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Crowding Externalities from Tourist Use of Urban Space

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Crowding Externalities from Tourist Use of Urban Space

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Popular urban tourist destinations are attracting large numbers of both overnight visitors and excursionists. Since urban cities perform a multitude of functions, the space requirements of tourists can, at times, interfere with those of local users. This paper addresses the issue of disutilities of space congestion through a dichotomous choice experiment model in order to offer a monetary valuation of tourist crowding in urban public space. A resident survey was carried out in the city of Amsterdam in order to estimate a random parameter logit model through which the residents' willingness to pay to avoid unfavourable crowding situations can be assessed. Their willingness to pay in order to increase the use levels by visitors in the Dam area from 'not at all crowded' or 'not crowded' to 'crowded' was respectively €1.36 and €0.83 annually, while the mean willingness to pay for a decline in the use level from 'very crowded' to 'crowded' was estimated to be €11.06 a year. While tourism is only partly responsible for these crowding levels, the results demonstrate that the social effects of tourist consumption can be positive as well as negative, depending on the existing use level and attitudinal perceptions of residents.

Keywords: public space, crowding, externalities, choice experiments, tourism, willingness to pay

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1. The Rise and Impacts of Urban Tourism

Throughout history, urbanised regions have continually attracted travellers (Page and Hall, 2003). However, only in the last century has travelling become associated with leisure, as can be seen from the word 'tourism', which has its etymological origin in the French 'travailler' (i.e., to work). Travelling in the past was mainly undertaken by scientists, merchants and pilgrims; as a necessity for knowledge acquisition, economic survival or borne out of religious piety. It was not until the 1960s that tourism as a leisure activity became more widespread. Since then, we have witnessed a continuous rise of a new leisure society, influenced by an increasingly mobile lifestyle, a higher discretionary income, more leisure time, new transportation means, and rapid developments in ICT services. In the past 15 years alone, international tourist arrivals have increased by approximately 77%, from 528 million in 1995 to 935 million in 2010 (WTO, 2011). In contemporary society, travelling is considered a necessity for completely different reasons than in the past, ranging from relieving occupational stresses to an existential search for the authentic self. Travellers have become the new ‘Argonauts’.

While advances in transportation, coupled with an increasing global awareness and interest in travel have opened up nearly all corners of the world, urban destinations have continued to rank among the most important tourist centres, receiving a large share of the total tourist arrivals. The top 150 city destinations of the world accounted for over 25% of global inbound tourism in 2006, supporting Law’s (1993: 1) notion that: “large cities are arguably the most important type of tourist destination across the world”. In 2006 London received over 15 million international tourist arrivals, with Paris counting close to 10 million international arrivals, and Rome, Barcelona, Madrid and Amsterdam having around 4 to 6 million international arrivals each (Euromonitor International, 2007). These numbers can be multiplied when accounting for domestic tourists and excursionists, which are much more difficult to measure consistently and, as a result, are often partly neglected.

It is undoubtedly true that these large numbers of excursionists and overnight visitors contribute significantly to the local economy, leading cities to compete against each other in order to increase tourist revenue (Matias *et al.*, 2011). However, increasingly, attention is also paid to the need for a sustainable management of tourist flows, thereby looking farther than economic profits and recognizing the potentially detrimental effects unsustainable growth can have on the quality of life of urban residents (Riganti and Nijkamp, 2008). A well-known example of this problem is Venice, where the number of visitors in the narrow streets in the tourist high season reaches unacceptably high levels and bring about much stress for the residents. Sustainability is then linked with the concept of carrying capacity; as a threshold above which further tourist development will no longer be sustainable on the socio-cultural level (see also Fusco Girard and Nijkamp, 2009).

Focusing exclusively on this socio-cultural dimension of sustainability, two general types of research can be identified: research aiming at establishing a capacity level for socio-cultural sustainability (see, e.g. Canestrelli and Costa, 1991), and studies examining the social implications of tourist consumption under different development levels and attitudes (see, e.g. Ap and Crompton, 1993; Bryon, 2005; Carmichael, 2000; Doxey, 1975). While these approaches offer interesting insights into different aspects of sustainability, they generally lack a quantitative approach to adequately value the implicit social costs of tourism. This lack of quantification results in two main problems: (1) since attitudes and utilities of economic actors do not have a natural scale, differences between utility cannot easily be compared or generalized; (2) as a result of the intangible nature of attitudinal objects, these elements are generally not accounted for in cost-benefit approaches, leading to a focus on strictly economic parameters instead. Another problem which is often unaccounted for is the problematic assumption that tourist consumption of public space is distinguishable from other sources of space use and is directly responsible for spatial crowding. However, tourist behaviour is clearly only one of many different consumptive space patterns and the notion of a spatial carrying capacity should thus be treated as a general subject in which tourist space use is a key variable.

Valuating these attitudinal and utility effects of, often unsustainable, tourist growth (i.e. an overconsumption of tourist places) within the wider system of urban space, could therefore contribute to a better understanding of the societal effects of tourism and improved destination cost-benefit models. Therefore, this paper tries to contribute to the existing literature by developing a valuation methodology of spatial overconsumption of a specific tourist area of a city through diverse sources of space use, and interpreting these results in the specific case of tourism.

2. Crowding and Externalities of Space Consumption

Theories of socio-cultural carrying capacity violation through tourist consumption of space find their origin in two distinct fields: transportation economics, and environmental and behavioural psychology. The concept of congestion, as developed in transportation economics, can be defined as a quantitative tension between demand and supply, leading to a suboptimal resource allocation (Hennessy and Wiesenthal, 1997). Congestion is seen as an objective characteristic resulting from the overconsumption of spatially limited resources (see for extensive modelling studies Verhoef, 2002).

