stakeholders' perceptions of green infrastructure financing. We contribute to populating this knowledge through the study's first objective.

The second objective is to investigate the determinants of support for funding mechanisms, which can be classified as a type of environmentally significant behaviour. The Attitude-Behaviour-Context Framework suggests three categories of variables that influence pro-environmental behaviour (Stern 2000); attitudinal variables which include values and beliefs, personal capability variables which include socio-demographic characteristics, and contextual variables which include social, economic and political factors. While this has been explored empirically in the context of environmental policies, due to the limited research on support for green infrastructure funding mechanisms, little is known about the determinants of this support. By using the Attitude-Behaviour-Context Framework as a framework of potential variables, we investigate how these variables play a role in influencing individuals' support, thereby allowing us to address this gap.

Below, we investigate public perceptions of green infrastructure funding by using a survey distributed to a representative sample of residents ($N = 400$) within a well-bounded region in the south of England, the Oxford–Cambridge Arc. We respond to two research questions (i) to what extent will residents support alternative green infrastructure funding mechanisms for neighbourhood scale and regional scale green infrastructure projects, and (ii) what attitudinal, contextual and personal capability variables influence support. This research will complement several aspects of the literature on public perceptions of green infrastructure funding, and the drivers of pro-environmental behaviour. The results will also provide valuable insight for policymakers who are attempting to develop sustainable funding streams for green infrastructure.

2. Funding green infrastructure

Given the importance of green infrastructure but increasing lack of clarity over how it should be funded and by whom, there is a growing body of literature that examines the key actors and mechanisms associated with its funding. First, it is possible for mechanisms to be categorised based on whether they were led by the local planning authority (LPA), proposed and sanctioned by local communities, and led by developers, or associated with private or commercial sector funding (Mell 2017). Mechanisms that are led by local authorities could include local taxation through council taxes and business rates, although these may be unpopular with local residents and businesses (Mell 2017).

In a review of financing barriers for urban nature-based solutions, Toxopeus and Polzin (2021) confirm that financing green infrastructure is traditionally seen as the responsibility of the local government, and while these are public goods it is difficult for the local governments to utilise measures such as local taxation because citizens typically have a low willingness to pay. However, it is possible that fundraising among residents could be successful in areas with higher household income (Toxopeus and Polzin 2021). A study on green infrastructure financing in the United States also suggested that the main actors involved in funding green infrastructure, specifically stormwater infrastructure, are municipalities and local governments, who tend to use mechanisms such as stormwater utility fees (Cousins and Hall 2021). This type of mechanism, similarly to taxation, requires an increase in direct funding from residents, so governments may be wary of increasing stormwater fee rates (Cousins and Hall 2021).

As an alternative to local taxation and fees, it was found that local governments in the UK have the options of using mechanisms such as S106 agreements, which are agreements between LPAs and developers about measures developers must take to reduce their impact on the community; community infrastructure levies (CIL) or charges levied by local authorities on new development in their area; and commuted sums from developers through planning obligations (Mell 2017). Therefore, instead of placing the financial burden on residents and businesses, these mechanisms involve developer contributions. Developers who were interviewed for a study on stakeholder perspectives of green infrastructure funding indicated that to gain planning consent and present their developments as having good ecological benefits, they have begun designing green infrastructure into their developments and investment plans (Mell 2021). They also identified that green infrastructure could be used as a marketing tool for their businesses and developments (Mell 2021), which highlights that even if local authorities impose mechanisms that place the responsibility for green infrastructure on developers, they can potentially benefit from this.

Mechanisms such as green bonds are increasingly being considered as potential alternatives (Frantzeskaki *et al*. 2019). In the United States, municipalities have started experimenting with financial measures such as tax increment financing and mitigation banking, in addition to green bonds as mechanisms to borrow money to finance stormwater management infrastructure (Cousins and Hall 2021). However, these types of mechanisms create financial risks, which can have impacts on residents as they are now exposed to these risks through their payment of water fees (Cousins and Hall 2021). Local authorities in the UK have been experimenting with public sector investment-based crowdfunding. For example, Swindon Borough Council issued the UK's first local authority bonds that raised funding from their residents to develop two solar parks, and other local authorities have been conducting feasibility studies to determine whether they could use this type of crowdfunding to finance their infrastructure projects (Davis 2019). These can potentially be used for green infrastructure funding. Some cities around the world have been considering co-financing green infrastructure between key actors (Tubridy 2020). There is also potential for co-funding and partnerships (O'Donnell, Lamond, and Thorne 2017) and the use of a mix of mechanisms, e.g. where the shortfall of funding from the use of fee systems can be made up by using bonds and other debt-financing measures (Cousins and Hall 2021).

Additional local authority led mechanisms include the sale of assets, park trusts and endowments. Although much of the responsibility falls on local governments to implement financing mechanisms, mechanisms led by other stakeholders have also been discussed in the literature. These include community-led mechanisms such as community asset transfer, guerilla gardening and informal greening/management and private investment, which include funding through corporate sponsorship, sale and endowment and private management for public use (Mell 2017).

The mechanisms outlined above have a different set of costs and benefits for a range of stakeholders, so deciding on the best options requires taking all of these into consideration. Along with considering the opportunities and challenges associated with each mechanism, the type of mechanism used may also be dependent on the nature and scale of the green infrastructure project being funded. Mell and Whitten (2021) provide a detailed analysis of the types of green infrastructure, along with the scale of the investment and type of funder associated with funding each. The research found that there is a lack of sustainable funding for larger and more public green infrastructure, such as public gardens and river corridors and water bodies, while more sustainable funding sources are available for smaller projects such as green walls and roofs.

Within the broader literature related to green infrastructure funding, several studies have investigated perceptions of stakeholder responsibility for funding green infrastructure. Most residents in a Florida-based study believed the funds for a regional river restoration project should come mostly from the state government, followed by the federal and local governments (Jones and Bi 2020). Only 10% suggested it should come from state residents, and 6% from local businesses. Ferreira *et al*. (2021) also reported that residents believe green infrastructure implementation is the responsibility of the government.

There is a subsection of research, which focuses on specific stakeholders' willingness to pay for green infrastructure and its services through specific payment vehicles. One study in particular conducted a review of 85 studies that investigated willingness to pay for green infrastructure (Venkataramanan *et al*. 2020). They found that among the studies that used descriptive questions to elicit willingness to pay, a large

percentage of respondents indicated that they were not willing to pay any amount. When studies used payment mechanisms such as housing expenses, it was found that, in Portugal, owners and tenants had a relatively low willingness to pay for green roofs and green walls through monthly housing expenses (Teotonio *et al*. 2020). In the UK, individuals were willing to pay up to 2% more in monthly rent or mortgage payments for high quality green infrastructure in their area (Mell *et al*. 2016). This willingness to pay was influenced by age and educational status; and willingness to pay was higher for infrastructure that is more visibly greener and functional.

