Is quiet the new loud? Towards the development of a methodology for estimating the economic value of quiet areas

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INTRODUCTION

While the adverse impacts of high levels of noise on health, quality of life and well-being are relatively well understood, the beneficial effects of access to quiet are less well recognized and are therefore often overlooked or undervalued in decision-making. The debate on noise impacts stimulated by the emergence of EC noise policy has raised concern about other spaces, particularly those used for recreation, that currently enjoy a peaceful environment, referred to as 'quiet areas'. Some Member States have become concerned that attempts to improve the noise climate in areas of high exposure may lead to a spreading of noise across areas that are currently almost free from environmental noise. This has generated a perceived need for measures or interventions to protect these quiet or tranquil areas.

Study rationale and approach

The UK Government requires that all new policies, programs and projects are subjected to a comprehensive but proportionate appraisal to ensure that interventions enacted by public sector bodies are in the best interest of society overall. A key component of appraisal is the comparison of the total benefits of a proposal to the full costs incurred by Government and society. While the costs of providing new, or protecting existing 'quiet areas' are relatively straightforward to obtain, estimating the benefits is far more difficult, largely because these are not routinely traded in the market place and therefore do not have well established monetary values.

Until the formation of the Interdepartmental Group on Costs and Benefits Noise Sub-Group (IGCB (N)) in 2007, valuation of noise pollution in the UK was centered on amenity impacts[1] through the Department of Transport's (DfT) webTAG values for annoyance (Department of Transport 2011). The IGCB (N)) was therefore established with a remit to develop and disseminate best practice economic approaches to valuing a wider range of the impacts of changes in environmental noise across all areas of government policy.

In 2010 Defra commissioned a piece of research on behalf of IGCB (N) to promote understanding of the range and value of benefits that people derive from 'quiet areas' and to develop an approach that can be systematically and consistently applied by policymakers to assess the benefits that people derive from quiet areas or conversely, the costs of loss of access to these areas. This paper describes some of the key findings from that research.

A comprehensive review of over 80 studies was undertaken to collate evidence on the nature and significance of the benefits that people derive from quiet and relatively quiet areas.

[1] Amenity impacts are defined by the IGCB (N) as the conscious annoyance or negative reaction to noise exposure.

Given the number of potential benefits from 'quiet areas' (including those that are relatively quiet compared to their surroundings), the scope of the review was necessarily broad and looked at (i) areas whose primary purpose is quiet and (ii) how quiet contributes to the overall quality of urban open spaces. This includes:

- areas that are absolutely quiet in terms of dBA levels (i.e. below a certain threshold),
- areas that are relatively quiet i.e. they are significantly less noisy than surrounding areas (an urban park with plenty of trees or other open spaces),
- areas that are quiet but not necessarily considered tranquil (an urban waste land),
- areas that should be quiet but are not (a side street which is used as a rat run),
- areas that are sensitive to noise but may or may not be quiet (churchyards and cemeteries).

DEFINING QUIET AND QUIET AREAS

There is no universally agreed definition of "quiet" or "quiet areas". Approaches taken to identify quiet and quiet areas generally fall into four distinct categories:

- Quantitative methods based on noise levels. These measured and/or predicted noise levels and may relate to absolute or relative quiet, i.e. how quiet an area is relative to its surroundings or an absolute threshold above which an area is deemed not to be quiet. Different values may apply for daytime and night-time periods.
- Quantitative methods based on location, or distance from major noise sources, etc. Such approaches may be appropriate in a rural context, but are unlikely to be applicable to urban quiet areas.
- Subjective methods based on users' identification with, and use of, quiet areas
- Subjective methods based on audibility of acoustic features, natural sounds, etc.

The research relating to the value of quiet is consistent in asserting the complexity of "quiet" and that one's experience of 'quiet environments' is inextricably linked with overall perceptions of the character and quality of the landscape or context in which it is present, on the soundscape (Kull 2006; Nilsson 2007) and, to a certain extent, with prior expectations (Memoli et al. 2008; Bruce et al. 2009). For example, evidence from a survey conducted as part of a previous study on tranquility in Westminster (Scott Wilson Ltd. 2009) revealed that park users in Westminster, London felt a range of factors or 'pillars' of tranquility were as important as relative or absolute quiet and these included the culture of a place, safety record, visual amenity and presence of nature. While the evidence did reveal the importance to residents, visitors and workers of spaces that are 'significantly quieter', noise levels in these spaces were rarely below 55 dB L_{Aeq}. The study suggested that areas with average noise levels in excess of 55 dB L_{Aeq} still had the potential to trigger tranquility if the other experiential factors distracted, or masked (i.e. enabled people to switch off) the ambient noise levels.