Environmental and behavioural psychology have, on the other hand, mainly been interested in the psychological results of congestion, associating crowding with a stress situation which develops as a result of the interference of spatial limitations upon social activities (Stokols, 1972). Partly influenced by findings in correlational (Mitchell, 1971; Schmitt, 1957, 1966; Winsborough, 1965), ecological (Barker, 1965, 1968; Hall, 1959, 1966), and experimental (Freedman *et al.*, 1971; Hutt and Vaizey, 1966; Proshansky *et al.*, 1970) crowding studies, Stokols concludes that spatial restrictions are only a necessary antecedent for the arousal of crowding stress, and not a sufficient condition. Crowding is thus a psychological construct, closely related to attitudes toward social density. Exactly this attitudinal construction leads Choi *et al.* (1976) to disagree with Stokols' assumption that crowding is a strictly unpleasant psychological experience, instead, making a distinction between crowding as a cognitive state and crowding as an affective state, thereby also acknowledging potentially positive attitudes towards crowding (see also Lindberg and Johnson, 1997).

While congestion relates to the physical carrying capacity of a situation, crowding results from the psychological carrying capacity, which is both place-specific and influenced by personal characteristics (Kyle *et al.*, 2004; Stokols *et al.*, 1973; Westover, 1989). Both concepts, however, are ultimately concerned with a similar outcome: the associated attitudinal and behavioural effects resulting from a perceived restriction of space.

Since crowding and congestion are situations which are levied upon an individual through the space consumption of other users, the resulting effects, in terms of loss of time (e.g. Riganti and Nijkamp, 2008), stress (e.g. Hennessy and Wiesenthal, 1997; Novaco *et al.*, 1990), depression (e.g. Nelson and Cohen, 1983), general health (e.g. Booth and Carroll, 2005), a decline in life or visitor quality (Patterson and Hammitt, 1990; Perdue *et al.*, 1999; Steward and Cole, 2001) or coping behaviour (e.g. Folkman *et al.*, 1986), can be considered as externalities to the consumption decision. Given that the particular societal outcome of a person's space consumption is not rationalized into the decision process, a suboptimal resource allocation is likely to be realised (Pearce, 1978). The crowding externality results from space being a shared variable in the utility function of more than one independent economic decision maker (Meade, 1973), leading to rivalry in consumption under a situation of limited resources, a problem which is exacerbated by the open access characteristics of the resource. This situation is comparable to crowding effects of urban green areas in the case of too many daily visitors, for instance, in urban parks (see Baycan and Nijkamp, 2011).

3. Valuation of the Social Effects of Crowding

Because crowding is an unplanned by-product of rational individual behaviour, it does not exist in a pure market environment in which all externalities are, or can be, accounted for. Consequently, non-market valuation techniques must be used to determine the implicit value of open public space with free access. Within the range of non-market valuation techniques, only stated preference methods are able to capture non-use value, which is essential in view of potential evasive behaviour resulting from congestion situations. The choice experiment method (or conjoint choice experiment) is most appropriate to establish the value of crowding, since both the value of the environmental asset as a whole (i.e. the public space under investigation), as well as the implicit values of its attributes (e.g. crowding) can be valued (Bateman *et al.*, 2003; Hanley *et al.*, 1998).This methodology, which has been used extensively in marketing research and has found more recent adaptations in environmental and health economics (e.g. Adamowicz *et al.*, 1994; Boxall *et al.*, 1996; Bullock *et al.*, 1998; Garrod and Willis, 1999; Hanson *et al.*, 2005; Horne and Petäjistö, 2003; Ryan *et al.*, 2008) is an application of the characteristics theory of value or multi-attribute utility theory (Lancaster, 1966), combined with random utility theory (Manski, 1977; McFadden, 1974) as a theoretical basis to integrate behaviour with economic valuation in choice experiments.

According to Lancaster's model of consumer choice, consumers receive satisfaction through the different attributes provided by a consumable good, rather than through the good as a whole. Translated to urban space, this theory states that the derived satisfaction of users is a function of a number of important attributes of space. Lancaster's hypothesis, when applied to public space, is supported by studies concerning environmental quality indicators, that consistently result in the identification of multifactorial influences on environmental quality and space utility (e.g. Amérigo and Aragones, 1997; Bonaiuto *et al.*, 1999; Tu and Lin, 2008). Therefore, the utility derived from the use of space can be written as:

$$U_{ij}=V(Z_{ij}, S_i)+ e_{ij} \quad (1)$$

where for any individual *i*, a given level of utility will be associated with a public space *j*, depending on the site attributes *Z*. These attributes may be viewed differently by different consumers, whose socioeconomic characteristics *S* also influence the utility received.

Random utility then assumes that, when given different options concerning the alternatives *Z*, space consumers will make the decisions which will generate maximum utility. However, apart from the deterministic component, the utility function in Equation (1) also consists of a random and unobservable error component e_{ij}. This error component implies uncertainty in the estimation and consequent predictions. The probability that an individual *i* will choose option *l* over option *k* is given by:

$$Prob(l \mid C)=Prob(V(Z_{il}, S_i)+ e_{il}> V(Z_{ik}, S_i)+ e_{ik}, \forall\, k \neq l \in C, \quad (2)$$

where C is the complete choice set. In order to estimate equation (2) the error terms are assumed to be independently and identically distributed, following a predetermined Gumbel distribution (McFadden, 1974). Furthermore, assuming Independence from Irrelevant Alternatives (IIA) in the choice experiments, therefore expecting that the ratio of choice probabilities between two alternatives is not affected by the introduction of a third alternative (Ben-Akiva and Lerman, 1985), equation (2) receives a convenient closed-form solution that can be estimated by a conditional logit model. The probability of individual *i* choosing alternative *l* over alternative *k* then becomes:

$$\text{Prob}(l) = \frac{\exp(V(Z_{il}, S_i))}{\sum_{k \in C} \exp(V(Z_{ik}, S_i))} \tag{3}$$

From equation (3) it should also be clear that socioeconomic characteristics of the individual *S* can only influence the choice probability if entered as interaction terms with different attribute levels *Z*.