When investigating willingness to pay through mechanisms such as taxes and tariffs, one study revealed that there was a willingness to pay for natural-based solutions for coastal flood protection through an increase in council taxes, but environmental education and direct contact with the object of study were important in gaining support (Rendon, Sandorf, and Beaumont 2022). For constructing sponge-cities or city-scale integrated SUDS, the public was willing to pay for government-issued credit securities and an increase in water tariffs, but they believed that government grants and public-private partnerships should be the main source of funding (Wang, Sun, and Song 2017).

Overall, the act of supporting a mechanism used to fund green infrastructure, or being willing to pay to fund it, can be classified as a type of environmentally significant behaviour (Stern 2000), and there is also a large body of research that investigates individuals' willingness to support environmental policies and the reasons behind their support or opposition (Drews and van den Bergh 2015, Rhodes, Axsen, and Jaccard 2017).

3. Methodology

3.1. Study area

The study was conducted in the Oxford–Cambridge Arc region, an area that comprises the counties of Bedfordshire, Buckinghamshire, Cambridgeshire, Northamptonshire and Oxfordshire. It has been one of the fastest growing economic areas in England over the past 20 years. Across the Arc, one of the main areas of concern is climate change and the natural environment, which currently faces several challenges such as poor air quality and high and growing flood risk. It is feared that the growth the region faces will cause even more harm to the natural environment and ecosystem services (Ministry of Housing, Communities & Local Government 2021).

Currently, the area in the Arc contains a high proportion of versatile agricultural land (ITRC 2020). However, the intensive agriculture limits the environment in the Arc from providing opportunities for people to interact with nature through various activities that have benefits to health and wellbeing. While there are a few woodlands, large parks and nature reserves, it has been suggested that there is a need for smaller, more local urban green spaces throughout the region (ITRC 2020). Except for a few woodlands in the region, the environment in the Arc also has a limited ability to protect against flooding (ITRC 2020), therefore highlighting the need for greater green infrastructure investment.

The Arc provides a suitable case study to investigate public perceptions of green infrastructure funding mechanisms, since the environment is currently an area of concern and since there have been calls for the government to work with local authorities to ensure that new settlements are strategically linked with investment in green

infrastructure (National Infrastructure Commission 2017). To fund this new infrastructure, they may be looking to identify new financing sources. Understanding public perceptions of green infrastructure funding mechanisms in the Arc is therefore a relevant and timely topic, as it could provide insight into suitable mechanisms that can be introduced.

3.2. Data collection

The data were collected using an online survey, which was accessible to respondents from December 2021 to January 2022. Survey design and deployment was approved by the relevant university ethics board. The survey took approximately 10 minutes to complete during pre-survey testing and respondents were recruited via the Qualtrics platform. Respondents were remunerated for their participation at the standard rate used by the survey platform operator. It has been found that incentives increase individuals' motivation to complete surveys by either activating the norms of reciprocity or by compensating for the barriers that could prevent their participation, such as cost or time (Stähli and Joye 2016). Related studies have shown that incentives can increase response rates in all survey modes (Lipps *et al*. 2019).

Although Internet-based panels are useful for collecting survey data, as they are cost-effective, quick and offer access to large and diverse samples, the one issue with online panels is data integrity and poor-quality responses (Hays, Liu, and Kapteyn 2015). We experienced some of these limitations, as there were a few completed surveys in which individuals did not accurately or sufficiently answer the open-ended questions. To control for these drawbacks, quality control measures were introduced, such as the use of speed checks which excluded individuals who completed the survey in under seven minutes, and the exclusion of respondents who provided incomplete or insufficient responses to the open-ended questions.

Another limitation of online surveys is that individuals self-select into the survey and the respondents are therefore limited to those who decide to participate for various reasons, such as interest in the topic, or financial incentives. If respondents were motivated by the financial incentives provided by completing the survey, it is possible that this could have resulted in a sample that has a lower average income than if we conducted a random sample of the same area. However, since we did not collect information on respondents' income levels, it is difficult to conclude whether this is the case. Since it is not possible to know the reasons or motives for their decisions to participate, it is difficult to understand whether there is any bias in their responses. Therefore, based on these limitations, among others, it is said that online survey results should be regarded as tentative (Andrade 2020). However, online surveys are still increasingly popular, as they provide an easy and inexpensive method of data collection, and if the sample is representative of the population, it is still possible to generalise the results to some extent (Andrade 2020).

The data were collected using quotas to achieve a representative sample based on age and gender so that the sample reflects these key socio-demographic characteristics of the wider population, which are known to be associated with pro-environmental behaviour (Alcock *et al*. 2020). Table 1 shows the descriptive statistics for the sample by age, gender and county compared to the population.

The demographics of the survey are mostly representative of citizens in the Oxford–Cambridge Arc region. There is a slight over-representation of the 55 and over

Table 1. Socio-demographic characteristics of respondents and population.

Variables	Population	Survey Sample
Age		
18–24	11%	8%
25–34	19%	19%
35–44	18%	19%
45–54	20%	20%
55+	32%	34%
Gender		
Male	49%	47%
Female	51%	53%
County		
Bedfordshire	14%	17%
Buckinghamshire	16%	23%
Cambridgeshire	27%	27%
Northamptonshire	15%	22%
Oxfordshire	28%	13%

age group, and under-representation of the 18 to 24 age group. Using a Pearson Chi-Square Test to compare observed frequencies to expected frequencies, we found that the proportions for age (Pearson Chi2 = 2.6352; $p = 0.621$), gender (Pearson Chi2 = 0.5543; $p = 0.457$) are not significantly different from the population. There is a slight over-representation of respondents from Buckinghamshire and Northamptonshire, whereas there is an under-representation of respondents from Oxfordshire. Using the Pearson Chi-Square (Pearson Chi2 = 55.5237; $p = 0.000$), it was found that the county-by-county distribution of the sample is statistically different from the distribution of the population.

3.3. Survey design

The online survey was designed and organised in seven sections. Section 1 consisted of questions related to respondents' socio-demographic characteristics. In this section, we included screening questions to ensure that respondents were from the target area, that we met the age and gender quotas. Section 2 provided respondents with an introduction to the study and the following description of green infrastructure; a description of sustainable urban drainage systems (SUDS) and its purpose and examples of different types.

Green infrastructure can vary by scale so as part of the survey we differentiated between the scales of provision so we could determine whether individuals' sense of place motivates their support for different mechanisms. Respondents were therefore provided with a description of small-scale green infrastructure and examples, followed by a description of large-scale green infrastructure projects and examples. Respondents were then asked questions related to the perceived benefits and challenges of green infrastructure with open-ended questions followed by rank order questions from a pre-determined list of benefits and challenges. The full outline of Section 2 which describes the information that respondents were given is provided in Appendix A (online supplemental material).

