Characterizing the Demand Side of Urban Greening to Inform Urban Planning -A Discrete Choice Experiment in the Paris Metropolitan Region

Mai-Thi Ta, Léa Tardieu, Harold Levrel

Characterizing the demand side of urban greening to inform urban planning - a discrete choice experiment in the Paris Metropolitan region

Mai-Thi Ta*† Léa Tardieu‡ Harold Levrel †

Abstract: As the multiple benefits from exposure to urban green spaces (UGSs) are increasingly acknowledged, urban greening policies have become an important component of the urban political agenda. Most targeting strategies of future UGS development are based on the pursuit of an equal distribution of UGSs among residents. These strategies implicitly assume that the development of any type of UGS will have the same effect on citizens' well-being, provided that their access is guaranteed. This paper questions this assumption and addresses the demand side of urban greening policies by evaluating which UGS characteristics are sought by urban dwellers. We apply a travel time-based discrete choice experiment (DCE) to capture the trade-offs between the UGS characteristics (e.g., tree cover, size, presence of water, accessibility) and the travel time that citizens are willing to spend to reach a hypothetical UGS compared to a "stay at home" option. We discover that all the respondents have a disutility in choosing the "stay at home" option instead of a scenario of UGS development, especially when the UGS contains trees. This disutility is however much higher among outer suburb inhabitants living in municipalities with relatively lower urbanization levels and rent prices. Further, the global time budget dedicated to reach a UGS is much lower for inner-city residents compared to outer-suburb inhabitants. Inhabitants living in less urbanized areas place a higher value on a large UGS ($>$ 1.5 hectares), while residents living in city centres do not seem to be influenced by this UGS characteristic. Our results suggest that strategies based on access criteria would benefit from being differentiated according to urbanization levels of cities, as the inhabitants of city centres value nearby and multiple UGSs but not necessarily large UGSs while the inhabitants of suburbs value larger UGSs, even when located farther away.

Keywords: urban green spaces, recreational services, urban greening policies, preference heterogeneity, choice experiment, green infrastructures.

*Corresponding author. *E-mail adress:* mai-thi.ta@agroparistech.fr

†Université Paris-Saclay, AgroParisTech, CNRS, Ecole des Ponts ParisTech, CIRAD, EHESS, UMR Cired, 94130, Nogent-sur-Marne, France

‡TETIS, Inrae, AgroParisTech, CIRAD, CNRS, Université Montpellier, Montpellier, France

Qualifier la demande de renaturation urbaine pour mieux renseigner les politiques d'aménagement des villes - une expérience de choix discrets en Ile-de-France

Abstract: Les multiples avantages de l'exposition aux espaces verts urbains (EVU) étant de mieux en mieux reconnus, les politiques de renaturation sont devenues une composante importante de l'agenda politique urbain. La plupart des stratégies de ciblage des futurs EVU sont fondées sur la recherche d'une répartition égale des espaces verts urbains entre les résidents. Ces stratégies supposent implicitement que le développement de tout type d'EVU aura le même effet sur le bien-être des citoyens, à condition que leur accès soit garanti. Cet article interroge cette hypothèse en caractérisant la demande en EVU et en spécifiant les caractéristiques recherchées selon les profils sociodémographiques des habitants. Pour cela, nous avons réalisé une expérience de choix discrets basée sur des temps de trajets mesurant les arbitrages entre différents attributs constitutifs des EVU (couvert forestier, taille, forme, accessibilité) et le temps de trajet que les habitants accepteraient d'effectuer pour se rendre dans un espace vert fictif. Nous montrons que l'ensemble des résidents a une désutilité à choisir l'option "rester à la maison" plutôt qu'un scénario de développement d'un EVU, en particulier lorsque l'EVU contient des arbres. Cette désutilité est cependant beaucoup plus élevée chez les habitants des banlieues, vivant dans des municipalités à faibles taux d'urbanisation et à loyers modérés. Par ailleurs, le budget temps global consacré pour atteindre un EVU est beaucoup plus faible pour les habitants des centres-villes que pour ceux des banlieues. Enfin, les habitants des zones moins urbanisées accordent une plus grande valeur aux grands EVU ($>$ 1,5 hectares), tandis que les habitants des centres-villes ne semblent pas être influencés par cette caractéristique. Les résultats suggèrent que les stratégies basées sur des critères d'accès gagneraient à être différenciées en fonction du taux d'urbanisation des villes, car les habitants des centres-villes semblent mieux valoriser des EVU proches et nombreux mais pas nécessairement grands, tandis que les habitants des banlieues valorisent des EVU plus grands, même lorsqu'ils sont plus éloignés.

Mots-clés: espaces verts urbains, services récréatifs, végétalisation, hétérogénéité des préférences, expérience de choix, infrastructures vertes.

1 Introduction

The issue of urban green space (UGS) deprivation is becoming increasingly material in highly urbanized, extended and populated areas. On the one hand, land is increasingly scarce in urban areas while on the other hand, the social demand for green space amenities has increased (Choumert and Salanié, 2008). The issue has been explicitly highlighted during the 2019 Coronavirus Disease (COVID-19) pandemic lockdowns when in cities like Paris, travel restrictions within one kilometer from a person's home prevented access to UGSs for thousands of residents. According to Picard and Tran (2021), large cities in Europe ($>$ 1 million inhabitants) have the same profiles regarding access to UGSs (following a non-monotonic concave function of the distance to city centres in response to the high opportunity cost of land and population density). In many of these large cities, inhabitants living in the denser and more expensive inner centre are more likely to be deprived of UGSs than the inhabitants of the outer suburbs. In the case of the Paris Metropolitan area, in which UGSs represent 9.5% of the Paris *intra-muros* area [1], more than 50% of the residents are deprived of UGS[2] (Liotta *et al.*, 2020). In the outer suburbs, this proportion decreases to 20% (Liotta *et al.*, 2020).

UGSs are local public goods, providing multiple health and well-being benefits to urban dwellers (Hamel *et al.*, 2021; Remme *et al.*, 2021). They have been found to enhance physical activity, reduce exposure to air pollution, improve mental health and reduce cardiovascular morbidity among others (World Health Organization, 2016). In France, UGSs are mainly supplied by local authorities, such as the regional council, that establish criteria to plan future UGS development. Currently, these targeting criteria are widely based on the ratio of the surface of UGS per capita, implicitly assuming that any UGS, regardless of its characteristics, is equally contributing to urban dwellers' well-being. For instance, Natural England recommends developing access to green spaces larger than 2 hectares within 300 meters of each inhabitant's residence, which is consistent with the World Health Organization's recommendations. The European Common Indicator of local public open areas defines a criterion of access to public open areas larger than 0.5 hectares and also advocates a perimeter of 300 meters from home. The Paris metropolitan area sets a goal of giving access to 10 square meters of open natural area per inhabitant (at the municipal level) by 2030.

The benefits derived from green spaces depend not only on UGS provision but also on one's preferences for different UGS characteristics. People may enjoy different types of UGSs and use them for different purposes (Swanwick, 2009). Thus, UGS provision lies not only in dedicating sufficient surface per capita but also in ensuring that its characteristics actually meet residents' needs (Hofmann *et al.*, 2012). In this context, understanding citizens' (satisfied or unsatisfied) demand regarding UGSs proximity and characteristics provides useful information to optimize investments and the use of available space while improving citizens' quality of life. This finding is particularly valid in a large metropolis such as the Paris metropolitan area where land scarcity

[1] according to the World Cities Culture Forum data, available following this link

[2] This percentage is calculated for an access to a UGS greater than 1.5 ha at 300m from each residence location

and high land prices motivate the optimal use of space (Alberti *et al.*, 2019).

In this paper, we use a discrete-choice experiment (DCE) to provide empirical insights regarding UGS demand in a large and dense metropolitan area. To our knowledge, our study is one of few DCEs that study UGS preferences in a metropolitan area with such pronounced spatial disparities in terms of UGS supply and urban morphology between the city centre and its suburbs. Through the DCE, we specify the maximum travel time that residents of the Paris metropolitan area are willing to spend to reach a fictive UGS according to its characteristics and the residents' socio-economic profiles. We apply the travel time as an adjustment variable that local authorities can use to provide various types of UGSs and create a portfolio of UGSs that meet a differentiated demand (Swanwick, 2009).

We show that two profiles of residents stand out regarding UGS demand, even if both profiles show a clear preference for the UGS alternatives compared to the "stay at home" option presented in the DCE. First, inner-city residents living in denser environments with higher rents[3] show a strong preference for having access to a UGS, regardless of its size. Their disutility for the "stay at home" option is strong but lower than that for outer city inhabitants living in less dense municipalities with lower rents. Inhabitants in outer suburbs appear to value larger UGSs (>1.5 hectares). Second, the time budget that inner city dwellers are willing to spend to reach a UGS is roughly four times lower than the time that inhabitants in outer suburbs are willing to dedicate. In terms of UGS attributes, apart from the size and proximity, the ranking is similar among the profiles. Both types of inhabitants place a high value on the presence of trees. We conclude that developing multiple small, wooded UGSs in city centres would help to improve residents' well-being, while larger UGSs, even those located farther away, would be valuable for citizens living in less densely populated areas. This finding is consistent with green investment capacities of planners regarding land prices, as the opportunity costs of developing large UGS in downtown areas, instead of alternative investments, are much higher than those in outer suburbs.

The remainder of this paper has 6 main sections. We briefly present in section 2 the principal literature findings regarding UGS preferences. Section 3 details the Paris metropolitan case study and specifies the adopted methodological choices. The section ends with a description of the materials used for the survey design. Section 4 presents the results of our DCE and compares a mixed logit (ML) and a latent class (LC) model. In section 5, we discuss our approach and compare our results to the actual behaviours of respondents. We also outline the main limitations of our study. Section 6 synthesizes our major findings and discusses why resident-driven urban greening designs are needed to improve greening policy decisions.

[3]Rent data were sourced from UMR 1041 CESAER (AgroSup Dijon-INRAE), based on data from SeLoger, leboncoin and PAP for the year 2018. Data are available here

2 Principal literature findings regarding UGS preferences

Preferences for outdoor recreation have been previously investigated using DCEs. In France, for example, Rulleau *et al.* (2010) evaluate the management of the Gironde forest. However, few DCEs have been carried out in the specific urban context. Bullock (2008) focuses on Dubliners' preferences for small local parks and larger municipal parks. De Valck *et al.* (2017) focus on preferences for outdoor recreational destinations in Antwerp. Arnberger and Eder (2011) worked on trail preferences in Vienna, while Tu *et al.* (2016) examined recreational preferences in peri-urban forests in Nancy (France). Bertram *et al.* (2017) investigate UGS value differences between weekdays and weekends in Berlin.

From this corpus, the major findings are as follows: Bullock (2008) shows that Dublin residents' preferences vary with the size of the UGS. The quality of small, local parks is improved with play facilities and "a mix of quiet and busier areas" (p. 27), while for larger parks, natural lakes and woodlands become positive attributes. Rulleau *et al.* (2010) discover that poorer people are less likely to accept a longer travel distance to benefit from the current Gironde forest quality. Tu *et al.*(2016) reveal that living near parks is preferred by people in general, but no specific characteristics of the parks are described.

Other papers, using alternative techniques to the DCE also provide useful insights. Suárez *et al.* (2020) rely on Geographic Information System (GIS) data to identify characteristics of preferred outdoor recreational destinations in Oslo. Their results indicate that residents living in peri-urban areas prefer natural areas with vegetation and water, while residents living in city centres prefer more artificial recreational destinations with facilities. Choumert and Travers (2010) show through a hedonic pricing method that people in Angers (France) prefer to live in areas with multiple small UGSs than in areas with fewer but larger UGSs.