It has been stated in the discrete choice literature (e.g. Carson *et al.*, 1994; Hanley *et al.*, 2001; Horne and Petäjistö, 2003) that, when a status-quo alternative is included in the choice sets, the results from the choice experiment method are consistent with neoclassical welfare theory, making it possible to estimate the welfare effects of a certain situation through the formula:

$$\text{CS} = \frac{\ln\Sigma \exp(V(Z_{il}, S_i)) - \ln\Sigma \exp(V(Z_{ik}, S_i))}{\alpha} \tag{4}$$

where CS is the welfare effect, and α is the marginal utility of the monetary attribute in the choice experiment. Consequently, the marginal value of change in a single attribute *Z*, under ceteris paribus assumptions, can be represented as:

$$\text{WTP} = -1\left(\frac{\beta_n}{\alpha}\right) \tag{5}$$

As a result, by expressing the utility received from public space as a function of different attributes of space, with crowding being one of these attributes, and by including a price component, equation (5) makes it possible to value the changes in crowding levels in monetary terms. This possibility to explicitly factor in the attribute under investigation is stated as one of the main advantages of using choice experiments in environmental economics (Bullock, 2006). The above described model will be used as the core of a quantitative analysis of perceived tourism crowding effects by the residents in the city of Amsterdam.

4. The Research Area of Amsterdam

Amsterdam is an important global tourist destination, attracting cultural tourists through its rich heritage dating back to the embanking of the IJ bay and Zuiderzee, as well as the damming of the estuary of the Amstel in the 13th century, creating an inhabitable area and an inland port adding to the landmark sights of the later city. At the same time, younger travellers and backpackers are attracted by the city's image as a free haven of tolerance and liberalism, embodied by the presence of coffee shops (i.e. shops specialising in the sale of mind-altering substances permitted locally) and legalized prostitution.

In 2009 a total number of 8,561,200 overnight stays were had in Amsterdam. With an average length of stay of 1.85 days, the total number of individual yearly visitors amounts to 4,627,800 (*Onderzoek en Statistiek Amsterdam*, 2011). While excursionists are not monitored continuously and are much harder to estimate, the *Amsterdam Toerisme en Congres Bureau* (2001) valued these at 30 million, or an average 83,000 day visits per day, for the year 1999. The large amount of tourists is an important economic revenue source for the city, with an estimated tourist expenditure of 5 billion euro and a job creation of 48,000 full-time positions. At the same time, however, it is increasingly recognized that these large visitor numbers can have adverse effects on both the tourist experience and the quality of life of local residents. Indeed, crowding was mentioned as a major negative aspect of Amsterdam by 10% of visitors in a survey conducted by *Amsterdam Toerisme en Congres Bureau* (2008). This problem is partly caused by a concentration of visitors in the historic inner city, as a result of the geographical concentration of most iconic sights in this area, with for instance, the infamous Red Light district, Dam palace, Madame Tussauds, the Amsterdam Dungeon, the Anne Frank House, and the old 'beguinage' all laying within the borders of the Singel moat, on a surface area of approximately 8 km².

Recognising the intense spatial demand on the inner city's infrastructure, which is, at times, not adjusted to the presence of large use numbers the city council has initiated redevelopment plans (the so-called Red Carpet project) for the central catchment area, to coincide with the building of the new North-South metro line. The focus of the inner city plans lies on the corridor running from the central station through the historic inner city, encompassing Damrak, the main street built on top of the ancient Amstel estuary, Rokin, the place of the old inland harbour, and the Muntplein. While also aiming to serve the local population, the development plans explicitly state the intention to create a high profile visitor corridor stretching into the city, as well as trying to plan for, and in part also generating, an intensification of space use.

Since Damrak connects the central railway station to the heart of the inner city, some 100,000 visitors claim this space daily, while it is estimated that the new metro line – at present under construction – will increase the number of users, most importantly pedestrians. At present, the layout of the street surface consists of a large sidewalk on the Westside, adjacent to a bicycle lane, a double railway for city trams, a one-way car lane, and a bicycle lane and smaller sidewalk on the East side. Identifying slow traffic (i.e. walking and biking) as the most important space claims of Damrak, the new development plans encompass a broadening of the sidewalk, while combining car and tram traffic in one lane in order to accommodate large numbers of pedestrians. At the same time, a quality improvement is planned where better quality stores will replace the existing cheap souvenir stores and coffee shops, and the planting of trees along the road will provide for a greener image.

Since the redevelopment plans concern a well-known tourist area of Amsterdam where crowding is, at times, problematic, the proposed plans for urban redevelopment in this area provide an interesting opportunity for research relating to tourist crowding in particular and to crowding in general. As such, we will limit the study area to the central zone of Damrak, Rokin, and Kalverstraat, as the most important shopping district adjacent to Rokin.