Sections 3 and 4 consisted of questions related to respondents' perceptions of funding mechanisms for small-scale and large-scale green infrastructure projects

Table 2. Green infrastructure funding mechanisms investigated.

Funder	Mechanism
Local Authority/ Council Taxpayer Funding	An increase in council taxes in the area
Local Authority/ Community Investor Funding	A bond issued to investors in the community through a crowdfunding platform
Water Companies/ Customers	An increase in water service tariffs
Local Authority/ Businesses Funding	A levy on local business that benefit from the proximity of the project
Local Authority/ Developer Funding	A levy on housing developments in the area which create new or additional internal area
Local Authority/ Institutional Investor Funding	A green bond issued to investors such as pension funds, banks and insurance companies
National Government/ Taxpayer Funding	The local authority should wait for funding from the national government

respectively. Respondents were provided with hypothetical scenarios which described the type of projects being funded and their scale (e.g. SUDS installed throughout their community or a regional waterway in the centre of the Oxford–Cambridge Arc). It also described the benefits of the projects, and the groups that will benefit from the projects (e.g. the respondents' neighbourhood or the wider Oxford–Cambridge Arc region). The full description of Sections 3 and 4 are provided in Appendix A (online supplemental material).

Following each scenario description, respondents were provided with a list and description of potential funding mechanisms and were asked to what extent they would support the use of each mechanism to fund the project using a Likert Scale. The mechanisms that were investigated are shown in Table 2, along with the descriptions that were provided. We chose a range of mechanisms which varied by the stakeholder group responsible for contributing the funds.[1]

In Sections 5 and 6, respondents were asked questions related to their environmental engagement and activism, their trust in key actors who will potentially deliver green infrastructure projects (e.g. national and local government, water utility). In Section 7, respondents were asked questions designed to expose their biospheric, egoistical and altruistic values. These questions were adapted from previous studies and are shown in Appendix B (online supplemental material).

3.4. Empirical approach

All data analysis was conducted using Stata/SE 17.0 software. We used descriptive statistics to assess individuals' willingness to support each of the seven mechanisms used to fund small and large-scale green infrastructure. We had fourteen variables measuring willingness to support seven mechanisms for two project scales. We measured respondents' willingness to support each mechanism by using a 5-point Likert Scale. Responses were coded as follows: strongly oppose = 1, somewhat oppose = 2, neither support nor oppose = 3; somewhat support = 4 and strongly support = 5.

The second research question was to determine what attitudinal, contextual and personal capability variables influence individuals' support for different mechanisms. Since the variables used to measure support are ordinal, the most suitable regression

model is an ordered logit model, as this estimates the relationship between an ordinal dependent variable and the independent variables. The ordered logit is set up as follows:

$$y_i^* = \beta' x_i + \varepsilon_i$$

In the equation, y_i^* is the unobserved dependent variable, which for the purpose of this study represents respondents' level of support for green infrastructure funding mechanisms. x_i represents a vector of explanatory variables, β' is the unknown parameter vector of regression coefficients and ε_i is the error term. Since we cannot observe y_i^*, we can only observe the following categories of responses, where μ represents unknown parameters to be estimated with β' which are thresholds or cut-off points between the categories.

$$\begin{aligned} y_i &= 1 \ \textit{if} \ y_i^* \leq \mu_1 \\ &= 2 \ \textit{if} \ \mu_1 < y_i^* \leq \mu_2 \\ &= 3 \ \textit{if} \ \mu_2 < y_i^* \leq \mu_3 \\ &= 4 \ \textit{if} \ \mu_3 < y_i^* \leq \mu_5 \\ &= 5 \ \textit{if} \ \mu_4 \leq y_i^* \end{aligned}$$

The independent variables used in the regression are described in Table 3. The descriptive statistics for all variables are shown in Appendix C (online supplemental material).

In line with the Attitude-Behaviour-Context Framework, we included variables that represented individuals' attitudes, specifically their biospheric, altruistic and egoistic values, and their pro-environmental engagement behaviour. For the engagement ($\alpha = 0.8927$), biospheric ($\alpha = 0.9017$), altruistic ($\alpha = 0.8859$) and egoistic ($\alpha = 0.8861$) variables, we computed Cronbach's alpha to determine whether the questions asked to construct each variable measured the same factors and there was internal consistency. Since for each variable the Cronbach's alpha exceeds 0.70 all variables measuring the given constructs are valid.

For the contextual variables, we included a variable measuring trust in the government, which consisted of trust in the national government and trust in the local government ($\alpha = 0.8300$). We also included variables that represented whether an individual was a homeowner and businessowner. We considered that homeowners and business owners would be more willing to support several funding mechanisms compared to non-homeowners and non-business owners, as green infrastructure nearby could lead to greater benefits for these groups, such as increases in land and property values, attraction and retention of more motivated staff, increased productivity, increased tourism, among others (Natural Economy Northwest 2008).

We also include personal capability variables in the form of socio-economic and demographic variables. One demographic variable includes the county in which the individual lives. However, the survey sample was not representative of the population with respect to this variable. In reflecting on the implication of this issue, we distinguish between implications for estimation of our model parameters and then on the appropriateness of their interpretation, given they are estimated on data which may have over representation from some groups in the population relative to others. With respect to the first issue – implications for estimation of our parameters – we consider there could be some sort of clustering given the skewed representation. In line with the literature on robust estimation in econometrics in the face of an undefined

Table 3. Description of independent variables.

Independent Variables	Definition
Attitudinal	
Biospheric	Scale of 1 to 5 representing how closely the biospheric values represented the individual
Altruistic	Scale of 1 to 5 representing how closely the altruistic values represented the individual
Egoistic	Scale of 1 to 5 representing how closely the egoistic values represented the individual
Pro-Environmental Engagement	Scale of 1 to 5 representing how likely individuals are to participate in pro-environmental activities
Contextual	
Trust in Government	Scale of 1 to 10 representing individuals' trust in the government to make reasonable use of revenue from taxes and fees.
Homeowner	1 if the respondent is a homeowner; 0 otherwise
Business Owner	1 if respondent is a business owner; 0 otherwise
Personal Capability	
Age	Categorical Variable – Reference: 18–24 years Categories: 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65+ years
Gender	0 if female; 1 if male
Location type	Categorical Variable – Reference: City Categories: Urban, Peri-Urban, Rural
County	Categorical Variable – Reference: Bedfordshire Categories: Buckinghamshire, Cambridgeshire, Northamptonshire, Oxfordshire

correlation structure (e.g. Greene (2017)), we adopt robust standard errors in our estimation, but do not change the estimator. With respect to the second issue – implications for interpretation of our model parameters – we reflect that we are interested in interpretation of the marginal influence of each variable, after – importantly – controlling for the influence of demographic factors, as opposed to making predictions for the aggregate population i.e. not conditioning on demographic factors. We consider that this conditional inference (conditional on demographic factors included in the model) remains valid even when we have a sample which is skewed to certain demographics.