In light of these findings, a subjective definition of quiet was applied. It is nevertheless recognized that in practice, identifying quiet areas is likely to include at least one objective element. The following key defining points, or tests of quiet, are considered appropriate:

- natural sounds are audible and not masked by man-made sounds – the Sound Quality test; and
- for relative quiet, the whole area or part of the area is noticeably less noisy than its immediate surroundings – the Relatively Quiet test.

For a subjective definition of quiet areas, one further test was developed, the Potential Use test which has two key indicators:

- an area users choose to visit due to its quiet nature (whether absolutely or relatively quiet, or an absence of inappropriate or unnecessary sound, perceived or not – for example escaping the hustle and bustle, whilst not a conscious decision about noise levels, has a very strong association with relative quiet); and
- an area used for quiet activities such as reading, strolling, meditation and reflection[2] .

The outline for an objective definition of quiet areas, based on recommendations from the literature reviewed is included below:

- Maximum noise level of 55 dB L_{day}. This level would apply at the perimeters of the space, and ideally levels within the space would be well below this level. Areas that are quiet for parts of the time (when they are likely to be used) should also be considered.
- For relatively quiet areas, the noise level across the majority of the area must be at least 10 dBA below the noise levels of the surrounding areas (e.g. possibly defined as the noise levels associated with all dwellings within a 200 m radius).
- The area that satisfies the noise criteria must meet a minimum area constraint to prevent the inclusion of large numbers of very small areas (e.g. area meeting noise criteria must be at least 1 ha);
- Any public open spaces shortlisted by the relevant Local Authority as candidate quiet areas.

To test this approach, some initial area selection was carried out (together with Westminster City Council) to identify potential quiet areas within the City of Westminster before these were tested against the above criteria. The quiet areas selected included a large public park (St. James's Park), a smaller park bounded by a canal on one side in a residential area (Westbourne Green) and a paved urban space (Golden Square) off a busy road.

Noise monitoring was conducted at each of these sites and used to refine the above objective (absolute and relative) approaches to defining quiet and relatively quiet areas in the context of available noise data and local knowledge and to determine which areas would be subjectively considered as quiet or relatively quiet areas.

[2] Consideration should also be given to the fact that some 'quiet areas' may also be used for criminal activities (e.g. mugging).

THE BENEFITS OF QUIET AND QUIET AREAS

The literature suggests that quiet (or absence of unnecessary or inappropriate sounds) has a number of important and often co-related benefits to human well-being, including improved creativity, problem solving, mental health, concentration and undisturbed sleep. In addition to the direct economic benefits that human well-being confers (in terms of, for example, savings on health costs and increased worker productivity), access to "quiet areas" also offers other services of economic and social value including impacts on property values (people generally prefer to live in "quiet" neighborhoods) and benefits to the wider community, including children and the elderly. The body of evidence reviewed relating to the benefits of quiet and quiet areas is summarized in Table 1.

Table 1: Evidence relating to the benefits of quiet and quiet areas

Broad Category	Benefits	Evidence
Health	Mental well-being	Berry & Flindell (2009); Defra (2010); New Economics Foundation (2005); Chu et al. (2004); van Kamp & Davies (2008)
	Psychological restoration / recovery	Clark et al. (2006)
	Psychological well-being, including stress release / relief	Öhrström et al. (2006); Gidlöff-Gunnarsson & Öhrström (2007)
	Physiological well-being (reduced risk of cardiovascular disease and hypertension)	Berry & Flindell (2009); Defra (2010); Health Protection Agency (2010); Babisch (2006); Sørensen et al. (2011)
Amenity	Reduced annoyance reflected in property price premiums	Bateman et al. (2001), Navrud (2002); Wardman & Bristow (2008); Nelson (2004)
	An escape from the 'hustle and bustle' of surrounding (relatively noisier) areas	van den Berg & van den Berg (2006)
	Relaxation / Recreation	Berglund et al. (2004); Gidlöff-Gunnarsson & Öhrström (2007); Klæboe (2005)
	Spiritual	Prochnik (2010)
	Quality of life	Lawton et al. (1980)
Productivity	Creativity and problem-solving	Stansfeld et al. (2000); Clark & Stansfeld (2007)
	Aid to concentration	Berglund & Lindvall (1995)
	Cognitive development	Berglund & Lindvall (1995); Evans & Maxwell (1997); Berry & Flindell (2009)
Ecosystems	Biodiversity (habitats for breeding, foraging, etc)	Environmental Protection UK (2010)
	Air quality (induced)	Environmental Protection UK (2010)