5. Research Methodology

The first important step in any choice experiment design is the definition of both the attributes and the attribute levels of the good under evaluation. The attributes of public space quality used in this study were primarily based on the proposed changes to the Dam area as relayed in the preliminary reports of the Red Carpet project (*Gemeente Amsterdam*, 2009). Since the attribute levels are related to an actual development scenario, a realistic background for the choice experiments could be created. Subsequently, the proposed attributes were compared to factors of the existing perceived residential environmental quality scale of Bonaiuto *et al.* (1999), which, combined with a number of informal interviews in the public spaces of Amsterdam, served to establish the relevance of the choices. This ultimately led to 6 attributes: 4 binary attributes, one 4-level attribute and a payment vehicle of 6 levels, as shown in Table 1.

Table 1. Attributes and attribute levels

Attribute	Attribute levels
Layout of Damrak	- No wider sidewalk, tram rails and car lane separate = 0
	- Wider sidewalk, tram rails on car lane = 1
Green areas	- No green areas = 0
	- Green areas = 1
Shops	- No change in quality of shops = 0
	- Fewer coffee shops and tourist stores in place of international chains and boutiques = 1
Public transportation	- Stops every 200 meters = 1
	- Stops every 500 meters = 0
Crowding	- Not at all crowded = 0
	- Not crowded = 1
	- Crowded = 2
	- Very crowded = 3
Tax	- €1.5 increase = 1
	- €2.5 increase = 2
	- €4 increase = 3
	- €6.5 increase = 4
	- €9 increase = 5
	- €14.5 increase = 6

The initial level of the payment vehicle was chosen by dividing the yearly budgeted investment in the redevelopment plans of the area (€1,000,000) by the total number of residents in Amsterdam

(756,347). Subsequent levels of individual budgeted tax levels B_n were established via Weber's law of exponential increase, described by the function:

$$B_n = B_1 \times (1 + k)^{n-1} \quad (6)$$

An exponential response scale is advocated here since it is reasonable to assume that respondents' accuracy in estimates, and the 'just-noticeable' differences between values, is proportional to the value (Rowe *et al.*, 1996).

Since a full factorial design would lead to an unmanageable number of choice sets (i.e. 384) for respondents, the method described by Street *et al.* (2005) was used to create orthogonal and balanced choice sets. The resulting 24 choices were divided over 3 surveys, each consisting of 8 dichotomous choice sets. Since the validity of welfare measures from stated preference methods depends on preferences being complete, monotonic, and transitive,while inter-test stability of choices can also be expected, ideally, appropriate tests should be included to identify these concepts. While completeness of preferences is generally forced upon residents through the survey structure, within-set monotonicity, which requires that subjects prefer better levels of an attribute to worse levels (Özdemir *et al.*, 2010), can be tested by including dominant choice sets, as proposed by Johnson and Mathews (2001). Two such dominant choice alternatives were included on positions 3 and 7 of the choice experiment series. Transitivity requires that respondents choices are logical over the entire range, meaning that a preference of A over B in one set and a preference of B over C in another set should also lead to a choice of A over C. Transitivity tests can be included implicitly in the sample design. Stability of choices, finally, is most easily measured by repeating earlier choice sets at a later stage. In our experiment, the final two choice sets repeated the first and second choice sets in order to test for choice stability. Consequently, each respondent ultimately received 12 binary choice sets, plus a 'neither of both' option in every set, providing the initial state for welfare analysis (Carson *et al.*, 1994).

The choice experiment was preceded by a description of the attributes and levels. The 'Layout of Damrak' and 'Green areas' were specifically visualised by computer generated pictures. The importance of visualisation of choice attributes for public space design was highlighted by Davies *et al.* (2002). In order to help respondents form a mental image of different crowding levels, as well as to be able to attach physical density levels to the crowding level descriptions, a preliminary set of questions showed respondents 6 pictures, depicting different use levels, and asking them whether the situation on the pictures was 'not at all crowded', 'not crowded', 'crowded', or 'very crowded'. The number of people depicted on these pictures was increased exponentially, with levels of 20, 30, 45, 70, 100, and 150 people on a surface area of approximately 150 m².

Data were collected through an online survey among a sample of 2,304 residents of Amsterdam, stratified by distance to Dam Square. A total of 1,280 respondents filled in the questionnaire, 1,064 of which answered all 12 choice set questions. Apart from the 12 choice sets, supplementary questions were asked about reasons for space use, mode of transport, crowding preferences, perceived environmental quality, and personal characteristics.

6. Modelling Results

The aforementioned data was used as an input for our choice experiment model. First of all, it is necessary to pay attention to the fall-out in responses, since a possible pattern in respondent drop-out could indicate respondent fatigue of the choice experiment design. Of the total drop-out of 216, 60.2% could be attributed to attitudinal questions preceding the choice experiment. Another 16.7% of respondents stopped the survey at choice set 1. Respondent loss in subsequent choice sets 2 to 12 centred at around a mean of 2.1%. These results indicate that respondents were, in general, able to diversify between the given choices given, adding to the conclusion of Carlsson and Martinsson (2008) and Hensher *et al.* (2001) that respondents are capable of handling a large amount of choice sets.

However, the quantity of complete responses does not say anything about the validity of the choices. This is indicated by the results on the inter-set monotonicity and choice stability tests. A total of 727 respondents passed both monotonicity tests, while another 296 respondents failed one of two. On a total of 1,064 surveys only 3.9% (41) failed both. Slightly fewer people passed both stability tests (619), while 33.9% (361) passed one. A total of 84 respondents failed the two stability tests. Table 2 compares our test results with the results of Johnson and Mathews (2001) and Özdemir *et al.* (2010).