3 Material and Methods

3.1 Case study: the Paris metropolitan area

Our study focuses on the French region of Ile-de-France. The region is composed of 8 areas, which are divided into Paris *intra-muros*, the *"little crown"* - inner suburbs of Paris containing Hauts-de-Seine, Val de Marne and Seine-Saint-Denis, and the *"big crown"*- outer suburbs containing Val-d'Oise, Yvelines, Essonne and Seine-et-Marne (Figure 1). Despite representing only 2% of the French territory, this region accounts for 18% of the population and generates 31% of the national growth domestic product.

As shown in figure 1, Ile-de-France is mostly covered by agricultural areas, which occupy nearly 50% of the territory (situated mainly in the big crown). The region benefits from 8,342 km of waterways, 30,000 ponds, and three national parks (Haute vallée de Chevreuse, Vexin and Gatinais). Globally, only 66% of residents have access to a public UGS of at least 1.5 ha

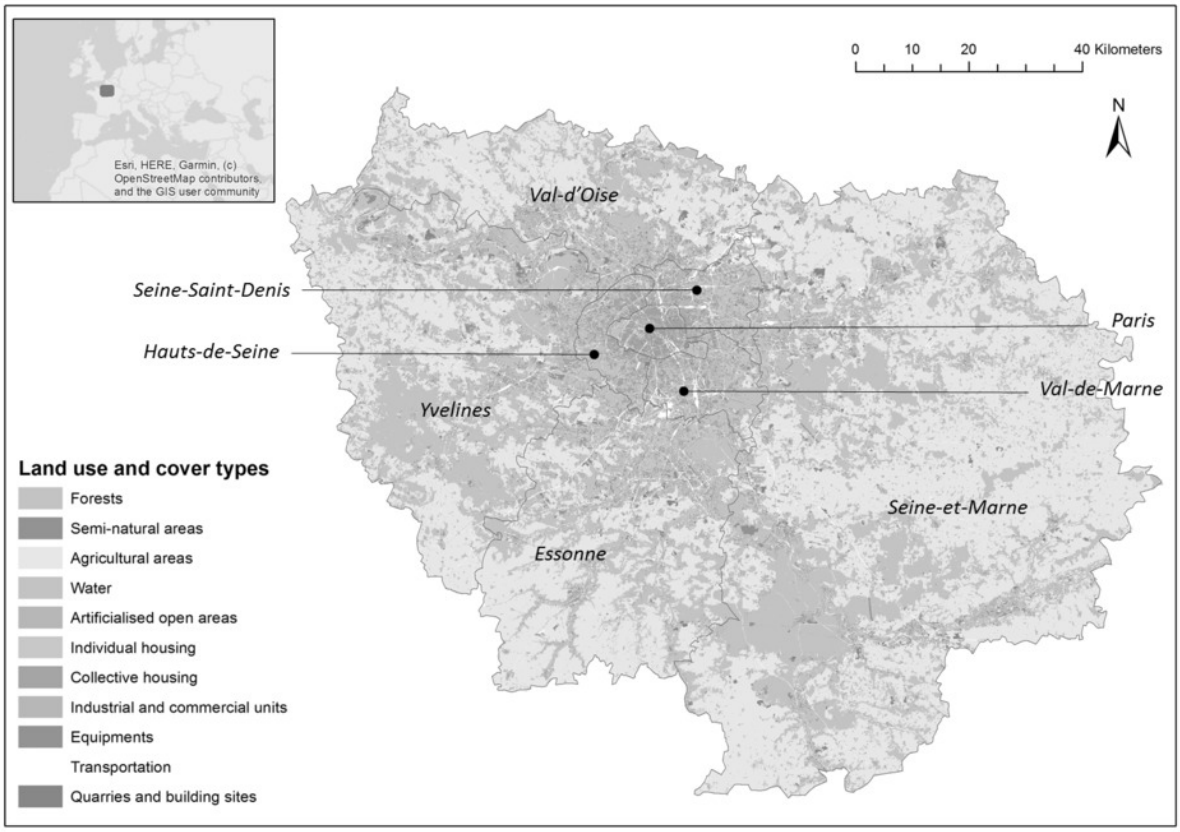


Figure 1: Land use and land cover in the Ile-de-France region, France (based on the *Mode d'Occupation des Sols* developed by the *Institut d'Aménagement Urbain*, source: IDEFESE project)

situated less than 300 meters from their residence [4] (Figure 2). Even though access to green spaces increased by 2% from 1982 to 2017 in the region and in Paris inner city, the surface area of UGS per inhabitant decreased by 24% during this period due to a net conversion of natural and open areas of roughly 40,700 hectares.

This finding is confirmed by the diagnosis of the 2017 Green Plan of the Paris metropolitan area[5]. The Plan declaimed that 72% of municipalities in the region are deficient in terms of access to green spaces and 5% of municipalities are very deficient. A municipality is considered deficient when more than 30% of inhabitants have no access to at least 10 square meters of UGS based on the master plan target. To reach the objective of 10 m^2 per inhabitant, 4,200 additional hectares of UGS would have to be created in these municipalities by 2030, but only 500 hectares are planned

[4]All the descriptive statistics hereafter are calculated with geographical information systems, based on the "Mode d'Occupation des Sols" database made available by the Institut Paris Région. Posts 1 to 4 of the "Mode d'Occupation des Sols" in 11 posts (forests, semi-natural environments, agricultural areas and water spaces) are considered non-urban.

[5]Conclusions of the Green Plan are available at `https://www.iledefrance.fr/espace-media/applis_js/rapports_cp-cr/2017-03-09/rapportsPDF/CR2017-50.pdf`

(Tardieu *et al.*, 2020).

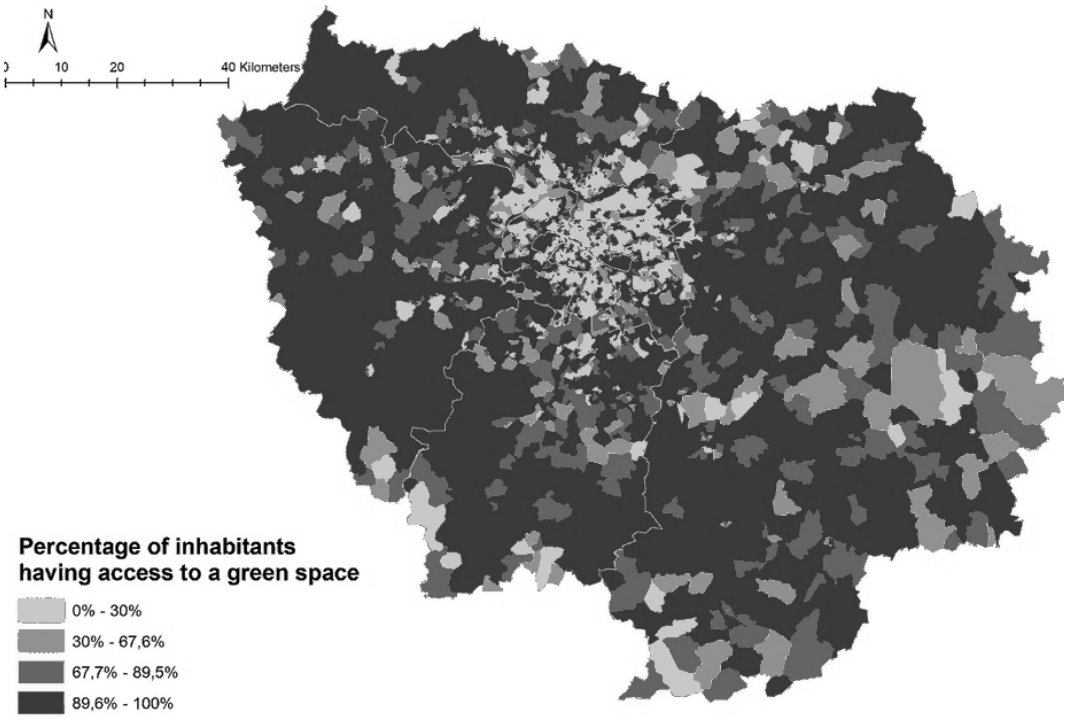


Figure 2: Share of inhabitants at the census tract level having access in 2017 to a recreational green space of at least 1.5 hectares at less than 300 meters from their residence

3.2 Methodological options

DCEs are non-market valuation techniques that are used to appreciate preferences for different options of a good or service. Individuals are presented with several choice situations that require them to choose between hypothetical versions of a good, described by its most representative characteristics. One characteristic is usually a monetary variable that is utilized to estimate the marginal rate of substitution. An additional option, which consists of choosing neither alternative, is generally added (Hanley *et al.*, 1998). This last option can either be a *status quo*, *i.e.*, the current situation where the individual keeps its consumption habits without any extra cost, or an opt-out option that expresses a default response in which a respondent opts "not to choose", *i.e.*, the individual does not consume any of the goods proposed (Boxall *et al.*, 2009).

3.2.1 Modelling framework

DCEs rely on Lancaster's theory of value (1966) and the random utility theory (McFadden *et al.*, 1973). Lancaster's theory (1966) argues that consumers perceive a good through its different attributes, while the random utility theory considers that the utility function contains both a deterministic component derived from observable characteristics and a random component that

accounts for unobserved variables that influence the choice. Therefore, the random utility $U_{n,i}$ that an individual n obtains from alternative i is:

$$U_{i,n} = V_{i,n} + \epsilon_{i,n} \tag{1}$$

where $V_{i,n}$ is the deterministic component and $\epsilon_{i,n}$ is the stochastic element.

The conditional logit, which has laid the theoretical basis of DCEs modelling, relies on two restrictive assumptions, the independence of irrelevant alternatives (IIA) and the independent and identically distributed errors. The first assumption states that the choice between any set of alternatives is not affected by the introduction of an additional alternative. The second assumption implies that unobserved variables cannot generate correlation. With these assumptions, individuals have the same utility function and consequently homogeneous preferences. Mixed Logit (ML) and Latent Class (LC) models relax the IIA hypothesis and allow for preference heterogeneity. The ML model considers individual heterogeneity through the introduction of a random coefficient distributed over individuals and alternatives. When this distribution considers a finite set of values, the model becomes an LC.

We use an ML model to explore heterogeneity at individual levels before investing it at a more macro level. The LC model is subsequently employed for three motives. First, we assume that some unobserved heterogeneity is likely to influence residents' preferences. This heterogeneity could be related to their sense of nature or health for example. Second, the LC model is less sensitive to the analyst's subjective assumption concerning parameters' distribution (Tu *et al.*, 2016). Identifying preference heterogeneity according to socio-demographic classes would also be useful for public policies since they cannot address individual preferences.

3.2.2 Models specification

Mixed Logit In ML models, the utility that individual n derives from alternative i is :

$$U_{i,n} = V_{i,n} + \epsilon_{i,n} = \beta_n \mathrm{X}_i + \eta_{i,n} + \epsilon_{i,n} \tag{2}$$

where X_i is the observed attributes vector associated with alternative i, β_n is the vector of parameters that represents an individual's preference and $\eta_{i,n}$ is a random term with zero mean that accounts for preference heterogeneity.

We assume a normal distribution of preferences among the population, except for time, which we assume to be log-normally distributed. The ML model estimates parameters through a simulated maximum likelihood. We considered 500 random draws.

Latent Class LC models assume that there is a number of classes (C) associated with different estimated parameters $\beta_c = \{\beta_1, ..., \beta_C\}$. The model estimates the probability that respondent n falls into class c and the probability $\mathrm{P}^c_{i,n}(\mathrm{i}|\beta_c)$ that respondent n chooses alternative i given his class. The unconditional logit probability is therefore the sum over all classes of the $\mathrm{P}^c_{i,n}(\mathrm{i}|\beta_c)$

probabilities weighted by the probability that respondent n falls into class c. We applied LC conditional logit models via the expectation-maximization algorithm developed by Pacifico and Yoo (2012), with the *lclogit* package in STATA 14.