Following the ordered logit regressions, we estimated predicted probabilities to further understand the regression models. We investigated whether individuals' possession of different characteristics significantly increases the probability that they would support a particular mechanism.[2] In calculating the predicted probabilities, for the attitudinal variables (biospheric, altruistic, egoistic and engagement) we varied the level of the variables and compared individuals who were at the medium level[3] to individuals who were at the high level for each variable (e.g. those who had a biospheric score of 3 versus a biospheric score of 5), while holding the other independent variables at the mean value. For the contextual variables, we varied the level of the trust variable and compared those who identified that they were in category 5 compared to those who suggested that they had high levels of trust and were in category 10. We also investigated the differences in predicted probabilities of homeowners and business owners compared to those who were neither. We tested to determine whether the differences

in predicted probabilities of support given a change in characteristic levels were statistically significant.

4. Results

Figure 1 shows the results of a descriptive analysis of levels of support for fourteen green infrastructure funding mechanisms. Out of the 14 mechanisms, 9 are supported by most respondents (at least 50% of respondents 'somewhat support' or 'strongly support' the use of the mechanism). The highest level of support was observed for developer levies for both small and large-scale green infrastructure (66% and 64%). For small-scale funding, the subsequent mechanisms that were also highly supported were debt financing mechanisms such as green bonds and community investment bonds (56% each). For large-scale funding, the other mechanisms that were highly supported were national government funding and local business levies (57% each).

As expected, mechanisms that required more direct funding from citizens were met with the most opposition (i.e. those who were 'somewhat opposed' and 'strongly opposed'). 46% and 39% opposed the use of water service tariff increases for small- and large-scale infrastructure respectively, and only 30% and 33% supported it. For funding small- and large-scale projects through an increase in council taxes, 47% and 50% were opposed, while only 30% and 26% supported it.

Tables 4 and 5 show the results of the ordered logit regressions. We interpret the coefficients as the effect of a change in the independent variable on the likelihood or log of odds of an individual being in a higher category of support for the funding mechanism.

Tables 6 and 7 provide the results of the predicted probabilities based on the ordered logit regressions. This allows us to gain further insights into what groups of people with specific characteristics may be more likely to support what mechanism.

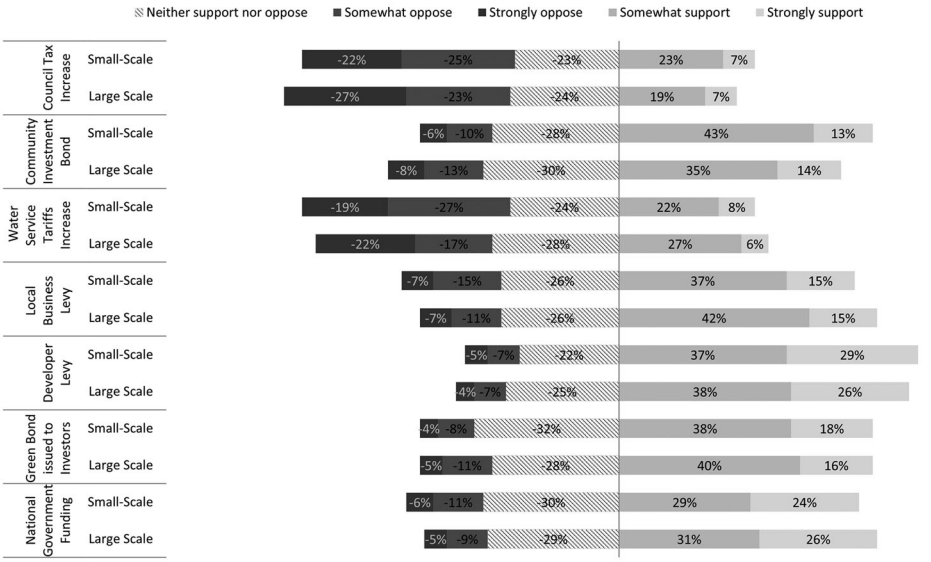

Figure 1. Support for funding mechanisms.

Table 4. Ordered logit results – marginal effects – small-scale.

Variables	Council Tax	Water Tariff	Comm. Bond	Green Bond	Business Levy	Dev. Levy	Gov. Funding
Attitudinal							
Biospheric	0.039	−0.036	0.212	0.373**	0.277	0.353*	0.177
(Scale of 1 to 5)	(0.162)	(0.159)	(0.162)	(0.372)	(0.185)	(0.189)	(0.157)
Altruistic	0.045	−0.029	0.263	0.323*	0.272	0.312	0.486***
(Scale of 1 to 5)	(0.161)	0.154	(0.172)	(0.189)	(0.187)	(0.193)	(0.169)
Egoistic	0.290**	0.306***	−0.011	−0.144	0.151	−0.218*	0.177
(Scale of 1 to 5)	(0.117)	(0.119)	(0.124)	(0.127)	(0.121)	(0.117)	(0.108)
Engagement	0.398**	0.483***	0.417***	0.431***	0.356**	0.300**	0.233**
(Scale of 1 to 5)	(0.165)	(0.156)	(0.142)	(0.144)	(0.139)	(0.149)	(0.132)
Contextual							
Trust	0.217***	0.250***	0.082	0.099**	0.118**	0.068	−0.016
(Scale of 1 to 10)	(0.053)	(0.052)	(0.053)	(0.049)	(0.049)	(0.051)	(0.047)
Homeowner	0.022	0.109	−0.224	−0.183	0.058	−0.086	−0.299
(Ref. not homeowner)	(0.212)	(0.198)	(0.022)	(0.211)	(0.207)	(0.214)	(0.207)
Business Owner	−0.147	−0.353	−0.494*	0.051	−0.616**	−0.284	−0.194
(Ref. not businessowner)	(0.243)	(0.262)	(0.275)	(0.261)	(0.265)	(0.278)	(0.278)
Personal Capability							
Age (Ref.18–24 years)							
25–34 years	0.289	−0.149	0.355	0.236	−0.266	−0.022	−0.215
	(0.325)	(0.326)	(0.390)	(0.394)	(0.411)	(0.420)	(0.403)
35–44 years	0.517	0.073	0.341	0.575	−0.069	0.481	−0.429
	(0.334)	(0.332)	(0.408)	(0.408)	(0.422)	(0.436)	(0.401)
45–54 years	0.312	−0.092	0.472	1.060***	0.205	0.787*	0.004
	(0.357)	(0.328)	(0.411)	(0.412)	(0.433)	(0.448)	(0.415)
55–64 years	0.236	−0.462	−0.126	0.388	−0.287	1.182**	−0.067
	(0.353)	(0.350)	(0.410)	(0.409)	(0.451)	(0.457)	(0.407)
65+ years	0.342	−0.272	0.383	0.887*	0.316	1.582***	−0.784*
	(0.433)	(0.424)	(0.439)	(0.479)	(0.523)	(0.515)	(0.474)
Male	−0.046	0.167	0.075	0.183	0.094	0.175	0.204
	(0.203)	(0.210)	(0.207)	(0.209)	(0.214)	(0.212)	(0.204)

(*Continued*)

Table 4. (*Continued*).