Table 2. Comparison of monotonicity and stability test results

	Our research	Johnson and Mathews (2001)		Özdemir *et al.* (2010)
		Environmental survey	Health survey	
Monotonicity				
- Failed 0	68.3%	35.2%	74.3%	
- Failed 1	27.8%	9.3%	25.0%	
- Failed 2	3.9%	55.4%	0.7%	18.0%
Stability				
- Failed 0	58.2%	9.7%	38.7%	
- Failed 1	33.9%	27.9%	36.3%	
- Failed 2	7.9%	62.5%	25.0%	25.0%

Table 2 shows an above average consistency of our values, which might be attributable to the high familiarity of the respondents with the research area in the survey. As Johnson and Mathews (2001) note, stated preferences for abstract commodities might be more susceptible to inconsistent responses than more tangible commodities. The higher error margin for the stability tests as compared to the monotonicity check is consistent with both learning effects, where the first questions can be noisy as subjects are still unfamiliar with the test at hand, and respondent fatigue (Johnson and Desvousges, 1997; Maddala *et al.*, 2003; Schwappach and Strasmann, 2005). All in all, from the relatively low failure rate on both monotonicity and stability analysis we can conclude that it is possible to impute valid welfare values from the data. Questions remain, however, about the handling of the respondents who did not pass the consistency tests. While it is common practise to drop subjects who fail (some) consistency checks (e.g. Ryan and Farrar, 2000; Ubach *et al.*, 2003; Wordswort *et al.*, 2006), Özdemir *et al.* (2010) raise concern about this practise in case specific subgroups fail consistency tests disproportionately. Therefore, key characteristics of the full sample need to be compared to the values in the subsample after consistency analysis. In Table 3 we have compared the proportions of gender, education, and income, and the means of family size, age, number of years lived in Amsterdam, and the distance of the dwelling from Dam Square. The subsample which was retained after consistency checks was composed of respondents who passed at least one monotonicity test and one stability test, treating one mistake on each test as a random error as proposed by Ryan *et al.* (2001).

Both samples show a masculinity of respondents. The ratio of respondents holding a university degree is rather high at nearly 50%, while the net monthly household income is evenly spread over the larger income categories. The average sample age is 53.3 years with, on average, 33.5 of those years spent living in Amsterdam. Finally, the mean distance between the respondent's neighbourhood and Dam Square is 3,792.9 metres.

It is clear from the chi-square and t-value statistics that both samples are not significantly different on a 95%-confidence level. In order to further improve our model estimates, respondents who failed all consistency tests were dropped from the sample in further analyses.

Table 3. Key socio-demographic characteristics of full sample and subsample

	Percentage/mean (n = 1,064)	Percentage/mean (n = 943)	Chi-square/ t-test (p-value)
% Female	48.2%	48.5%	.034 (.854)
% University Degree	43.8%	45.6%	1.25 (.264)
Household income			
- 0-1000 EUR	2.9%	2.8%	.471 (.976)
- 1001-2000 EUR	22.4%	22.2%	
- 2001-3000 EUR	28%	28%	
- 3001-4000 EUR	22.9%	23.8%	
- >4000 EUR	23.9%	23.1%	
Family size	2.0	2.0	-.079 (.937)
Age	53.3	53.2	-.80 (.936)
Years lived in Amsterdam	33.5	33.1	.49 (.624)
Distance to Dam square	3,792.9	3,789.6	-.40 (.968)

Table 4 shows the subsample statistics of characteristics of space use in the area under investigation, i.e. the Red Carpet area. Attention is given to the perceived function of the neighbourhood for the respondents, the main reasons of visiting the Dam area, and the modes of transportation used. Since all items were measured on a 5-point ordinal scale, central tendency of the data is given by the mode of the subsample and the percentage of respondents represented by this mode. Large percentages are an indication of convergence of the data around this value.

Table 4. Characteristics of space use of subsample

	Mode (scale 1-5)	Percentage (n = 943)
Perceived function of neighbourhood		
- living	1[a]	53.1%
- working	1[a]	44.5%
- shopping	4[a]	44.3%
- transportation	4[a]	42.4%
Reason of space use		
- going to work or school	1[b]	67.9%
- visiting friends or relatives	1[b]	66.1%
- playing sports	1[b]	94.5%
- doing groceries	1[b]	82.5%
- leisure shopping	2[b]	52.3%
- walking	2[b]	40.7%
- going out	2[b]	46.0%
Mode of transportation		
- walking	4[c]	34.8%
- bicycle	4[c]	32.3%
- car or motorcycle	1[c]	72.2%
- public transport	2[c]	42.7%

[a] 1 = not at all important; 2 = not important; 3 = neither important nor unimportant; 4 = important; 5 = very important

[b] 1 = (practically) never; 2 = a few times a year; 3 = a few times a month; 4 = a few times a week; 5 = (almost) daily

[c] 1 = never; 2 = sometimes; 3 = regularly; 4 = often; 5 = always

The characteristics of space use show that the area Damrak-Rokin-Kalverstraat is mainly perceived of as a space for shopping and transportation, with 51.5% and 55.9% respectively indicating these functions as important to very important. The residential function, on the other hand, is considered important to very important by 13.6% of respondents. While the area functions slightly more as a leisure space, with the majority of respondents visiting the district at least a few times a year for shopping (90.5%), walking (64.6%), or going out (72.7%), the low values for both leisure and work-related activities indicate that most respondents do not often visit this part of the city. The preferred modes of transportation are walking and biking, while a car or motorcycle is almost never used.

Furthermore, ‘perceived quality of built environment’ and ‘neighbourhood inconvenience experienced’ were measured through a number of Likert items and analysed by an exploratory factor analysis to identify underlying dimensions. Since the initial measurement items were ordinal in nature, weighted least square factor analysis was carried out, based on the polychoric correlation matrix, as proposed by Jöreskog and Sörbom (1988). The number of factors to retain was chosen through Horn’s parallel analysis of principal components (Horn, 1965). Applying the requirement of adjusted eigenvalues greater than one, two factors could be identified for both ‘perceived quality of built environment’ and ‘neighbourhood inconvenience experienced’ as seen in Tables 5 and 6.