Alternative Specific Constant For ML and LC models, an Alternative Specific Constant (ASC) is specified for the *status quo* (ASC=1 if the status quo alternative is chosen, and 0 otherwise) to capture a potential bias. When the respondents chose neither of the suggested alternatives, ASC = 1 and the selected option is to stay at home (refer to table 1). To limit possible misinterpretation of the constant variable (Bech and Gyrd-Hansen, 2005), all variables are effect-coded, except for the ASC. In effects coding, a variable equals 1 if the observed qualitative level is present, 0 otherwise, and -1 for the reference level (table 1). The utility of the reference level is then equal to the negative sum of the estimated parameters (Bech and Gyrd-Hansen, 2005).

3.2.3 Willingness to accept additional travel-time (WTT) to reach a UGS and conversion into willingness to pay (WTP)

The compensating variation of welfare for a unit-change in one attribute k is generally given by the willingness-to-pay (WTP), which is defined as $WTP = -\frac{\beta_k}{\beta_m}$ with β_k and β_m, the estimated parameter for attribute k and the monetary attribute, respectively. However, estimating the WTP as the marginal rate of substitution with the monetary attribute can be complicated as, depending on the assumptions for the distributions of the parameters, problems of unrealistic skewed distributions appear. This approach is referred to as estimations in "preference space". A solution to these skewed distributions is to estimate the models in the WTP space (Train and Weeks, 2005). The authors present a revised formulation of equation 2, which avoid issues of skewed distributions as it derives the distribution of parameters from the assumption of WTP distributions. Train and Weeks (2005) determine that models estimated in the preference space better fit the data, while models estimated in the WTP space provide more reasonable WTP distributions.

In our case, we run estimations in the WTP space. We replace β_m by the time parameter to estimate the willingness-to-accept a longer travel time (WTT) to a UGS for a unit increase of a given attribute. Furthermore, effects coding involves that marginal utility is multiplied by a factor 2. We thus define WTT as :

$$WTT = -2\frac{\beta_k}{\beta_{time}} \tag{3}$$

For the LC model, the WTT is the weighted average of WTT for each class using the probability of class membership as weights. We use STATA 14 package "mixlogit" with the command "mixlogitwtp" to estimate the ML model in WTP space. LC post-estimations are calculated with the STATA 14 *lclogitml* command (with 3 iterations) and class memberships described after using the *lclogitpr* command.

At least two methods of conversion can be used to convert the WTT into WTP. The first is to rely on the “reference value” of time for project evaluation in France, estimated from traffic

simulation models (Quinet, 2013). The second is to rely on the opportunity cost of time (OCT), generally calculated as a ratio of hourly income. The second option is generally used in recreation studies, but is still under debate (see for example Feather and Shaw, 1999; Earnhart, 2003; Larson ry al., 2004; Palmquist *et al.*, 2010). Indeed, the OCT is based on the assumption of a trade-off (and therefore flexibility) in the allocation of time between work and leisure. However, time allocation between work and leisure is rarely fully flexible. Moreover, there is increasing evidence that individuals value their travel for a recreation destination. Despite this debate, a small consensus seems to have been found around a ratio equal to 1/3 of salary (see for example Cesario, 1976; Riera Font, 2000; Roussel *et al.*, 2016; or Parsons, 2017).

We opted for the "reference value" of time developed in the Quinet report (2013). For the Ile-de-France region, this value is calculated from the calibration of three urban traffic simulation models and two meta-analysis grouping values estimated from revealed preferences and stated preferences. The reference value is calculated as the average of the values obtained in these papers by distinguishing four travel motives: work; home/work/study/childcare; leisure (shopping, care, visiting, recreation, tourism, etc.) and without motive details. To convert the WTT into WTP, we used the value corresponding to a leisure trip in the Ile-de-France region, i.e. a value of 8.7€/hour. This value is equivalent to the COT approach when the rate used is 1/3 of the hourly wage. Indeed, in Ile-de-France, 1/3 of the average gross hourly wage of private sector employees in Ile-de-France in 2019 corresponds to a value of 8.8€/hour (the average gross wage being 26.4€/hour). However, this value may be overestimated as there are sectoral disparities.

3.3 Survey and questionnaire description

3.3.1 Questionnaire development

The questionnaire contains three main parts (appendix F gives a questionnaire example). The questionnaire begins with a short introduction explaining the aim of the study. The first part of the survey consists of questions regarding respondents' socio-economic situation (place of residence, gender, socio-professional category, and household composition). Instructions concerning the DCE are then given, and choice sets are presented in a randomized order (to avoid having less attention dedicated to the same choice sets). The third part of the questionnaire asks follow-up questions regarding respondents' habits concerning UGS, their revenue and their diploma.

Selection of attributes and definition of attribute levels A primary selection of attributes has been conducted through a literature review on preferences regarding access to UGS. UGS public acceptability has been shown to vary depending on the distance to UGS (Choumert and Travers, 2010; De Valck *et al.*, 2017; Kong *et al.*, 2007; Sander and Polasky, 2009), type of vegetation (Brun *et al.*, 2017; Bullock, 2008; De Valck *et al.*, 2017, Rulleau *et al.*, 2010; Schindler *et al.*, 2018), size (Bullock, 2008), presence of water (Ives *et al.*, 2017; De Valck *et al.*, 2017), type of facilities (Suarez *et al.*, 2020; De Valck *et al.*, 2017; Bertram *et al.*, 2017; La Rosa *et al.*, 2018), and cleanliness (Rulleau *et al.*, 2010; Bertram *et al.*, 2017). After this first selection, planning stakeholders' of

the Ile-de-France region have been consulted during the IDEFESE[6] project focus groups (Tardieu *et al.*, 2021). Fifty-six stakeholders from the urban planning, environmental protection, non-governmental organizations (NGOs) and civil society sectors, representing more than 27 French and European institutions, have been involved during the different focus groups (planning stakeholders are described in Appendix A). During the focus group (held on 24 September 2018), aiming more generally at collecting suggested indicators for different ecosystem services, the attributes and levels of attributes have been discussed. The "transportation mode", for example, has been added by planning stakeholders and was not initially proposed by our team.

We ultimately chose six attributes (see table 1 for an overview):

- The first attribute is *forest cover*, which represents the degree of wilderness through the density of tree cover. The attribute considers three levels: non-wooded UGS, woodland and forest.

- The second attribute describes the *shape* of the fictional green space: either linear (as for a riverbank) or not linear.

- The third attribute describes the *size* of the fictional green space. We follow a commonly employed threshold: a green space is considered to be large if it is larger than 1.5 ha (Niemelä *et al.*, 2010; Cabral *et al.*, 2016; Levrel *et al.*, 2017). Otherwise, the green space is considered to be small.

- The fourth attribute specifies the presence (or not) of a *water* body in the fictional green space.

- The Ile-de-France transportation mode considerably influences everyday choices, the fifth attribute is the *transport mode* by which the green space is accessible. The attribute considers 3 levels: walking, biking, and taking public transport or a car. To estimate the extent to which biking can be utilized as an alternative transportation mode, we isolated biking as a unique level, whereas public transport and car were combined as we considered them to be substitutes. If the respondent chose "public transport or car", we added a follow-up question asking whether the respondent would prefer the car or public transport.

- The last attribute, *transportation time*, indicates how long it takes to travel from the respondent's house to the fictional green space. Given the high variability of transportation time needed to travel a fixed distance in Ile-de-France (see appendix B), we chose transportation time over distance as an indicator of accessibility. For this attribute, the lowest level is 5 min, which corresponds to a 300-meter walking trip. The highest level is 30 min, which is 5 min less than the average commuting time spent in the little crown and Paris to travel to work[7]. Between these limits, we added 2 more levels: 10 min and 20 min.

[6] refer to `https://idefese.wordpress.com/` for more information about IDEFESE project

[7] *Les temps de déplacement entre domicile et travail*, Dares Analyses, Publication from the Directorate for Research, Studies and Statistics (Direction de l'Animation de la Recherche, des études et des Statistiques - DARES) , november 2015

Table 1: Attributes and level description

Attributes	**Description**	**Level**	**Coding**
Forest cover	Density of trees covering the UGS	Woodland	1 if woodland, 0 if forest
		Forest	1 if forest, 0 if woodland
		Non-wooded UGS	*Reference (-1)*
Shape of the UGS	Shape of the UGS	Linear	1 if linear
		Polygonal	*Reference (-1)*
Size of the UGS	Size of the UGS	Large ($>$ 1.5 ha)	1 if large
		Small ($\leq$1.5 ha)	*Reference (-1)*
Presence of water	Presence of water in the UGS	Presence	1 if presence
		Absence	*Reference (-1)*
Transportation mode	Type of transportation used to travel to the fictive UGS	By bike	1 if by bike, 0 if by car
		By car or public transport	1 if by car, 0 if by bike
		By foot	*Reference (-1)*
Travel time to reach the UGS	Time required to travel to the fictive UGS from home	5 min	5
		10 min	10
		20 min	20
		30 min	30
ASC	Stay at home alternative	Fictive UGS alternative 1 or 2	0
		Status quo alternative	1

We consider that for each alternative, respondents can only use the suggested transportation mode. Even if this hypothesis is implausible, it has been explained at the beginning of the DCE that attributes' levels could not be changed and that each alternative had to be considered as packages that could not be modified. This hypothesis allows us to independently interpret transportation mode from transportation time[8].

Experimental design and choice experiment description The second part of the questionnaire is the DCE. Choice cards were presented asking respondents to choose between two hypothetical green spaces described by attributes considering different levels and the stay-at-home option. Since we have 6 attributes, each taking between 2 and 4 levels, the full factorial design yielded 296 combinations. Given the large number of combinations in the full factorial design, we decided to implement a fractional factorial design, *i.e.,* a sample of the full factorial (Hoyos, 2010). We used SAS software to select the minimum number of choice sets allowing statistically

[8]As we proposed choice cards with fixed "transportation modes" and "travel time" to reach a UGS, without connecting these two attributes (e.g., we are not proposing lower travel time when the UGS are reached by car for example), we think that these two attributes have been independently considered by respondents, thereby revealing their independent preferences for a transportation mode and for a travel time to a UGS. Moreover, although transportation time and transportation mode are generally correlated, recent studies on the specific case of the Paris metropolitan area indicate that the correlation between both variables is not so clear. Traffic jams cause high variability in time spent driving, while the extended and reliable public transportation network reduces the time spent on public transportation (refer to appendix B). This variability can also be observed when problems occur in public transport, making the "travel time" a variable with a high expectancy and variance (except for the "by foot" travel mode).

robust results. Choice sets were selected among the full factorial design using N-Gene software and a Bayesian D-optimal design with zero priors (which amounts to an orthogonal design). The 100% efficient design led to 72 or 144 choice sets, which was still excessive. We, therefore, chose to present 24 combinations with 1 violation. Gathered in pairs, this selection provided 12 choice sets. Figure 3 gives an example of a choice set, presenting two fictive UGS alternatives and the *status-quo* option (i.e., "stay at home").