Variables	Council Tax	Water Tariff	Comm. Bond	Green Bond	Business Levy	Dev. Levy	Gov. Funding
Location Type (Ref. City)							
Urban	−0.705***	−0.361	−0.241	−0.442	−0.239	−0.416	−0.603**
	(0.239)	(0.232)	(0.264)	(0.273)	(0.260)	(0.289)	(0.291)
Peri-Urban	−0.028	−0.107	−0.235	0.085	−0.068	−0.437	−0.601*
	(0.290)	(0.268)	(0.303)	(0.309)	(0.336)	(0.328)	(0.313)
Rural	−0.412	−0.077	−0.027	−0.226	−0.007	−0.138	−0.543*
	(0.294)	(0.291)	(0.292)	(0.315)	(0.321)	(0.336)	(0.290)
County (Ref. Bedfordshire)							
Buckinghamshire	−0.116	0.162	0.182	0.543*	0.665**	0.544	−0.375
	(0.348)	(0.301)	(0.317)	(0.323)	(0.337)	(0.332)	(0.313)
Cambridgeshire	0.075	−0.085	−0.177	−0.004	0.057	−0.059	−0.313
	(0.296)	(0.273)	(0.316)	(0.291)	(0.321)	(0.314)	(0.309)
Northamptonshire	−0.087	0.036	0.182	0.137	0.305	−0.075	−0.171
	(0.327)	(0.318)	(0.337)	(0.323)	(0.352)	(0.321)	(0.304)
Oxfordshire	0.364	0.868	−0.042	0.035	0.104	−0.049	−0.315
	(0.352)	(0.351)	(0.368)	(0.339)	(0.359)	(0.374)	(0.369)
N	392	392	392	392	392	392	392
Chi2	102.25***	105.37***	68.93***	84.36***	71.67***	96.24***	66.35***

Notes: Statistical significance at ***1%, **5%, *10.
Robust Standard Errors in brackets.

Table 5. Ordered logit results – marginal effects – large-scale.

Variables	Council Tax	Water Tariff	Comm. Bond	Green Bond	Business Levy	Dev. Levy	Gov. Funding
Attitudinal							
Biospheric	−0.044	−0.041	0.153	0.251	0.187	0.457 **	0.157
(Scale of 1 to 5)	(0.157)	(0.159)	(0.154)	(0.160)	(0.173)	(0.185)	(0.172)
Altruistic	−0.096	−0.063	0.157	0.200	0.349 *	0.141	0.151
(Scale of 1 to 5)	(0.162)	(0.164)	(0.180)	(0.178)	(0.192)	(0.192)	(0.176)
Egoistic	0.238 ***	0.212 *	0.074	−0.084	0.143	−0.171	0.014
(Scale of 1 to 5)	(0.116)	(0.120)	(0.117)	(0.125)	(0.117)	(0.129)	(0.109)
Engagement	0.594 ***	0.533 ***	0.471 ***	0.498 ***	0.446 ***	0.323 **	0.178
(Scale of 1 to 5)	(0.167)	(0.151)	(0.144)	(0.141)	(0.143)	(0.146)	(0.129)
Contextual							
Trust	0.231 ***	0.179 ***	0.049	0.070	0.113 **	0.031	0.035
(Scale of 1 to 10)	(0.053)	(0.058)	(0.054)	(0.051)	(0.054)	(0.048)	(0.053)
Homeowner	0.176	0.252	−0.251	0.086	−0.109	0.089	−0.037
(Ref. not homeowner)	(0.215)	(0.207)	(0.221)	(0.218)	(0.209)	(0.208)	(0.218)
Business Owner	−0.346	−0.362	−0.493 *	−0.573 **	−0.330	−0.254	−0.277
(Ref. not businessowner)	(0.255)	(0.264)	(0.253)	(0.242)	(0.252)	(0.248)	(0.264)
Personal Capability							
Age (Ref. 18–24 years)							
25–34 years	0.305	−0.008	0.606	−0.023	0.037	0.689 *	−0.058
	(0.362)	(0.392)	(0.442)	(0.361)	(0.448)	(0.391)	(0.356)
35–44 years	0.212	−0.033	0.418	0.455	−0.064	0.798 **	−0.178
	(0.264)	(0.387)	(0.446)	(0.361)	(0.413)	(0.394)	(0.343)
45–54 years	0.284	−0.163	0.868 *	0.866 **	0.016	1.065 ***	0.083
	(0.402)	(0.407)	(0.454)	(0.394)	(0.447)	(0.415)	(0.373)
55–64 years	0.191	−0.422	0.115	0.209	−0.063	1.193 ***	0.264
	(0.411)	(0.418)	(0.457)	(0.383)	(0.457)	(0.417)	(0.390)
65+ years	0.425	−0.453	0.734	0.490	0.645	1.709 ***	−0.529
	(0.527)	(0.473)	(0.200)	(0.500)	(0.502)	(0.483)	(0.487)
Male	0.316	0.333 *	0.428 **	0.143	0.157	0.134	−0.065
	(0.207)	(0.199)	(0.202)	(0.210)	(0.213)	(0.208)	(0.202)

(*Continued*)

Table 5. (*Continued*).

Variables	Council Tax	Water Tariff	Comm. Bond	Green Bond	Business Levy	Dev. Levy	Gov. Funding
Location Type (Ref. City)							
Urban	−0.578 **	−0.341	−0.517 *	−0.677 **	−0.453 *	−0.615 **	−0.444 *
	(0.257)	(0.253)	(0.273)	(0.268)	(0.250)	(0.265)	(0.261)
Peri-Urban	−0.377	−0.296	0.072	−0.289	−0.251	−0.562	−0.592 **
	(0.311)	(0.306)	(0.322)	(0.298)	(0.327)	(0.347)	(0.300)
Rural	−0.629 **	−0.379	−0.042	−1.065 ***	−0.041	−0.410	−0.275
	(0.300)	(0.314)	(0.309)	(0.320)	(0.303)	(0.322)	(-.307)
County (Ref. Bedfordshire)							
Buckinghamshire	−0.135	0.074	0.202	0.727 **	0.399	0.656 **	0.208
	(0.312)	(0.298)	(0.341)	(0.314)	(0.338)	(0.310)	(0.334)
Cambridgeshire	0.342	0.237	−0.092	0.482	−0.113	−0.013	−0.153
	(0.294)	(0.296)	(0.312)	(0.103)	(0.299)	(0.274)	(0.290)
Northamptonshire	0.206	0.046	0.080	0.596 *	0.259	0.121	0.122
	(0.325)	(0.332)	(0.334)	(0.311)	(0.322)	(0.305)	(0.314)
Oxfordshire	0.657 **	0.992 ***	−0.006	0.429	−0.149	−0.108	−0.037
	(0.333)	(0.373)	(0.362)	(0.331)	(0.391)	(0.333)	(0.354)
N	392	392	392	392	392	392	392
Chi2	111.54 ***	91.93 ***	65.58 ***	85.04 ***	71.61 ***	70.13 ***	29.30 ***

Notes: Statistical significance at ***1%, **5%, *10.
Robust Standard Errors in brackets.