Table 5. Standardized loadings of weighted least square factor analysis of perceived quality of built environment

	F1	F2
Nice architecture	0.34	0.04
Accessibility by car	0.01	0.86
Accessibility by public transport	0.21	0.33
Parking space	-0.03	0.89
Safety	0.49	0.30
Cleanliness of streets	0.67	0.00
Availability of green spaces	0.57	0.01
Availability of shops	0.68	-0.07
Recreational facilities	0.71	-0.06
Cordiality of other people	0.55	0.04
Cronbach’s alpha	0.74	0.69
Eigenvalue	2.46	1.75
Explained variance	0.25	0.18

Table 6. Standardized loadings of weighted least square factor analysis of neighbourhood inconvenience experienced

	F1	F2
People walking on bicycle lane	-0.05	0.92
Jay-walking	0.06	0.88
Incorrectly parked cars	0.40	0.29
Badly placed bicycles	0.53	0.24
Noise nuisance from traffic	0.64	0.12
Noise nuisance from youths	0.90	-0.08
Noise nuisance from tourists	0.81	0.01
Litter	0.63	0.13
Public drunkenness	0.80	-0.01
Vandalism	0.83	-0.06

Cronbach's alpha	0.87	0.90
Eigenvalue	4.20	1.97
Explained variance	0.42	0.20

Table 5 shows the results of the exploratory factor analysis on environmental quality indicators. Two factors could be identified: 'accessibility' ('accessibility by car', 'accessibility by public transport', 'parking space'), and 'social and functional quality' ('nice architecture', 'cleanliness of streets', 'availability of green spaces', 'availability of shops', 'recreational facilities', and 'cordiality of other people'). The final scores of the different factors were subsequently calculated as the mean of the summated ratings of the different factor variables (see Spector, 1992). The computed mean score of the factor 'accessibility' equals 3.14 on a scale from 1 to 5, with a standard deviation of .745. The social and functional quality of the neighbourhood, on the other hand, has a mean value of 2.99 and a standard deviation of .565.

Nuisance was perceived from two main sources: 'nuisance because of traffic' ('people walking in bicycle lane', and 'jay-walking') and 'social disturbances' ('incorrectly parked cars', 'badly placed bicycles', 'noise nuisance from traffic', 'noise nuisance from youths', 'noise nuisance from tourists', 'litter', 'public drunkenness', and 'vandalism'). Both factors were scored in the same way as the 'perceived quality of built environment' components, with a mean score of the factor 'nuisance because of traffic' equal to 2.19, with a standard deviation of 1.110. 'Social disturbances' had a mean value of 2.36 and a standard deviation of .751. Both mean values are based on a rating scale from 1 to 5.

The choice experiment data were coded according to the levels of the attributes, 0 being associated, in most cases, with the baseline value. The attributes 'Layout of Damrak', 'Green areas', 'Shops', 'Public transportation', and 'Tax' were coded with a zero value for the 'neither of both' option, while 'Crowded' was deemed to be the average initial level of space use under the 'no development' alternative. This can be justified by the mean values of the 'neighbourhood inconvenience experienced' factors which lie between the values 'sometimes' and 'regularly'. The alternative specific constants (ASC's) were equal to 1 for alternatives A and B, and to 0 under the 'neither of both' choice. Employing a strictly additive linear function, a conditional logit model was fitted to the data.

The results in Table 7 show that the local population prefers a situation with a wider sidewalk, resulting in a shared road for cars and trams. This could be expected since most people do not enter this area by car, as can be seen in Table 4. Also, green areas increase place utility significantly. There exists a preference for a reduction in coffee shops and tourist shops, in favour of higher quality shops. This observation could serve as an explanation for the limited use of the area for shopping by the respondents, as noted earlier in Table 4. Since the respondents indicate a clear preference for higher quality shopping, we can suspect that the current shopping experience offered is inadequate. The difference between public transport stops (i.e. bus stops, tram stops, or metro stations) every 200 or every 500 metre does not significantly affect the choice on a 90%-confidence level, coinciding with the mean value of the 'accessibility' factor which showed that respondents were neither satisfied nor unsatisfied with the current condition. A situation which is crowded is preferred over a situation which is not crowded or not at all crowded. However, a very crowded situation decreases utility markedly. This observation supports the notion of a curvilinear crowding function also observed by Bullock (2006). As could be expected, an increase in taxation decreases utility. Interestingly, the alternative specific constants show that consumers actually experience disutility as a result of development possibilities, suggesting reluctance to change. This might be attributable to the perceived quality of the built environment which shows acceptable mean values for both the 'accessibility' (3.14) and 'social and functional quality' (2.99) of the current situation. However, Mørkbak *et al.* (2010) note that the alternative specific constants also capture all unobserved attributes, as well as nay-saying, so care must be taken when using these values to make general statements about acceptability.