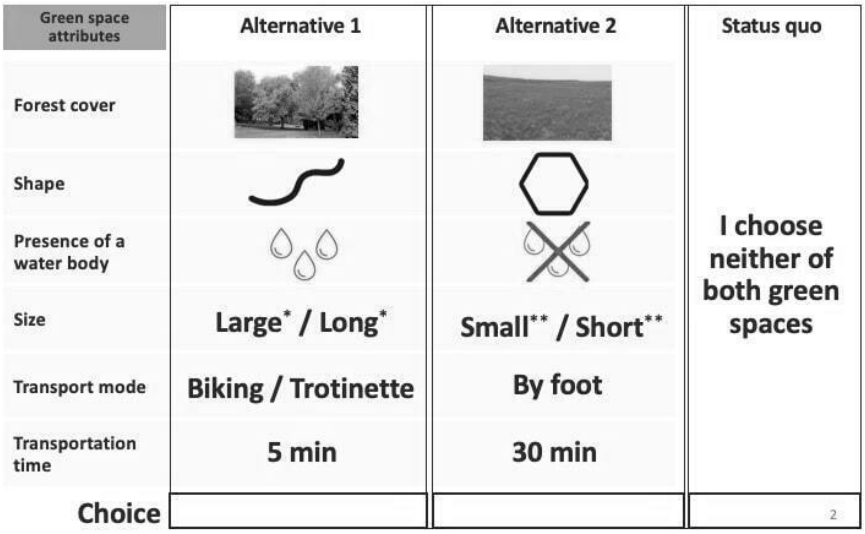


Figure 3: Example of a choice set of different UGS alternatives

Follow-up questions The third part of the questionnaire is composed of several follow-up questions that are aimed at controlling different biases and collecting other socio-economic characteristics. First, a question regarding systematically omitted attributes was asked to identify the possible existence of attribute non attendance. Second, we asked a set of questions aimed at better characterizing respondents' profiles and at helping us interpret the results. Several follow-up questions concerned habits regarding green space attendance, ecological sensitivity and socio-economic profile. To identify a different use of UGS, we asked about the main activities in which respondents participate when visiting a green space. We also asked about the frequency of their visits to UGSs, their most frequently visited UGS, how long it takes on average for them to travel to a UGS and how long they usually stay in UGSs. We ended the questionnaire with two socio-economic questions about the individual's highest diploma and current income.

3.4 Survey design

The surveys were delivered to 320 people from April 15 to May 24, 2019, representing 3,840 choices. Given the short time available, we were assisted in the field by 5 students from Ecole des Ponts. We conducted face-to-face interviews as online surveys have lower response rates (Heerwegh and Loosveldt, 2008; Lindhjem and Navrud, 2011). Furthermore, these interviews provided a good way to reach the less-connected portion of the population (elderly or poor people, for example).

To standardize questionnaire delivery, all five interviewers met to decide on a homogeneous protocol to follow. Interviewers randomly picked respondents in the streets, not in a UGS, introducing themselves as researchers working on the recreational service provided by UGSs in the region. A brief introduction has been delivered to respondents who were then asked to answer to the questions on the first page (refer to appendix F). At the beginning of the choice exercise, explanations concerning what was expected from the respondent were given, and attributes were described before allowing the respondent to answer the choice cards and follow-up questions.

We travelled to 17 representative cities of Ile-de-France to deliver the questionnaire. To select the cities, we classified the municipalities of the region regarding 3 criteria:

- Density: the ratio between the municipality's population and its surface.

- Median standard of living: the ratio between household available income and consumption unit.[9].

- Urbanization ratio: the ratio between a municipality's urbanized surface and its total surface. Urbanized and non-urbanized surfaces were determined based on the French land use classification in 11 posts[10]. Following the definition given in the SDRIF, we consider urbanized areas as agricultural, forests and natural areas where urban sprawl happens. Therefore, areas considered non-urban surfaces were those classified as forest, semi-natural areas, farmlands and water[11]. We also considered open areas with some infrastructure (such as running trails, man-made urban parks, or cemeteries) as non-urban areas (class 5 of the MOS). All other types of land-use [12]—mostly housing, lands dedicated to economic activities, equipment, transport, quarries and landfills—were considered to be urban surfaces.

Each criterion was divided into 3 classes to cluster municipalities into groups (Table 2). To determine the optimal cut defining classes, we utilized the Jenks classification method (refer to appendix C). This method minimizes the variance within classes while maximizing the variance between classes. Table 2 describes the classes for each criterion.

Table 2: Jenks classification results

	Low	Medium	High
Urbanization ratio	< 0.22	$[0.22, 0.56]$	> 0.56
Density (hab/km2)	$< 3,941$	$[3,941; 14,549]$	$> 14,549$
Standard of living (€/ UC))	$< 9,276$	$[9,276; 19,025]$	$> 19,025$

[9]INSEE calculated consumption unit based on Organisation for Economic Co-operation and Development (OECD) equivalence scale: the first household adult accounts for 1 consumption unit (UC); all other persons aged 14 years or older account for 0.5 UC each; and children younger than 14 years account for 0.3 UC each.

[10]*Mode d'Occupation des Sols (MOS) developed by the Institut Paris Région*

[11]Classified from 1 to 4 in the MOS year 2017 in 11 posts available at `https://www.iau-idf.fr/fileadmin/DataStorage/IauEtVous/CartesEtDonnees/Mos/NomenclatureMOS-11-24-47-81.pdf`

[12]From number 6 to 11 of the French MOS, year 2017, 11 posts

With 3 classes per criteria, we had 27 possible combinations, but only 17 combinations actually existed. For each unique combination, we randomly selected a municipality.

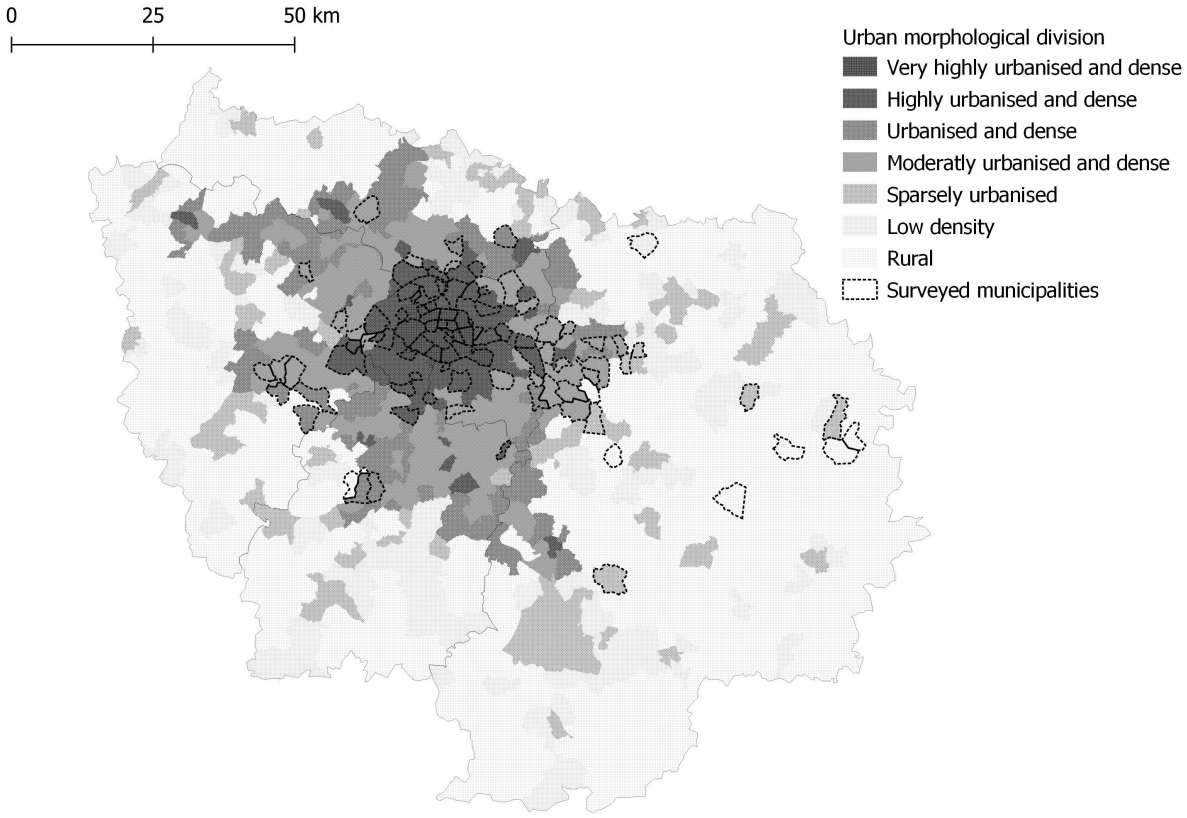


Figure 4: Geographical distribution of respondents according to the urban morphological division (Institut Paris Région)

Despite targeting the 17 selected cities, it was difficult to avoid interviewing people from other municipalities, but eventually, 66% of the respondents were from the sampled municipalities. Figure 4 represents all cities in which at least one individual of the survey resides.

A total of 320 respondents completed the questionnaire in full, while 13 respondents did not complete all the choice situations, leaving 307 useful responses (corresponding to 3,684 observations). We found no protest answers in the collected data, that is no respondents systematically chose the "stay at home" option. Table 3 presents the data on gender, age, socio-professional category, and revenue of the sample population and the region. In terms of age and income distribution, our sample is representative of the region: 52% of the respondents are women, and 60% earn less than 2,000€monthly. The age distribution matches that of the region, although the 45-59-year-old group is slightly under-represented, and the 18-29-year-old group is over-represented. In our sample, intermediate professions are under-represented, and employees are over-represented, possibly because we interviewed people in the streets during standard business hours when most workers are not outside. We rectified this disparity by applying a weight to the responses of the

categories that are under- or over-represented to match their proportions in the region. Our whole sample is small but sufficiently representative for drawing accurate conclusions.

Table 3: Sample and population characteristics

		Proportion of respondents in the sample (%)	Proportion of the population in Ile-de-France (%)
Gender	Male	48.0	48.0
	Female	52.0	52.0
Age class	[18,29]	30.1	20.4
	[30,44]	31.4	28.0
	[45,59]	18.6	25.5
	[60,74]	15.7	17.1
	Older than 75	4.2	9
Socio-professional category	Farmer	0.1	0.1
	Craftsman, retailer, entrepreneur	6.3	3.2
	Managerial and higher-education professions	17.6	17.7
	Intermediate professions	8.5	16.1
	Employees	29.5	16.8
	Workers	4.4	8.7
	Retirees	14.2	19.7
	Other without professional activity	19.5	17.8
Monthly disposable income	<1400\euro	32.5	30
	1400\euro to 2000\euro	35.0	30
	2000\euro to 3000\euro	20.0	20
	>3000\euro	12.5	10

Source : INSEE. Dossier complet. Région Ile-de-France at the 10th July 2021

4 Results

4.1 General perception of UGS characteristics

Table 4 presents the results of the ML model. All attributes, except shape and forest, were found to significantly influence respondents' choices. Individuals do not take into account whether a green space is linear. This result is consistent with Choumert and Travers (2010), who report that the form of a UGS does not influence UGS preferences. People also do not seem to take into account whether a UGS is a forest, possibly because they do not distinguish the difference between woodlands and forests. Respondents also seem to favour larger UGSs. The significant negative ASC coefficient indicates that people prefer going to a UGS rather than staying at home. The standard deviation is significant for all variables influencing respondents' choice, except for size and time. This result indicates significant variation in the respondents' preferences and some potential unobserved heterogeneity.