Table 6. Predicted probabilities for attitudinal and contextual variables – small-scale.

	Biospheric			Altruistic			Egoistic			Engagement		
Somewhat Support	3	5	Chi2	3	5	Chi2	3	5	Chi2	3	5	Chi2
Council Tax	0.232	0.241	0.06	0.231	0.245	0.08	0.247	0.347	6.02**	0.227	0.361	5.73**
Water Tariff	0.214	0.203	0.05	0.213	0.204	0.04	0.219	0.317	6.11*	0.197	0.351	9.05***
Community Bond	0.444	0.504	1.83	0.433	0.509	2.49	0.472	0.469	0.01	0.462	0.543	21.08***
Green Bond	0.397	0.475	5.58**	0.339	0.471	3.12*	0.436	0.396	0.99	0.431	0.481	12.13***
Business Levy	0.379	0.452	2.49	0.377	0.45	2.25	0.419	0.454	2.37	0.407	0.476	13.41***
Developer Levy	0.435	0.438	0.09	0.436	0.443	0.32	0.446	0.421	1.13	0.446	0.428	0.62
National Tax	0.317	0.345	1.37	0.284	0.356	8.01***	0.334	0.353	7.02***	0.328	0.355	5.44**
	Trust			Homeowner			Business Owner					
Somewhat Support	5	10	Chi2	0	1	Chi2	0	1	Chi2			
Council Tax	0.232	0.411	17.06***	0.235	0.239	0.01	0.242	0.219	0.38			
Water Tariff	0.204	0.399	22.12***	0.199	0.215	0.31	0.219	0.17	2.03			
Community Bond	0.471	0.522	3.64*	0.492	0.459	1.08	0.486	0.406	2.75*			
Green Bond	0.438	0.478	7.76**	0.453	0.431	0.79	0.439	0.444	0.04			
Business Levy	0.413	0.472	10.85***	0.411	0.418	0.08	0.431	0.337	4.58**			
Developer Levy	0.447	0.442	0.18	0.448	0.447	0.15	0.448	0.439	0.539			
National Tax	0.332	0.325	0.11	0.345	0.322	2.17	0.334	0.317	0.42			

Table 7. Predicted probabilities for attitudinal and contextual variables – large-scale.

	Biospheric			Altruistic			Egoistic			Engagement		
Somewhat Support	3	5	Chi2	3	5	Chi2	3	5	Chi2	3	5	Chi2
Council Tax	0.189	0.177	0.08	0.196	0.171	0.36	0.191	0.263	3.62*	0.171	0.351	11.29***
Water Tariff	0.273	0.258	0.07	0.277	0.255	0.15	0.275	0.353	3.02*	0.251	0.443	13.41***
Community Bond	0.364	0.41	1	0.362	0.409	0.78	0.387	0.408	0.45	0.373	0.471	23.29***
Green Bond	0.421	0.486	2.78*	0.425	0.479	1.3	0.451	0.425	0.39	0.441	0.512	16.82***
Business Levy	0.444	0.495	1.27	0.417	0.512	3.55*	0.473	0.506	2.32	0.457	0.533	17.13***
Developer Levy	0.399	0.423	2.31	0.421	0.431	0.6	0.425	0.401	0.81	0.424	0.419	0.08
National Tax	0.318	0.334	0.88	0.318	0.334	0.82	0.327	0.329	0.02	0.325	0.337	3.90**
	Trust			Homeowner			Business Owner					
Somewhat Support	5	10	Chi2	0	1	Chi2	0	1	Chi2			
Council Tax	0.179	0.356	16.48	0.169	0.192	0.69	0.193	0.148	2.04			
Water Tariff	0.262	0.425	9.46***	0.239	0.283	1.51	0.279	0.218	2.03			
Community Bond	0.384	0.419	0.99	0.408	0.371	1.36	0.399	0.321	3.53*			
Green Bond	0.452	0.491	2.81*	0.445	0.457	0.16	0.467	0.381	4.74**			
Business Levy	0.466	0.524	8.28***	0.478	0.463	0.28	0.477	0.427	1.51			
Developer Levy	0.427	0.431	0.89	0.424	0.428	0.17	0.429	0.415	0.66			
National Tax	0.327	0.334	0.67	0.328	0.326	0.03	0.331	0.312	0.369			

First, we consider the effects of the attitudinal variables. Based on the ordered regression results, we found that biospheric values are positively associated with support for green bonds for funding small-scale green infrastructure and developer levies for small and large-scale green infrastructure. This means that as an individuals' level of biospheric value score increases by 1, we expect an increase in the likelihood that they are in a higher category of support for green bonds and developer levies. The relationship between biospheric values and support for green bonds is further identified by the predicted probabilities. If an individual has a higher biospheric value, there is a greater probability that they would support the use of green bonds for both small- and large-scale green infrastructure funding.

Altruistic values were positively associated with support for green bonds and national government funding for small-scale projects, and business levies for large-scale projects. As an individuals' altruistic value score increases by 1, this increases the likelihood that they would be in a higher category of support for these. These relationships were confirmed using the predicted probabilities, and if an individual has a higher level of altruism, the probability of them supporting these three mechanisms is greater than those who are less altruistic. Egoistic values were found to be significantly and positively associated with support for council tax and water tariff increases for small- and large projects and developer levies for small-scale projects. As individuals egoistic value score increases by 1, this increases the likelihood that they would support these mechanisms. Again, these are confirmed by the predicted probabilities, and individuals with increased egoistic values were found to have a higher probability of supporting these mechanisms.

Finally, it was found that if there was an individuals' level of pro-environmental engagement increases, this increases the likelihood that they would be in a higher category of support for all mechanisms for small-scale projects and all mechanisms except for national government funding for large-scale projects. When comparing the predicted probability of support for water tariff increases for small-scaled projects across two groups with different pro-environmental engagement scores (level 3 versus level 5), the predicted probability increases significantly, and increases more than the increase in support for the other mechanisms. This further highlights the influence of this characteristic on individuals' support for even the least supported mechanism.