Table 7. Basic conditional logit model

	Coefficients (s.e.)
ASC1	-0.36312***
	(0.04952)
ASC2	-0.53615***
	(0.05002)
Layout of Damrak	0.08300*
	(0.03334)
Green areas	0.81098***
	(0.03433)
Shops	0.55508***
	(0.03410)
Public transportation	0.05943
	(0.03439)
Not at all crowded	-0.20541***
	(0.04918)
Not crowded	-0.12099**
	(0.04609)
Very crowded	-0.97081***
	(0.05635)
Tax	-0.09836***
	(0.00524)
Log-likelihood	-7,187.9
Log-likelihood ratio test	1,760.2 (< 2.22e-16)
McFadden ρ^2	0.10908

Significance codes: 0.001 '***', 0.01 '**', 0.05 '*', 0.1 '○'

Although most coefficients are significant and have the expected a priori signs, the overall fit of the model, as measured by McFadden's ρ^2, is low. Furthermore, the basic conditional logit model, while theoretically attractive, is only appropriate if the Independence of Irrelevant Alternatives (IIA) condition is met. This property states that the relative probabilities of two alternatives are unaffected by other alternatives and can be tested by the Hausman-McFadden Test on a subset of options. This test essentially measures the statistical significance of two sets of estimates: the base model with the full set of alternatives, and a conditional logit model on a specified subset of alternatives. If IIA holds, then the difference between estimated models should be statistically insignificant (Hausman and McFadden, 1984). The Hausman-McFadden test results between the base model, and a model in which alternative A is dropped, shows a χ^2-value of 51.3811 on 9 degrees of freedom, indicating that the IIA condition cannot be rejected on a 99% significance level (p-value = $5.917e^{-8}$).

Even though compliance to the IIA property is proof of the acceptability of a conditional logit model, by assuming homogeneous preferences across respondents, estimates might still be biased in case of heterogeneity, which is invariably present in real-life choice situations. One way of accounting for this preference heterogeneity, and at the same time relaxing the IIA assumption, is by using the random parameter logit model, which has proven to be superior to the conditional logit model in terms of model fit and welfare estimates (Breffle and Morey, 2000; Layton and Brown, 2000). Since this method treats preference parameters as random variables, estimation is based on simulated maximum likelihood (Birol *et al.*, 2005). Assuming a normal distribution of the attributes, a random parameter logit model was estimated with 500 draws.

Interestingly, the new data in Table 8 show a reversal in the coefficient of the Layout of Damrak, which might be attributable to the large standard deviation, implying large variation in the data. It should also be noted that 11 respondents explicitly stated they would prefer a traffic-free Damrak, if this option had been given. Therefore, the variations, and lower significance, in the preference for the street layout may be partly attributed to a lack of preferred attribute level. The estimate for public transportation stops now becomes significant, showing an increased utility for more stops (every 200 metres). The signs of the different crowding levels remain the same, again showing a curvilinear relationship, while McFadden's model fit ρ^2 increases markedly to 0.19990, implying the improvement of the estimated model.

We can further analyse the preference structure, based on the distance between the residence and the research area, as shown in columns 2 to 4 of Table 8. Three groups were created; the first group consisting of residents living within 2 kilometres of Dam Square, the second group made up of people residing between 2 and 4 kilometres of the research area, while the final group comprised residents with an address with a distance of more than 4 kilometres from Dam Square. The most interesting differences which emerge are a reversal of the coefficient sign of the Layout of Damrak, with the first group, albeit not significant, preferring a situation with a larger sidewalk and a combined car and tram traffic, while the second and third group show a preference for the current situation. Looking at the crowding situation, only high congestion levels remain significant on the group analysis level, with a higher coefficient for residents living closer to the area, indicating a more pronounced preference to elevate overcrowding in these groups.

As noted earlier, the main advantage of using a choice experiment method lies in the possibility of assigning a marginal monetary value of change to a single attribute. By comparing the crowding coefficients with the coefficient of monetary value, the marginal value of crowding in public space can thus be estimated. This stated preference approach will now be outlined.

Table 8. Random parameter logit model for total data and distance groups

	Coefficients (s.e.) *s.d.*			
	Total data	Distance <2km	Distance 2-4km	Distance >4km
ASC1	-0.52356***	-0.26322*	-0.79620***	-0.47016***
	(0.06245)	(0.11708)	(0.11045)	(0.09968)
ASC2	-1.09560***	-0.52583***	-1.36081***	-1.32223***
	(0.06844)	(0.12146)	(0.12418)	(0.11529)
Layout of Damrak	-0.10930*	0.13968	-0.20431*	-0.23448**
	(0.05386)	(0.09750)	(0.09210)	(0.08944)
	1.43918	*-1.15282*	*1.38026*	*1.67686*
Green areas	1.31704***	1.17338***	1.32286***	1.39254***
	(0.05755)	(0.10773)	(0.09887)	(0.09670)
	1.31412	*-1.34009*	*1.09892*	*1.37081*
Shops	0.92290***	0.78192***	1.05282***	0.82977***
	(0.05976)	(0.10931)	(0.10142)	(0.09853)
	1.41192	*-1.34009*	*1.38510*	*1.39194*
Public transportation	-0.10947*	-0.22325*	0.10001	-0.19567*
	(0.05353)	(0.09768)	(0.09092)	(0.08962)
	-0.98458	*-0.80097*	*1.07632*	*1.00783*
Not at all crowded	-0.19587**	-0.20660	-0.22192°	-0.15567
	(0.06945)	(0.12761)	(0.12364)	(0.11731)
	-0.19309	*-0.22926*	*-0.24505*	*-0.10573*
Not crowded	-0.12030°	-0.09738	-0.06641	-0.15833
	(0.06749)	(0.12478)	(0.11176)	(0.11489)
	0.30083	*-0.25886*	*-0.14160*	*-0.33220*
Very crowded	-1.59543***	-1.91941***	-1.69558***	-1.30984***
	(0.10247)	(0.21067)	(0.18974)	(0.16690)
	-1.47054	*1.58449*	*1.60875*	*1.58300*
Tax	-0.14425***	-0.15423***	-0.13868***	-0.13900***
	(0.00694)	(0.01328)	(0.01152)	(0.01174)
Log-likelihood	-6,455.2	-1,772	-2,241.3	-2,414.7
Log-likelihood ratio	3,225.6 (< 2.22e-	893.88 (< 2.22e-	1,174.2 (< 2.22e-	1,187.5 (<2.22e-

test	16)	16)	16)	16)
McFadden ρ^2	0.19990	0.20142	0.20758	0.19736

Significance codes: 0.001 '***', 0.01 '**', 0.05 '*', 0.1 '°'

Table 9 indicates the willingness to pay for a change in attribute level to the base level 'crowded'. The results show that a certain amount of crowding is valued positively in an urban setting, implicating a positive externality of space use when extra users arrive. However, after a certain use level, rivalry in space use sets in, and extra users result in a negative societal externality. As is to be expected, these negative externalities are felt most by the local population living closest to the research area.