Table 4: Mixed Logit Estimates

Variables	Mean	SD
Shape	-0.909	-0.756
	(0.613)	(1.244)
Water	5.969***	5.635***
	(0.823)	(0.989)
Size	2.008***	-1.405
	(0.648)	(1.678)
Woodland	29.84***	21.17***
	(3.507)	(2.995)
Forest	-1.336	8.709***
	(1.666)	(2.057)
Bike	-3.730***	-9.834***
	(1.138)	(1.431)
Car or Public Transport	-5.638***	-13.89***
	(1.209)	(1.537)
ASC	-76.42***	45.22***
	(6.562)	(5.503)
Time	-3.284***	0.0928
	(0.0661)	(0.0720)

Standard errors in parentheses

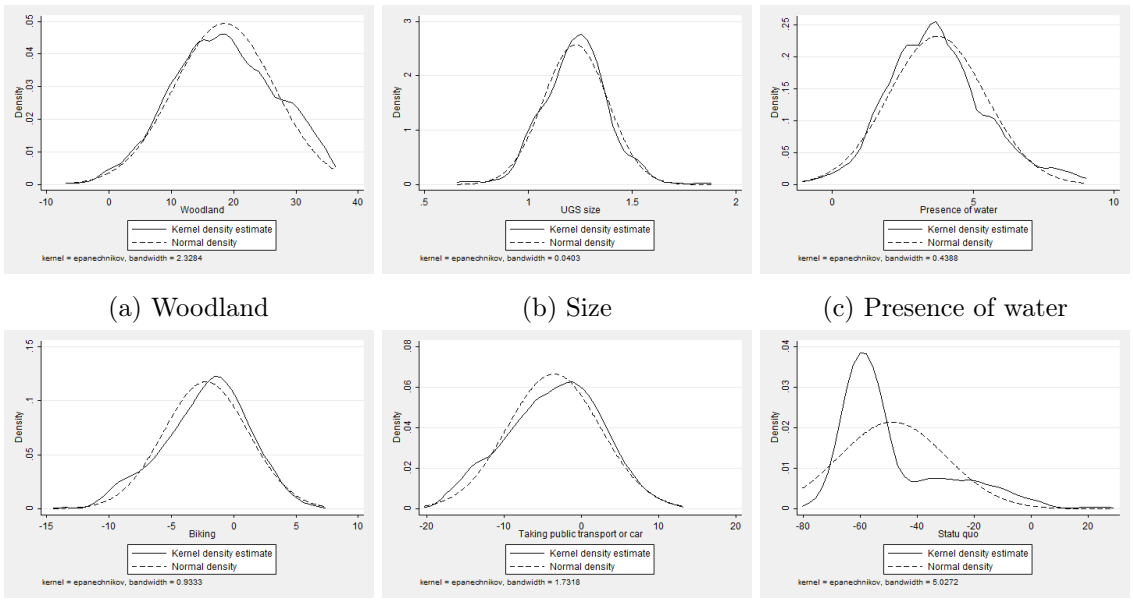
***p<0.01, ** p<0.05, * p<0.1

From equation 3, we calculate the average WTT for all significant attributes (Table 5) and show in figure 5 the kernel densities of the distribution of the individual parameter estimates (solid line) and corresponding normal distribution (dashed line).

Table 5: Willingness-to-accept additional travel time (WTT) and willingness-to-pay (WTP) estimates

	Woodland	Water	Size	Bike	Public transport or Car	Reach a UGS by foot	Stay at home
Average WTT	18 min	4 min	1 min	- 2 min	- 3 min 30	5 min 30	- 48 min
Average WTP	2.61€	0.58€	0.15€	- 0.29€	- 0.51€	0.80€	- 6.96€

Woodland People are positively influenced by the presence of trees when choosing a UGS. However, they do not derive higher utility from a forest compared to a woodland. Tree coverage is nevertheless the most sought-after characteristic: on average, people are willing to spend 18



(a) Woodland (b) Size (c) Presence of water

(d) Bike (e) Public Transport or Car (f) Stay-at-home alternative

Figure 5: Individuals' WTT distribution for each significant attribute (from subfigure a to e) and the stay-at-home alternative (f)

minutes to travel to a wooded UGS compared to a non-wooded UGS. Preferences regarding woodlands are also widespread: the minimum WTT is -4.5 minutes (refer to appendix D), while the maximum WTT is 34 minutes. These results indicate that people who dislike woodlands the most are still willing to travel to a wooded UGS rather than a non-wooded UGS if their travel time is reduced by 4.5 minutes. However, very few respondents have a negative WTT (refer to figure 5a), and the vast majority of people would agree to a higher travel time to visit a woodland than a non-wooded UGS.

Size Compared with a small UGS, a large UGS (greater than 1.5 ha) positively influence respondents' choice. However, respondents are not willing to spend much time travelling to a large UGS compared to a small UGS, as the average WTT is only 1 minute. The estimated WTT is concentrated, as the maximum WTT is approximately 2 minutes and the minimum WTT is 0.7 minutes.

Presence of water On average, the presence of water significantly increases respondents' utility. People on average are willing to travel an additional 4 minutes to visit a UGS with water compared to a UGS without water. Figure 5c shows that very few respondents associate the presence of water with decreased utility. This could be the case of disabled or elderly persons who could associate water with increased difficulties regarding mobility. However, the large majority of people associate the presence of water with increased utility, with a maximum WTT of 8 minutes and 30 seconds (refer to appendix D).

Bike To maintain a constant utility, people are willing to ride a bike instead of walking if their journey is reduced by 2 minutes. Although the average WTT for biking is negative, 35% of respondents are willing to accept a longer travel time by bike rather than that by foot (figure 5d). This finding indicates that more than one-third of respondents prefer going to a UGS by bike than by foot. This could mean that they enjoy the time spent travelling and value it positively if they are biking but do not value it if they are walking. In this case, the maximum accepted additional travel time is 6 minutes, which represents a distance of 1.6 km (biking at 16 km/hour).

Car or Public Transportation The average utility derived from going to a UGS by driving or taking public transportation instead of walking is negative. On average, people are willing to drive or take public transportation if their travel time is reduced by 3 minutes and 30 seconds. However, 34% of respondents prefer to go to a UGS with motorized transportation means rather than by foot (figure 5e). This could be the case for families or senior residents.

Stay at home The utility associated with staying at home is negative, indicating that people generally derive disutility from staying at home and prefer going to a UGS. This disutility is high as, on average, residents are willing to travel 48 minutes to enjoy UGS, which corresponds to 40% of the declared average recreational time spent on-site.

4.1.1 Preference heterogeneity

Plotted distributions in figure 5 indicate potential heterogeneity for woodland, water and size preferences as WTT distributions present some inflection points. We therefore assume the existence of distinctive groups of individuals having different preferences concerning UGS characteristics. Preferences concerning transportation modes described in the previous section also indicate the potential existence of distinctive groups. Indeed, a noticeable proportion of respondents receives an increased utility biking, taking public transport or driving. Concerning the ASC, the plotted distributions distinctly reveal two groups of individuals, with the inflection point at approximately -40 minutes.

As two groups of people with distinctive WTT for the stay-at-home alternative clearly emerge, we further explore preferences for the stay-at-home alternative and run the ML model with interaction terms. We investigate the influence of diverse socio-economic variables on the probability of choosing this alternative. These variables are described as follows: living in a highly urbanized municipality (more than 2/3 of the municipality's surface is urbanized); having a private garden; having children; benefiting from a monthly disposable income greater than 2,000€; having received higher education; and paying a high rent (greater than 19.5€per square meter). Detailed results are presented in appendix E. The interaction terms with the facts of living in an urbanized area with high rents are significant and positive. These results indicate that the more people live in urbanized areas with high rents, the more their disutility in staying at home reduces, even if this alternative still produces a disutility. This finding could be explained by the fact that neighbou-

rhoods with high rents in Ile-de-France are also those with limited access to UGSs. People leaving in these areas may have integrated the fact that they have little access to UGS (Faburel and Gueymard, 2008; Liotta *et al.*, 2020).

4.1.2 Latent classes

To determine how many classes best fit our data, we obtained the log-likelihood function (LLF), Bayesian information criterion (BIC) and Akaike information criterion (AIC) for an LC model with 2, 3, 4 and 5 classes (results figure in table 6). However, as the AIC seems to be biased towards an over-estimation of the number of classes (Scarpa and Thiene, 2005) and the BIC criteria seems to be biased towards an under-estimation of the number of classes for small sample sizes (Mclachlan and Peel, 2000), the choice of the appropriate number of classes should be based on not only model-quality indicators but also "the analyst's judgment on the meaningfulness of the parameter signs" (Scarpa and Thiene, 2005). Given that the larger the number of classes, the greater the possibility that the estimated parameters lose significance, we consider that 3 classes would produce an insufficient number of individuals in each class. Based on the predictive quality, we choose a 2-class model.

Table 6: Model comparison indicators

	Model comparison				Final calibration
Number of latent class	2	3	4	5	2
LLF	-2640.5	-2579.8	-2536.0	-2504.2	-2346.9
AIC	5318.9	5217.5	5150.0	5106.4	4749.9
BIC	5389.1	5324.6	5294.1	5287.4	4850.2
Predictive quality (%)*	96	89	88	87	96

*The predictive quality of the model measures the average probability of individuals belonging to their assigned class.

The results (Table 7) show that individuals living in denser areas, paying higher rents and having a private garden are more likely to belong to class 2 rather than class 1. Other socio-economic variables do not influence the probability to belong to one class or the other: having children, age, income, gender and education level. Class-2 profile tends to correspond to residents from the heart of the urban areas (Paris and inner suburbs) while class-1 profile is rather consistent with residents living in the outer suburbs (living in less dense and less expensive areas).

Table 8 presents the willingness to accept additional travel time of both classes for each attribute and its conversion in WTP. Regardless of the attribute, class-2 members accept to spend less time traveling to a UGS than residents from class-1. All residents would rather walk to wooded UGSs with water. While class-1 members could walk 23 minutes to a wooded UGS, class-2 members accept to walk 6 minutes. This represents around 1.9 km for class 1 (vs. 500m for class 2) for individuals walking at a 5km/h speed. Class-1 members could extend their travel time by 2 minutes (which represents a walking distance of roughly 166m) if the UGS is large while this attribute does not deserve additional time for class-2 members.

Table 7: Latent Class parameter and class membership results

Variables	Class 1	Class 2
Woodland	0.820***	1.068***
	(0.117)	(0.233)
Forest	0.0256	-0.0773
	(0.0659)	(0.131)
Shape of the UGS (linear)	-0.0243	0.00842
	(0.0239)	(0.0514)
Presence of water	0.196***	0.123**
	(0.0252)	(0.0543)
Size of the UGS	0.144***	0.125
	(0.0508)	(0.108)
Access by bike	-0.110***	-0.546***
	(0.0357)	(0.0752)
Access by car of public transport	-0.193***	-0.362***
	(0.0340)	(0.0678)
Travel time to reach the UGS	-0.0280***	-0.0383***
	(0.00259)	(0.00599)
ASC	-3.898***	-0.691***
	(0.326)	(0.211)
Class membership		
Urbanization ratio	-1.665**	
	(0.835)	
Having a private garden	-0.736*	
	(0.403)	
Rent price per square meter in the municipality	-0.0614*	
	(0.0361)	
Constant	4.278***	
	(1.003)	
Class share (in %)	68	32

Standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

The ASC for both classes is negative. As we coded the alternative specific constant on the "stay-at-home" alternative, this option seems to decrease the utility of individuals in both classes but not with the same amplitude. Even if all other attributes were held constant, the respondents would prefer moving from their current situation to improve UGS provision. The disutility for class 1 is however more important (approximately -140 min) than that estimated for class 2

Table 8: Willingness to travel additional time (WTT) and willingness to pay (WTP) for class 1 and class 2

Variables	Class 1 (living in relatively lower density and lower rents areas)		Class 2 (living in relatively higher density and higher rents areas)	
	WTT	WTP	WTT	WTP
Woodland	23 min	3.34€	6 min	0.87€
Non-wooded UGS	-23 min	-3.34€	-6 min	-0.87€
Water	6 min	0.87€	1 min	0.15€
Size	2 min	0.29€	0 min	0.00€
Bike	-1 min	-0.15€	-3 min	-0.44€
Car or Public Transport	-5 min	-0.73€	-2 min	-0.30€
Reach a UGS by foot	6 min	0.87€	5 min 30	0.80€

Should be read as: people of class 1 accept an additional travel time of 29 min to go to a wooded UGS by foot and people of class 2 accept an additional travel time of 11 min.