Among the contextual variables, as individuals' trust in the government increases, this increases the likelihood that that they are in a higher category of support for council tax increases, water tariff increases and business levies for both small- and large-scale projects and green bonds for small-scale projects. When we compare the predicted probabilities of support for each mechanism between those who have moderate levels of trust in the government versus those who have high levels of trust, the difference in probability of support is largest when it comes to water tariff and council tax increase. This suggests that for these two mechanisms, ensuring that there is public trust is crucial for gaining support. If individuals are homeowners; this had no effect on their support for any of the mechanisms. On the other hand, if individuals are business owners, this decreased the probability that they would support the use of community bonds and business levies for small-scale infrastructure, and community bonds and green bonds for large-scale infrastructure.

Finally, the personal capability or socio-demographic variables provide several insights. Compared to 18- to 24-year-olds, those in the age categories 45 to 54 and 65 and over are more likely to be in a higher category of support for green bonds for

small-scale projects. Those aged 45 to 54 are more likely to support community bonds and green bonds for large-scale projects. All age categories are more likely to support developer levies for small-scale projects compared to 18- to 24-year-olds, along with those aged 45 and over supporting developer levies for large-scale. Males were more likely to support water tariffs and community bonds for large-scale projects.

For funding small-scale projects, those who live in urban areas compared to cities were less likely to support council tax increases and those who live in urban, peri-urban and rural areas were less likely to support using government funding. Interestingly, it appears that these groups are simply less likely to support mechanisms that are publicly funded. When it comes to large-scale projects, however, compared to those who live in a city, those in urban areas are more likely to be in a lower category of support for all mechanisms except for water tariff increases. This suggests that those who live in cities would be more supportive of most funding mechanisms. Finally, we found that compared to individuals from Bedfordshire, individuals from Buckinghamshire have a likelihood of being in a higher category of support for green bonds and business levies for small-scale green infrastructure, and green bonds and developer levies for large-scale infrastructure. Individuals from Oxfordshire are more likely to support increased council taxes and water tariffs for large-scale projects.

5. Discussion

There is a vast amount of academic research around green infrastructure financing that seeks to understand individuals' non-market economic valuation of green infrastructure and its services. While this can provide insight into individuals' willingness or unwillingness to pay through specific payment mechanisms, it does not provide deeper insight into their perceptions of who should pay and how. This study contributes to the literature by investigating public perceptions of, and support for, the use of a range of green infrastructure funding mechanisms.

Our findings suggest that individuals have strong preferences for the use of developer levies to fund both small and large-scale green infrastructure projects. This could be because the public has seen the environmental impacts of increasing developments, such as pollution, and believe that developers should contribute to offsetting these effects (Brown and Mijic 2019). Debt-financing mechanisms such as green bonds and community bonds were also supported for small-scale green infrastructure, whereas for large-scale green infrastructure this was national government funding and business levies, with more than 50% supporting each. It therefore seems like a wide range of mechanisms would be well received by the public. Local authorities may be able to use a mix of mechanisms where the costs are shared by the government along with businesses and developers (Toxopeus and Polzin 2021).

Attempting to share these costs with the public may, however, not be welcome, as mechanisms such as increases in council taxes and water tariffs were the most resisted. Previous studies have found that salient policies with visible costs usually have strong opposition (Kitt *et al*. 2021). This is also in line with the results of studies that were examined in Section Two, which showed that there is a generally low willingness to personally contribute to and pay for green infrastructure (Venkataramanan *et al*. 2020), that mechanisms that increase local taxation would be unpopular with residents (Mell 2017) and that there is a belief that the government should be responsible (Jones and Bi 2020). Research has shown that, indeed, the onus has been on local governments to

fund green infrastructure (Toxopeus and Polzin 2021), but that they are searching for alternative options that involve contributions from developers (Mell 2017) or financial mechanisms such as green bonds or crowdfunding measures (Frantzeskaki *et al*. 2019).

While there are clear overall preferences for mechanisms, full reliance on developer levies may not be feasible in practice and sometimes it may be necessary to introduce alternatives. As such, it makes sense to look at groups of individuals with disparate characteristics who have dynamic and different preferences and levels of support for the range of mechanisms, so that effective funding mechanisms can be identified, and their use appropriately promoted. This type of information can provide useful insight and open up opportunities to tailor the form and presentation of the mechanisms to secure support from individuals with specific characteristics, especially socio-demographic characteristics where data is already available, or characteristics where the data can be easily proxied, such as individuals who are engaged in environmental activities and activism.

Our analysis allowed us to provide evidence of the association between different characteristics and funding mechanism preferences. It was expected that individuals who are more biospheric or altruistic would be in higher categories of support for most mechanisms. This is because altruistic and biospheric values are typically associated with pro-environmental behaviour, since individuals with these values tend to have a concern for the welfare of society and the environment. This association has been found for a wide range of environmental behaviours in different countries and contexts (Bouman, Steg, and Kiers 2018).

However, biospheric and altruistic values appeared to have a significant association with support for green bonds, whilst they also supported developer and business levies. Neither biospheric nor altruistic values are associated with support for mechanisms such as council tax and water tariff increases. Conversely, individuals with egoistic values are thought to value personal resources and are usually less inclined to exhibit pro-environmental behaviour, especially if the behaviour is effortful, costly or uncomfortable (Bouman, Steg, and Kiers 2018). However, our results found that individuals with egoistic values were more strongly linked with support for council tax and water tariff increases, whereas we thought that they would value their own resources too much to support these. Overall, this behaviour is inconsistent with expected behaviour.

These results highlight that people who identify as biospheric and altruistic prefer mechanisms such as bonds and levies, where the financial burden is placed on select groups such as investors, developers and businesses, while all individuals in the area or region benefit. As they are concerned with the welfare of society and the environment, they may believe that the benefits of green infrastructure, such as reduced air pollution, climate change mitigation, improved health and wellbeing, are things that would significantly improve wider environmental and society. However, placing the financial burden only on individuals in the area, when the benefits of green infrastructure can potentially be more far reaching, would then reduce the welfare of these individuals. Therefore, to maximise the benefits to residents and the environment, they may prefer that other external groups such as investors, businesses and developers fund it while also giving back to the environment and society which they operate and profit from.

On the other hand, egoistic individuals prefer approaches where those who benefit from the green infrastructure projects are made to pay for it. In some cases, individuals with egoistic values tend to consider the costs of their action compared to the personal

benefits and may act in an environmentally friendly way if the perceived benefits outweigh the costs (Jannson, Marell, and Nordlund 2011). They may believe that the benefits they will receive from the green infrastructure being funded may outweigh the personal cost to them, and as a result may be willing to support the mechanism out of self-interest. Given these results, to encourage individuals with egoistic values to support these funding mechanisms, it may be useful to highlight benefits of green infrastructure that are more personal to them, such as a potential increase in property values.