Table 9. Marginal willingness to pay for a change to a crowded use level

Label	Number of persons on 150 m²	Attribute value per year			
		Total data	Distance <2km	Distance 2-4km	Distance >4km
Not at all crowded	20-30	€1.36	€1.34	€1.60	€1.12
Not crowded	45-70	€0.83	€0.63	€0.48	€1.14
Very crowded	>150	€11.06	€12.45	€12.23	€9.42

While low crowding situations are valued less positively than a crowded urban environment, the utility received from a rise in use level (€1.36 and €0.83 respectively) is much less than the utility which is given to a change from very high to high levels (€11.06), coinciding with the fact that the coefficient values for 'not at all crowded' and 'not crowded' were found to be less significant. Since these values are on a per capita basis, and many respondents claimed they practically never visited the Dam area (4.1%) or travelled there only a few times per year (41.1%), the real costs of high crowding levels can be quite significant when measured on a per visit basis.

Taking into account the responses on the different crowding pictures incorporated in the survey, an approximation of the value per person in space can be made. A majority of people (78.4% and 53.3%) described a situation between 20 and 30 people on a surface area of 150 m² as 'not at all crowded'. The pictures depicting 45 and 70 space users were valued 'not crowded' by 60.6% and 62.1%. Finally, 100 people occupying the space was deemed 'crowded' by 61.9%, while a total number of 150, or one person per square metre, was found to be on the border of a 'crowded' (53.2%) and a 'very crowded' (43.8%) situation. Therefore, a rise in use level from 20-30 to 100 results in a utility increase of €1.36 while a rise from 45-70 to 100 people accounts for €0.83. Conversely, visitor levels above 150 involve a utility decrease of €11.06.

Finally, these results, which concern use levels in general, need to be translated to tourist crowding, since congestion by tourists cannot be analysed as a separate entity, as tourism is not necessarily distinguishable from other motives of space use. Instead, tourists form part of the urban crowd. Their share in space can be translated into a ratio by which tourists are responsible for a certain amount of crowding. Knowing that there are both positive and negative values concerned with crowding, the external societal influence can be accounted for. A first observation can be that tourism during periods of low seasonality can have a very positive effect on the quality of life of local residents. However, during times of high tourist (and other) space consumption, their presence can cause high externalities for locals, as is witnessed by the crowding situation in Venice.

7. Concluding Remarks

Congestion phenomena in public space can cause disutilities of space use, resulting in longer waiting times, discontinuous traffic flows, and a generally lower quality of experience. At the same time, however, an urban structure needs a certain amount of users in order to function appropriately. Therefore, every (potential) space user affects the utility of others in that space, whether in a positive or negative way. Accounting for these externalities adds economic insights into a field which is dominated by attitudinal studies.

Our analysis has tried to distinguish the monetary costs and benefits of certain crowding situations in a specified central location in Amsterdam. As an important urban tourist destination, the central area of Amsterdam attracts large numbers of tourists as well as residents, commuters, and other types of space consumers. As a result, congestive situations are often levied upon the local residents. Through a discrete choice experiment design conducted among a sample of residents, the average attitude towards crowding levels was estimated in terms of willingness to pay. The results proved the curvilinear nature of general use level acceptance, whereby a ‘crowded’ urban area (associated to a use level of 100 to 150 people) is preferred over a ‘not at all crowded’ (a use level of between 20 and 30), and ‘not crowded’ space (45 to 70 people) on the one hand, and a ‘very crowded’ situation (in excess of 150 space users) on the other. However, the average willingness to pay to alleviate high crowding conditions was much higher than the value placed on improving lower use numbers. By quantifying social costs and benefits of crowding in general, it becomes possible to aggregate the tourist ratio in total space use, and thereby defining the costs and benefits of tourist space consumption.

These results offer interesting findings for cost-benefit analyses and future development plans. It provides city officials with a tool in order to assess the social impacts of a rise or fall in tourism at certain times and in a certain place. Social impacts can then be considered on a scale similar to economic and ecological costs and benefits in order to improve the completeness of these analyses.

Further research in this field is needed in order to estimate the tourist ratios in urban space at different times and on different locations. This can be done ideally by capturing movements in a certain space through a series of time-interval photographs, which can subsequently be converted into an overall mean space use. Subsequently, random interviews of passers-by may give an insight into the user characteristics. Other areas of further interest are possible interactions between attitudinal and social characteristics and willingness to pay. The study area can also be extended to city areas with different use characteristics (e.g. living quarters) in order to account for the influence of different urban functions on crowding externalities. In addition, more studies concerning the appraisal of crowding through non-market valuation techniques are necessary in order to compare the results, particularly the willingness to pay estimates. The use of choice experiments seems to provide good opportunities, as it is capable of distinguishing both use and non-use value and is less abstract than contingent valuation. However, alternative methods of choice experiment design can be explored in order to further improve the reliability and stability of responses.

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