(approximately -18 min).

To sum up, class-1 members who tend to live in less dense and less expensive areas prefer walking to a large wooded UGS with water, while class-2 members, who tend to live in denser and more expensive areas, prefer walking to a wooded UGS with water regardless of its size. Both classes prefer to move from the *status quo* and see an improvement in the UGS provision, even if this preference is stronger for class-1 members.

Comparison between ML and LC models We applied the Vuong test to choose which model—between the ML and the 2-class LC—best fit our data. The results suggest that we cannot discriminate in favour of one model. Both models are equivalent, as the V-statistic equals 1.78. However, because class membership probability is linked to socio-demographic variables, the LC results would be more useful to public decision-makers. For example, a policy aimed at developing woodlands in city centres on the basis of an 18-min WTT—which is the average WTT estimated with the ML model—would result in disregarding class 2 members, who already lack access to UGSs (as 18 minutes exceeds their acceptable travel time).

5 Discussion

Our principal results suggest a high heterogeneity in preferences between city-centre dwellers living in dense and more expensive environments and outer suburb dwellers living in less dense and more inexpensive environments. The major differences lie in (1) the disutility of remaining in the *status quo* scenario, which is much lower for city-centre dwellers, (2) the global time budget that dwellers are willing to dedicate to reach a UGS, which is much lower for city centre dwellers, and (3) the size characteristic of a UGS (>1.5 hectares), which is important for suburban inhabitants but not for inhabitants of city centres.

More generally, our results provide insight to improve the quality of urban green spaces in a region experiencing densification and urban sprawl. The quantitative approach to develop UGSs (i.e. 10 m^2/inhabitants or 300m-distance from home) bears the risk of developing urban green spaces that do not meet residents' needs.

In a context of increased densities in many metropolitan cities in the developed and developing world, policies investing in small UGSs in highly urbanized areas can increase the welfare of city-centre dwellers. This result is consistent with Choumert and Travers (2010) who also report that developing small UGSs would be a suitable policy in Angers. Peschardt *et al.* (2012) using interviews in "pocket parks" of Copenhagen show that these parks improve residents' everyday life. In the case of the Paris Metropolitan region, small UGSs with trees rather than grass would respond to residents' needs in the city center.

We find that residents less willing to spend time traveling to a UGS tend to live in denser and more expensive areas. One could expect on the contrary that residents living in denser areas have less access to urban green spaces (this corresponds to Paris *intra-muros* and the little crown) and would therefore be willing to spend more time to benefit from green spaces. Maat and de Vries (2006) study supports this counter-intuitive result. The authors test the compensation theory stating that people living in less green environments would value UGS more. They show that this hypothesis is not validated in the case of the Municipality of Arnhem, in the Netherlands. For the authors, a possible explanation is self-selection: when deciding on a residential location people who value urban green spaces will choose a residential location close to UGSs. Tu *et al.* (2016) results also invalidate the compensation theory by suggesting that wealthier residents benefit from substitutes such as street trees. They could also afford to pay to have access to private UGS or could travel to the countryside on weekends. Residents from less dense and less expensive neighborhoods could be less sensitive to this type of substitution effect. It is also worth noticing that even though residents living in areas that are more expensive are less willing to spend time reaching a UGS, they still prefer not to remain in a status quo scenario and value better access to UGS.

In less urbanized areas and municipalities with lower rents, policies could aim at developing large, wooded UGSs, with water and improved walking access. This type of UGS answers better to inhabitants' needs. This is in line with the findings of Tu *et al.* (2016) showing that urban forests and parks are not substitutes. These results provide insight for resource allocation showing

that public policies can deviate from the "300m-distance from home" or 10 m^2/inhabitants rules by providing more qualitative UGSs in outer suburbs. Indeed, dwellers seem to accept to travel longer distances to reach a qualitative UGS. Public policies can thus adapt these quantitative thresholds according to UGSs quality.

By converting the willingness to spend additional time to reach a UGS in monetary terms, we find that residents belonging to class 2 are willing to pay 0.87€to benefit from wooded UGSs while this amount reaches 3.34€for class-1 members. If we take the example of a fictive project of afforestation of the Park André Malraux in Nanterre city, we can estimate the budget that residents would be willing to support to plant trees. Nanterre is a highly populated city with a low access rate to nature (Liotta al., 2020). In this example, if we make the hypothesis that all Nanterre residents belong to class 2 (as their socio-economic characteristics corresponds to class 2 members), we compute that around 13,200 inhabitants[13] would visit the wooded UGS after the reforestation project, which represents a budget of roughly 11,500€. Based on the financial figures provided by the French National Forest Office for an afforestation project in Sénart (another city located in the big crown), this could finance 2 ha of afforestation[14].

Although these results are useful for calibrating land-use planning in urban areas, urban greening and conservation policies cannot be measured by the sole channel of recreational services. Complementary research includes exploring other ecosystem services, such as urban heat island mitigation, natural heritage and water retention (Tardieu *et al.*, 2021). Moreover, greening policies may also consider environmental justice considerations when targeting future UGS development. Liotta *et al.* (2020) show that in the case of the Paris Metropolitan area, targeting areas less endowed with UGSs, for example in Paris *intra-muros* or in the west of the little crown, could benefit the more affluent segment of the population.

Our results should be considered within the limits of the IDEFESE project and the specific interests of its stakeholders (Hamel *et al.* 2021; Tardieu *et al.* 2021). For example, regarding the choice of attributes, the focus groups led to include both time and mode of transportation, which are considered as independent variables in the analysis. Even though transportation time is highly variable in the Paris Metropolitan area, these two variables may not be entirely independent. In the present study, we consider that each respondent realized the choice experiment considering that no other transportation mode than the one suggested in each alternative was available. As the transportation mode was given, we believe that respondents evaluated transportation time independently. Since this hypothesis is based on the guidelines provided to respondents but has not been tested, it constitutes a limit to our study.

Our work also presents the limits of stated preferences methods, including hypothesis bias

[13]This is calculated based on a density of 7,941 inhabitants/km^2, this corresponds to the number of residents living at a maximum of 6min-walk to the park, which corresponds to a 500m-wide circle around the park, if people walk at a 5km/h speed

[14]This is calculated based on the publicly available figures provided by the ONF (French Forest Organization) for the afforestation project of the Sénart Forest : 38,700 plants cost 110,000€with a density of 2,000 plants/ha in the densest areas.

(when respondents have difficulty envisioning fictive situations) and anchoring bias (when respondents rely too much on the first information they obtain when they make a decision). Responses might also have been influenced by the presence of the interviewer as some studies report higher WTP with face-to-face interviews than online or self-reported questionnaires (Snowball and Willis, 2011; Lindhjem and Navrud, 2011). These findings could be tested with a mixed survey (online and face-to-face) to assess if they also apply in the case of UGS choices.

Our study also disregards the spatial connection between green spaces, which may have a strong influence on individuals' preferences to practice some activities, such as running or cycling. For instance, STRAVA data show that Francilians cover different types of green spaces when they run[15]. This aspect could be integrated in further research.

However, these limits can be nuanced due to the high consistency between the DCE results and the actual behaviours of residents. As the questionnaire addressed people's actual behaviour regarding UGSs, we can compare the LC results to their actual willingness to dedicate time to reach a UGS[16]. The results reveal that class 2 members, who are more urbanized dwellers and less willing to travel to reach a UGS, effectively spend less time to reach a UGS than class 1 members. The individuals in class 2 stated travelling an average of 17 min to reach a UGS, while those in class 1 declare travelling an average of 19 min, mostly by foot. When examining the most frequently travelled distances, individuals belonging to class 2 on average travel 1.02 km (approximately 17 minutes by foot for a speed of 3.6 km/h), and individuals of class 1 on average travel 2.22 km (approximately 37 minutes by foot). These answers correspond to the same orders of magnitudes of the WTTs obtained in the DCE. However, even if class 2 members are less willing to spend time reaching a UGS, individuals visit it more frequently (93 times/year on average; median of 50) compared to individuals from class 1 (74 times/year on average; median of 42).

Even if our results are foremost instructive for the Paris Metropolitan area, they might be representative of other large metropolitan areas. They are consistent with the findings of Suárez *et al.* (2020), who also find that inhabitant's residence location and particularly, whether it is situated in a central area or an outlying area, influence Oslo's residents' outdoor recreational preferences. These results indicate that an individual's place of residence, characterized by its urbanization degree, is likely to influence their preferences regarding UGS characteristics in large European cities. However, as cultural factors influence UGS use (Lo and Jim, 2010), we cannot confirm this hypothesis. Further studies in other dense and populated cities are needed to corroborate our results.

[15]See `https://bit.ly/3Gouvbb`

[16]In the questionnaire, respondents indicated the time spent travelling to the most visited park in the past year and their mode of transportation (walking, biking, public transportation or car). Actual distances to the most visited UGS were calculated with the distance between the centroid of their municipality (the only data available from the survey) and the centroid of the most visited park. Results were double-checked using the stated travel time and travel mode indicated by the respondent by assuming a walking speed of 3.6 km/h, a cycling speed of 16 km/h and a travel speed of 60 km/h for driving and public transportation.

6 Conclusion

Urban greening has become an important component of the urban political agenda. Targeting future UGS development in highly urbanized areas is a difficult issue as land is increasingly scarce (and expensive) and the social demand for natural amenities increases. This study attempts to provide useful insights to public decision-makers for a better allocation of UGSs according to their characteristics and the socio-demographic profiles of potential users. We show with a DCE that dwellers' preferences concerning UGSs are likely to strongly differ according to the urbanization level of their residence location. While all residents value wooded UGSs, the presence of water, the ability to travel to a UGS by foot, the time budget they are willing to dedicate to reach UGSs is much lower for people living in denser, more urbanized and more expensive environments.

We also show that the size of a UGS is valued by inhabitants of outer areas but not necessarily by residents of central districts. This finding suggests that outer suburb inhabitants would prefer larger UGSs, even if they are located farther away, while inner centre inhabitants would prefer multiple, nearby and even smaller UGSs. Our results call for a better integration of individual preferences in the process of urban greening and suggest that the "access to UGS" criterion may be subjective.

Acknowledgements

This research was funded by ADEME, MTES and AgroParistech. This study is part of the IDEFESE project (https://idefese.wordpress.com/). We thank Claire Benedetti, Claire Lefebvre, Victor Leon, Lucie Thiolliere, and Baptiste Wozniak for their help with the interviews. We also thank all the stakeholders involved in the IDEFESE project for their useful feedbacks, and in particular, the Ile-de-France region and the Institut Paris Region. We also thank the entire IDEFESE team for their useful comments on a previous version of the manuscript. We express our sincere gratitude to the three reviewers and editor of the journal for their time and detailed comments, which helped us to greatly improve the quality of the manuscript.

Conflict of Interest

The authors declare that they have no conflicts of interest.

References

Alberti V., Alonso Raposo M., Attardo C., Auteri D., Ribeiro Barranco R., Batista e Silva F., Benczur P., Bertoldi P., Bono F., *et al.* [2019], The Future of Cities: Opportunities, Challenges and the Way Forward. *Working Paper JRC116711*, European Commission.

Arnberger A., Eder R. [2011], The Influence of Age on Recreational Trail Preferences of Urban Green-Space Visitors: a Discrete Choice Experiment with Digitally Calibrated Images, *Journal of Environmental Planning and Management*, 54, 891–908.

Bech M., Gyrd-Hansen D. [2005], Effects Coding in Discrete Choice Experiments, *Health Economics*, 14(10), 1079–1083.

Bertram C., Meyerhoff J., Rehdanz K., Wüstemann H. [2017], Differences in the Recreational Value of Urban Parks Between Weekdays and Weekends: A Discrete Choice Analysis, *Landscape and Urban Planning*, 159, 5–14.