Given the counter-intuitive results which suggest that egoistic individuals engage in behaviour that has a cost to them, it is useful to reflect on the fact that the average egoistic score was less than 3, and only 35% of the respondents had an egoistic score that was above 3. In comparison, the biospheric and altruistic scores had averages of above 3, where 80% and 75% of respondents had a rating above 3 for altruistic values and biospheric values respectively. This suggests that while most of the respondents would consider themselves to be highly altruistic and biospheric, most respondents in the sample do not consider themselves to be highly egoistic. So, while there may be a relationship between egoistic values and support for council tax and water tariff increases, this relationship may not be truly reflective of people who are considered to be truly and highly egoistic.

In line with our expectations, engagement in pro-environmental activities is positively correlated with support for all mechanisms, except for one. This variable represented individuals who are more likely to join a group that promotes environmental goals, donate money to an environmental organization, or volunteer to maintain green infrastructure, among other activities. Therefore, given their dedication to engaging in environmental activities, it is no surprise that they are willing to support all mechanisms, even the ones that come at a personal cost to them. Since green infrastructure can have benefits to those living within the area or region, they are open to supporting mechanisms where those directly benefitting from it pay for it, including themselves. These findings are in line with the literature, as it has been found that environmental and social justice values have the potential to affect acceptance of environmental policies more than self-enhancement values affect opposition (Drews and van den Bergh 2015). Due to the significance of this value, to gain further support, policymakers could hold communication campaigns highlighting the benefits of green infrastructure to the environment and society to appeal to these individuals.

Trust in the government was also positively associated with support for mechanisms such as council tax and water tariff increases. These mechanisms would require direct funding from the individual, for which the government would be responsible for collecting and using to fund and deliver the green infrastructure projects. Therefore, the more trust they have in the government to carry out these duties and make fair and responsible use of their money, the more they would be likely to support it. The significance of this variable is in line with other studies that have investigated the role of trust in public support for environmental policies and taxes (Kallbekken and Saelen 2011). Similarly, Rhodes, Axsen, and Jaccard (2017) also found that trust in government was associated with support for carbon taxes. Gaining public support for any of these mechanisms may require the public to see the government as trustworthy and able to make appropriate use of the revenue collected. There may be a need for greater transparency from government bodies on where the funds come from and how they have been used to finance the green infrastructure project that they were collected to fund.

Although this was not the case, we assumed that homeowners would be more likely to support multiple mechanisms, since they could potentially benefit more from green infrastructure being funded than non-homeowners, as it could lead to an increase in land and property values (UK Green Building Council 2015). Business owners' lack of support for business levies is unsurprising, since they would be the ones negatively affected. However, their lack of support for bonds could be because they are more aware of the potential financial risks and negative consequences that would be placed on residents.

Residents in urban, peri-urban and rural areas appear to be less likely to support mechanisms that are publicly funded compared to residents living in cities. This could be because they assume that these projects would be built within cities and may not want their tax or tariff payments going towards these projects if they will not directly benefit. When it comes to large-scale projects, however, those in urban areas are more likely to be in a lower category of support for all mechanisms except for water tariff increases, compared to those who live in a city. This suggests that those who live in cities would be more supportive of most funding mechanisms, which is expected as they may have less access to green infrastructure and its benefits, but they may be more affected by increasing urbanization and its effects, such as air pollution and flooding.

Finally, another interesting result was that individuals from Oxfordshire were more likely to support an increase in council taxes and water tariffs compared to individuals from Bedfordshire. This could be because the average income in Oxford is higher than the average income in Bedford and all of the other areas in the Arc (Savills 2019), so this may increase the willingness to pay of residents in this area. Studies have found that income has an impact on pro-environmental behaviour (Blankenberg and Alhusen 2019). Therefore, when introducing new policies, especially those that require funding from members of the public, it would be important to take this into consideration. However, since there was an under-representation of respondents from Oxfordshire, there are some limitations in further interpreting these results.

Despite the insights provided by the study, there are a few other limitations that should be acknowledged. First, in our attempts to investigate public support for mechanisms used to fund small-scale and large-scale green infrastructure projects, there was not much difference in support or determinants of support between the two scales. This could potentially be because we did not provide respondents with sufficient information to allow them to differentiate between the scales and their respective benefits. Additional research could be conducted in this area to further investigate this. Additionally, the study was limited to residents in the Oxford–Cambridge Arc in England, but perceptions and preferences for green infrastructure funding mechanisms may vary by region and country. However, it is possible that the determinants of support, specifically altruistic-biospheric values, environmental engagement and trust in the government may be applicable across different contexts.

6. Conclusions

Given the current financial barriers faced in the widespread adoption of green infrastructure, there is a need to investigate new funding mechanisms and identify more effective and sustainable funding streams. Understanding public perceptions and support for mechanisms to fund different types of green infrastructure is a key step before any new mechanisms or policies are introduced, as it can ensure that there is not strong opposition. By analysing survey data collected from a representative sample of residents in the

Oxford–Cambridge Arc, we addressed the two research questions set out in Section One by identifying public support for a variety of green infrastructure funding mechanisms, and by applying the Attitude-Behaviour-Context framework to determine the attitudinal, contextual and personal capability variables that determine support.

Overall, we provide evidence about how individuals support a range of funding mechanisms and the perceptions that they have around who should fund green infrastructure. Citizens were found to have preferences for both small- and large-scale green infrastructure to be funded by developers, whereas they are most opposed to mechanisms that have a direct additional cost to themselves. Furthermore, this research advances the existing literature and understanding of the determinants of environmentally significant behaviour by studying a new context that has not been previously explored in the literature. By doing so, we found that individuals' pro-environmental engagement attitudes along with their trust in the government are associated with increased support for most funding mechanisms. Therefore, while citizens may prefer the use of some mechanisms over others, their support for most mechanisms might be increased by engaging with individuals' desires to improve the environment and by improving their perceptions of the government. By taking these findings into consideration, policymakers may be able to identify suitable mixes of mechanisms that can be implemented to fund different types of green infrastructure and develop strategies to increase support and reduce barriers to implementation.

Notes

1. One sector specific mechanism, an increase in water tariff rates, was introduced since the projects were described as SUDS that helped with flood management.
2. For simplicity, we estimated the predicted probability that an individual would be in category 4, or that they would somewhat support the mechanism. We chose level 4 and not level 5 as an indicator of support because the majority of respondents who supported a mechanism only somewhat supported and did not strongly support it.
3. We choose the medium level – 3 – rather than the lowest level, as very few respondents select values below 3 in the survey.

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Supplemental data

Supplemental data for this article can be accessed here.

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Data availability statement

Data underlying this study can be accessed through the Cranfield University repository (CORD) at: https://doi.org/10.17862/cranfield.rd.19890478.

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