Boxall P., Adamowicz W.L., Moon A. [2009], Complexity in Choice Experiments: Choice of the Status Quo Alternative and Implications for Welfare Measurement, *Australian Journal of Agricultural and Resource Economics*, 53(4), 503–519.

Brun M., Di Pietro F., Bonthoux S. [2018], Residents' Perceptions and Valuations of Urban Wastelands are Influenced by Vegetation Structure, *Urban Forestry & Urban Greening*, 29, 393–403.

Bullock C. [2008], Valuing Urban Green Space: Hypothetical Alternatives and the Status Quo, *Journal of Environmental Planning and Management*, 51, 15–35.

Cabral P., Feger C., Levrel H., Chambolle M., Basque D. [2016], Assessing the Impact of Land-Cover Changes on Ecosystem Services: A first Step Toward Integrative Planning in Bordeaux, France, *Ecosystem Services*, 22, 318–327.

Cesario F.J. [1976], Value of Time in Recreation Benefit Studies, *Land Economics*, 52(1), 32–41.

Choumert J., Salanié J. [2008], Provision of Urban Green Spaces: Some Insights from Economics, *Landscape Research*, 33(3), 331–345.

Choumert J., Travers M. [2010], La Capitalisation Immobilière des Espaces Certs dans la Ville d'Angers. Une Approche Hédoniste, *Revue Economique*, 61(5), 821–836.

De Valck J., Landuyt D., Broekx S., Liekens I., De Nocker L., Vranken L. [2017], Outdoor Recreation in Various Landscapes: Which Site Characteristics Really Matter?, *Land Use Policy*, 65, 186–197.

Earnhart D. [2003], Do Travel Cost Models Value Transportation Properly?, *Transportation Research Part D: Transport and Environment*, 8, 397– 414.

Faburel G., Gueymard S. [2008], Inégalités Environnementales en Région Île-de-France: Le Rôle Structurant des Facteurs Négatifs de l'Environnement et des Choix Politiques Afférents, *Espace Populations Sociétés*, 2008/1, 159–172.

Feather P., Shaw W.D. [1999], Estimating the Cost of Leisure Time for Recreation Demand Models, *Journal of Environmental Economics and Management*, 38(1), 49–65.

Hamel P., Guerry A.D., Polasky S., Han B., Douglass J.A., Hamann M., Janke B., Kuiper J.J., Levrel H., Liu H., *et al.* [2021], Mapping the Benefits of Nature in Cities with the InVEST Software, *Urban Sustainability*, 1(1), 1–9.

Hanley N., Wright R., Adamowicz V. [1998], Using Choice Experiments to Value the Environment, *Environmental and Resource Economics*, 11(3), 413–428.

Heerwegh D., Loosveldt G. [2008], Face-to-Face Versus Web Surveying in a High-Internet-Coverage Population: Differences in Response Quality, *Public Opinion Quarterly*, 72(5), 836–846.

Hofmann M., Westermann J., Kowarik I., Van der Meer E. [2012], Perceptions of Parks and Urban Derelict Land by Landscape Planners and Residents, *Urban Forestry & Urban Greening*, 11(3), 303-312.

Hoyos D. [2010], The State of the Art of Environmental Valuation with Discrete Choice Experiments, *Ecological Economics*, 69(8), 1595–1603.

Ives C.D., Oke C., Hehir A., Gordon A., Wang Y., Bekessy S.A. [2017], Capturing Residents' Values for Urban Green Space: Mapping, Analysis and Guidance for Practice, *Landscape and Urban Planning*, 161, 32–43.

Kong F., Yin H., Nakagoshi N. [2007], Using GIS and Landscape Metrics in the Hedonic Price Modelling of the Amenity Value of Urban Green Space, *Landscape and Urban Planning*, 79, 240–252.

La Rosa D., Takatori C., Shimizu H., Privitera R. [2018], A planning Framework to Evaluate Demands and Preferences by Different Social Groups for Accessibility to Urban Greenspaces, *Sustainable Cities and Society*, 36.

Lancaster K.J. [1966], A New Approach to Consumer Theory, *Journal of Political Economy*, 74(2), 132–157.

Larson D.M., Shaikh S.L., Layton D. [2004], Revealing Preferences for Leisure Time From Stated Preference Data, *American Journal of Agricultural Economics*, 86(2), 307-320.

Levrel H., Cabral P., Feger C., Chambolle M., Basque D. [2017], How to Overcome the Implementation Gap in Ecosystem Services? A User-Friendly and Inclusive Tool for Improved Urban Management, *Land Use Policy*, 68, 574–584.

Lindhjem H., Navrud S. [2011], Are Internet Surveys an Alternative to Face-to-Face Interviews in Contingent Valuation?, *Ecological Economics*, 70(9), 1628–1637.

Liotta C., Kervinio Y., Levrel H., Tardieu L. [2020], Planning for Environmental Justice - Reducing Well-Being Inequalities through Urban Greening, *Environmental Science & Policy*, 112, 47–60.

Lo A., Jim C.Y. [2010], Willingness of Residents to Pay and Motives for Conservation of Urban Green Spaces in the Compact City of Hong Kong, *Urban Forestry & Urban Greening*, 9(2), 113–120.

Maat K., De Vries P. [2006], The Influence of the Residential Environment on Green-Space Travel: Testing the Compensation Hypothesis, *Environment and Planning A*, 38(11), 2111–2127.

McFadden D. [1973], Conditional Logit Analysis of Qualitative Choice Behavior, in: Zarembka P. (ed.), *Frontiers in Econometrics*, New-York, New-York Academic Press, 105-142.

Mclachlan G., Peel D. [2000], *Finite Mixture Models*. New-York, John Wiley.

Niemelä J., Saarela S.R., Söderman T., Kopperoinen L., Yli-Pelkonen V., Väre S., Kotze D.J. [2010], Using the Ecosystem Services Approach for Better Planning and Conservation of Urban Green Spaces: a Finland Case Study, *Biodiversity and Conservation*, 19(11), 3225–3243.

Pacifico D., Yoo H. [2012], Lclogit: A Stata Module for Estimating Latent Class Conditional Logit Models via the Expectation-Maximization Algorithm, *Stata Journal*, 13.

Palmquist R.B., Phaneuf D.J., Smith V.K. [2010], Short Run Constraints and the Increasing Marginal Value of Time in Recreation, *Environmental and Resource Economics*, 46(1), 19–41.

Parsons G.R. [2017], The Travel Cost Model, in: Champ P.A., Boyle K.J., Brown T.C., Peterson L.G. (eds.), *A Primer on Nonmarket Valuation. 2nd Edition*. Dordrecht, Springer.

Peschardt K.K., Schipperijn J., Stigsdotter U.K. [2012], Use of Small Public Urban Green Spaces (SPUGS), *Urban forestry & Urban Greening*, 11(3), 235–244.

Picard P.M., Tran T.T.H. [2021], Small Urban Green Areas, *Journal of Environmental Economics and Management*, 106.

Quinet E. [2013], L'Evaluation Socioéconomique des Investissements Publics, *rapport*, Commissariat général à la Stratégie et à la Prospective.

Remme R.P., Frumkin H., Guerry A.D., King A.C., Mandle L., Sarabu C., Bratman G.N., Giles-Corti B., Hamel P., Han B., *et al.* [2021], An Ecosystem Service Perspective on Urban Nature, Physical Activity, and Health, *Proceedings of the National Academy of Sciences*, 118(22).

Riera Font A. [2000], Mass Tourism and The Demand for Protected Natural Areas: a Travel Cost Approach, *Journal of Environmental Economics and Management*, 39(1), 97–116.

Roussel S., Salles J.M., Tardieu L. [2016], Recreation Demand Analysis of Sensitive Natural Areas from an On-Site Survey, *Revue d'économie Regionale et Urbaine*, 2016/2, 355–384.

Rulleau B., Dehez J., Point P. [2010], Une Approche Multi-Attributs de la Demande de Loisirs sur les Espaces Naturels: l'Exemple de la Forêt Publique, *Revue Française d'économie*, 25(1), 175–211.

Sander H., Polasky S. [2009], The Value of Views and Open Space: Estimates from a Hedonic Pricing Model for Ramsey County, Minnesota, USA, *Land Use Policy*, 26, 837–845.

Scarpa R., Thiene M. [2005], Destination Choice Models for Rock Climbing in the Northeastern Alps: a Latent-Class Approach Based on Intensity of Preferences, *Land Economics*, 81(3), 426–444.

Schindler M., Le Texier M., Caruso G. [2018], Spatial Sorting, Attitudes and the Use of Green Space in Brussels, *Urban Forestry Urban Greening*, 31, 169–184.

Snowball J.D., Willis K.G. [2011], Interview Versus Self-Completion Questionnaires in Discrete Choice Experiments, *Applied Economics Letters*, 18(16), 1521–1525.

Suárez M., Barton D.N., Cimburova Z., Rusch G.M., Gómez-Baggethun E., Onaindia M. [2020], Environmental Justice and Outdoor Recreation Opportunities: A Spatially Explicit Assessment in Oslo Metropolitan Area, Norway, *Environmental Science Policy*, 108, 133-143.

Swanwick C. [2009], Society's Attitudes to and Preferences for Land and Landscape, *Land Use Policy*, 26(Suppl. 1), S62-S75.

Tardieu L., Viguié, V., Hamel P., Lemonsu A., De Munck C., Kervinio Y., Coste L., Claron C., Faure E., Geoffroy E., *et al.* [2020], Prise en Compte des Services Ecosystémiques dans les Décisions d'Aménagement Urbain - Méthodologie et Retour d'Expérience du Projet IDEFESE Mené en Ile-de-France, *Rapport Efese*, La documentation Française.

Tardieu L., Hamel P., Viguié V., Coste L., Levrel H. [2021], Are Soil Sealing Indicators Sufficient to Guide Urban Planning? Insights from an Ecosystem Services Assessment in the Paris Metropolitan Area, *Environmental Research Letters*, 16(10).

Thompson C.W., Aspinall P., Montarzino A. [2008], The Childhood Factor: Adult visits to Green Places and the Significance of Childhood Experience, *Environment and Behavior*, 40(1), 111–143.

Train K., Weeks, M. [2005], Discrete Choice Models in Preference Space and Willingness-to-Pay Space, in: Scarpa R., Alberini A. (eds.), *Applications of Simulation Methods in Environmental and Resource Economics*, Dordrecht, Springer.

Tu G., Abildtrup J., Garcia S. [2016], Preferences for Urban Green Spaces and Peri-Urban Forests: An analysis of Stated Residential Choices, *Landscape and Urban Planning*, 148, 120–131.

World Health Organization. [2016], Urban Green Spaces and Health - a Review of Evidence, WHO Regional Office for Europe, Copenhagen.

Appendices

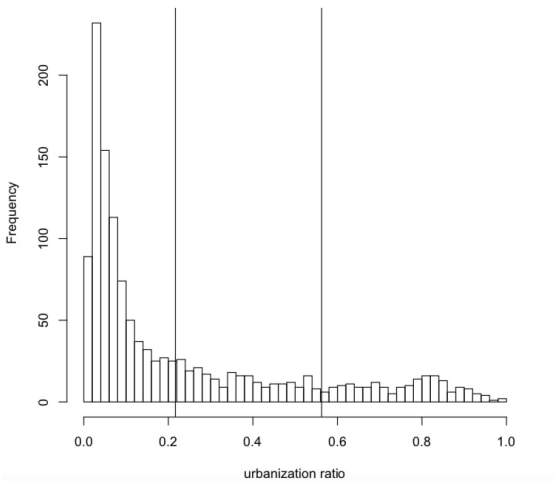
A Composition of IDEFESE focus groups

Institution type	Institution	Department (number of interviewees)
Administration		
Ministry	French ministry of the environment	General commission of the sustainable development (3) General direction of planning, housing and nature (2) Urban planning, construction, development (1)
Decentralized state services	Interdepartmental regional directorate for equipment and planning (DRIEA)	Development and land planning department (2) Urban planning documents office (1) Service of knowledge and prospective studies (1)
	Interdepartmental regional directorate of food agriculture and forest (DRIAAF)	Commission of preservation of natural, agricultural and forest areas (1) Regional service of forest, wood and biomass (2)
	Departmental directorate of territories (DDT)	Planning department (2) Urban planning and regulations department (1)
Local authorities	Region Metropolis Municipality	Region Ile de France advisor (1) "Grand Paris" advisor (2) Paris city advisor (1) City council (2) Urban planning department (1)
Regional assembly	Social and environmental economic advice (CESER)	Committee on Spatial Planning and Employment (2)
Agencies	Institute of urban planning	Department of Urban and Rural Environment (1) Planning Mission (1) Project managers (2)
	Natural park office	Director (1)
	National forest office Environment and Energy Management Agency Regional agency of biodiversity National agency for biodiversity French agency for development	Project manager (1) Project manager (1) Project managers (2) Project managers (1) Project managers (1)
Groups	Chambers of agriculture Public interest group for forests	Project manager (1) Director (1)
Developers	Local planning and development authority Consulting agency	General directorate (1) Parisian agency (1)
NGOs	France Nature Environnement Terres de liens European river network	Departmental federations (8) Project manager (2) Project manager (1)
Think tank and scientific institutions	AgroParisTech Météo-France IDDRI	Ecology (1) Urban climatology (2) Political sciences (1)

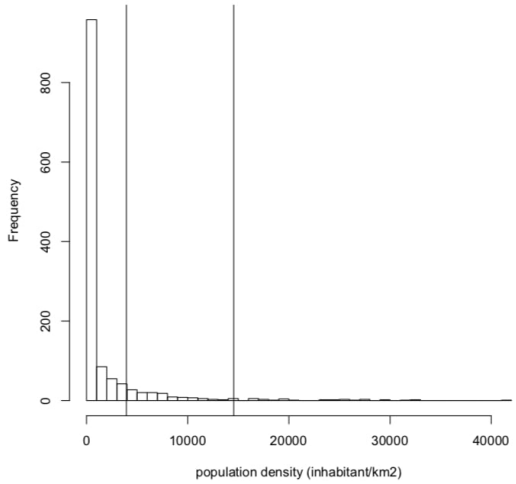
B Transportation time depending on transportation mode to travel a fixed distance

Distance trip (km)	Trip departure/ Trip destination	Travel-time by car (min without traffic jam - min with traffic jam)	Travel-time by public transport (min)	Travel-time by bike (min)	Travel-time by foot (min)
2.6	Paris/Paris	10 – 15	20	15	30
10	Paris/Little crown	30 – 70	25	35	120
15	Paris/Little Crown	35 – 70	40	45	N.A
20	Paris/Big Crown	35 – 60	30	50 (with electric assistance)	N.A
30	Paris/Big crown	40 – 90	45	90 (with electric assistance)	N.A
50	Paris/Big Crown	40 – 110	30	N.A	N.A

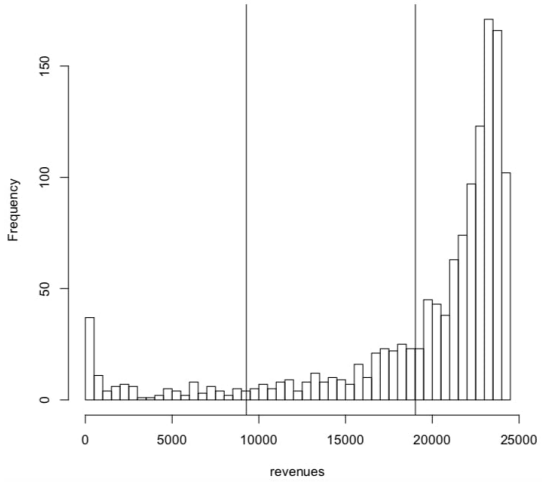
C Jenks class results for clustering municipalities



(a) Clusters of municipalities according to their urbanization ratio



(b) Clusters of municipalities according to their population density



(c) Clusters of municipalities according to their revenue

D Mixed logit results : minimum and maximum WTT

	Woodland	Water	Size	Bike	Public transport or Car	Reach a UGS by foot	Stay at home
Average WTT	18 min	4 min	1 min 20	- 2 min	- 3 min 30	5 min 30	- 48 min
Minimum WTT	4 min 30	- 1 min	1 min	- 13 min	- 18 min	-31 min	- 75 min
Maximum WTT	34 min	8 min 30	2 min	6 min	11 min	17 min	24 min

E Mixed logit with interactions

Variables	Mean	SD
Shape	-0.851	1.236
	(0.607)	(1.107)
Water	5.873***	-5.949***
	(0.815)	(1.017)
Size	1.871***	-0.127
	(0.633)	(1.597)
Woodland	31.39***	23.85***
	(3.604)	(2.486)
Forest	-1.965	3.144
	(1.581)	(2.096)
Bike	-3.470***	8.822***
	(1.108)	(1.537)
Car or Public Transport	-6.784***	-15.40***
	(1.260)	(1.578)
ASC	-83.78***	-22.40***
	(7.949)	(4.697)
ASC*urb_high	12.11**	-13.46*
	(6.038)	(7.302)
ASC*garden	9.544**	-18.04***
	(4.312)	(6.483)
ASC*children	-4.699	27.14***
	(3.657)	(8.183)
ASC*income_sup2000	8.889	-40.02***
	(6.021)	(6.085)
ASC*higher_education	-8.080	-12.91*
	(6.151)	(6.780)
ASC*rent_high	11.08*	-9.947*
	(6.129)	(5.941)
time	-3.268***	0.0667
	(0.0665)	(0.0959)

Standard errors in parentheses

*** p0.01, ** p0.05, * p0.1

F Questionnaire example

T1

Questionnaire on green spaces in Ile-de-France

Hello,

We are conducting a survey in Ile-de-France to better understand people's preferences concerning green spaces (parks, forests, riverbanks, etc.) in Ile-de-France.

Would you please have a few minutes to answer the questionnaire? *(10 minutes maximum)*

The questionnaire is **anonymous**.

Only persons over 18 years-old are allowed to answer

Profile

1) What is your place of residence?

CITY	POSTAL CODE
_____	_____

2) Are you a man or a woman?

☐ Man ☐ Woman

3) How old are you?

☐ 18 – 29 years-old ☐ 45 – 59 years-old ☐ 75 years-old and older
☐ 30 – 44 years-old ☐ 60 – 74 years-old

4) What is your socio-professional category?

☐ Farmer
☐ Craftsman, Retailer, Entrepreneur
☐ Managerial and higher-education profession
☐ Intermediate profession
☐ Employee
☐ Worker
☐ Retiree
☐ Other without professional activity

5) How many adults and children (without age limit) constitute your household ?

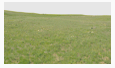
ADULT(S)	CHILD/CHILDREN (if any)
_____	_____

Choice experiment

For your next visit, what would be your favourite green space among the 3 alternatives suggested?

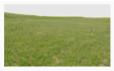
If your answer involves « Car or Public Transport », circle which one you would rather take.

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			I choose neither of both green spaces
Shape			
Presence of a water body			
Size	Large* / Long*	Small** / Short**	
Transport mode	Biking / Trotinette	By foot	
Transportation time	5 min	30 min	
Choice			

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			I choose neither of both green spaces
Shape			
Presence of a water body			
Size	Small** / Short**	Large* / Long*	
Transport mode	Biking / Trotinette	Public Transport/Car	
Transportation time	5 min	30 min	
Choice			

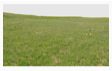
*__Large/Long:__ corresponds to a green space larger than 1.5ha (100x150m) or longer than 1.5 km

**__Small/Short :__ corresponds to a green space smaller than 1.5ha (100x150m) or shorter than 1.5 km

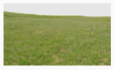
Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Large* / Long*	Small** / Short**	
Transport mode	By foot	Biking / Trotinette	
Transportation time	10 min	20 min	
Choice			3

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Small** / Short**	Large* / Long*	
Transport mode	By foot	Public Transport/Car	
Transportation time	20 min	10 min	
Choice			4

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Small** / Short**	Large* / Long*	
Transport mode	Public Transport/Car	Biking / Trotinette	
Transportation time	30 min	5 min	
Choice			5

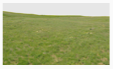
Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Small** / Short**	Large* / Long*	
Transport mode	By foot	Biking / Trotinette	
Transportation time	10 min	20 min	
Choice			6

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Small** / Short**	Large* / Long*	
Transport mode	Public Transport/Car	By foot	
Transportation time	10 min	20 min	
Choice			7

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Large* / Long*	Small** / Short**	
Transport mode	Public Transport/Car	Biking / Trotinette	
Transportation time	5 min	30 min	
Choice			8

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Large* / Long*	Small** / Short**	
Transport mode	Biking / Trotinette	Public Transport/Car	
Transportation time	30 min	5 min	
Choice			

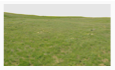
9

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Large* / Long*	Small** / Short**	
Transport mode	By foot	Public Transport/Car	
Transportation time	20 min	10 min	
Choice			

10

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			
Shape			
Presence of a water body			I choose neither of both green spaces
Size	Small** / Short**	Large* / Long*	
Transport mode	Biking / Trotinette	By foot	
Transportation time	20 min	10 min	
Choice			

11

Green space attributes	Alternative 1	Alternative 2	Status quo
Forest cover			I choose neither of both green spaces
Shape			
Presence of a water body			
Size	Large* / Long*	Small** / Short**	
Transport mode	Public Transport/Car	By foot	
Transportation time	30 min	5 min	
Choice			

12

Have you systematically omitted one or several attribute(s) in the choices you had to make? If yes, which one?

Respondent's type

1) **How many times have you been to a green space (park, forest, riverbank, garden…) last year (March 2018 to March 2019)?**

2) **What is the name of the green space you visited the most last year (March 2018 to March 2019)?**

3) **What activities do you usually do when going to a green space? (Rank from 1 to 3)**

☐ Walk the dog
☐ Practice sports
☐ Cool-off
☐ Enjoy kids' facilities
☐ Observe nature
☐ Fishing / Hunting
☐ Have a picnic
☐ Relax
☐ Walk
☐ Other: ……

4) **How long do you stay in average in a green space?**

5) **How long it took you to go to a green space, in average, last year (March 2018 to March 2019)?**

6) **What facilities do you prefer when going to a green space?**

☐ None
☐ Benches

☐ Lights
☐ Sports facilities
☐ Playground for kids
☐ Food and beverage facilities
☐ Multiple entries and exists
☐ Other: ……

7) In average last year (March 2018 to March 2019), how much did you spend for your green spaces' excursion (sport equipment, binoculars, fishing rod…)?

8) Did you feel secure the last time you went to a green space?

☐ Yes
☐ No

9) What are the 3 main activities that you do when leaving your house?

1: 2: 3:

10) Do you have a private garden?

☐ Yes
☐ No

11) Do you feel concern by environmental issues?

☐ Yes, a lot
☐ Yes but not more than other issues
☐ Not that much
☐ Not at all

6) Which income range do you fall under (net, but including social services)?

☐ Strictly lower than 1 400 euros
☐ Between 1 400 and 2 000 euros
☐ Between 2 000 and 3 000 euros
☐ More than 3 000 euros

7) What is the highest diploma you obtained?

☐ None, French Certificate of general Education
☐ Certificate of professional competence or Higher technical certificate
☐ Baccalaureate (general, technological or professional)
☐ Higher education diploma

Interview

Place of the interview:

Date and hour :