To date, most research effort has been dedicated to understanding the relationship between noise, annoyance and health. There is comparatively little focusing specifi-

cally on the benefits of quiet and access to quiet areas. This may be partly as a result of the complexity of defining quiet and quiet areas. Nevertheless, using a combination of evidence from the literature on the influence of noise on people's enjoyment of urban open spaces, it is clear that both 'quiet' and access to 'quiet areas' (or opportunities to experience freedom from unwanted sound) make an important contribution to human health and well-being, with growing interest in the restorative benefits.

In the absence of quantitative evidence on the benefits that people derive specifically from quiet and quiet areas (i.e. over and above those obtained through a reduction in noise levels), the scope of the literature review was broadened to investigate whether or not it is possible to determine the contribution of quiet to the overall quality of urban spaces. Interest in the social, economic and environmental value of urban spaces has grown considerably over the last decade, with both qualitative and quantitative studies on streets, parks and open spaces.

One particular gap in the evidence base is where quiet ranks amongst the many different features of urban open spaces and whether removing quiet (i.e. allowing more noise into such spaces) creates a snowball or tipping effect whereby other key amenities (e.g. biodiversity, mixing of ages groups) also suffer and users start to vote with their feet. The study included some preliminary testing of questions to users of public open spaces that might illuminate this tipping point further. However, there appears to be no existing mechanism or conclusive evidence for estimating the difference between the value of a quiet open space and a similar non-quiet open space. Furthermore, the evidence that does exist appears to focus overwhelmingly on the benefits or attributes that are important to users of open spaces; there is relatively little that examines the features that are important to non-users or those who could use a quiet area or urban open space but choose not to.

THE ECONOMIC VALUE OF QUIET AND QUIET AREAS

There has been significant progress in the quantification and valuation of environmental noise impacts over the past decade, as well as advances in spatial modeling, allowing estimation of average noise exposure across defined areas. However, until fairly recently, valuation of noise pollution, at least in the UK, has centered on amenity impacts[3] using hedonic pricing analyses (see for example, Tomkins et al. 1998; Bateman et al. 2001, 2004; Day et al. 2007) that examine the impact on property prices of households' exposure to road and rail noise. These studies fail, however, to capture the value of quiet areas to those who (i) may not be able to afford to live in 'quiet' neighborhoods and arguably, for whom, a quiet space in a noisy neighborhood would be more highly valued and/or (ii) those who may work in a noisy environment and seek refuge from the 'hustle and bustle' during the day.

The open space literature provides an indication of the direct and indirect use values of public parks, greenbelt and undeveloped land (McConnell & Walls 2005; CABE 2005; CLG 2006; The Trust for Public Land 2009; Green Space 2010; Gensler & the Urban Land Institute 2011) but no studies specifically identified 'quiet' as a valued benefit. Some studies (e.g. CLG 2006) infer a value for tranquility from existing studies, where tranquility is defined as the effect that undeveloped land may have in buffering nearby residential properties from noise, vibration and light pollution.

[3] Amenity impacts are defined in Defra (2008) as the conscious annoyance or negative reaction to noise exposure.

The studies reviewed demonstrate a number of important points. First, not all forms of open space are valued equally by households. Rather, values are determined on the basis of environmental quality (including security) and the available facilities. In the context of US studies for example, parks designed for natural habitat preservation and light recreation contribute significant amenity effects and outperformed golf courses with respect to neighboring property value enhancement. Second, developable open space such as farmland and forested land (and sometimes vacant sites) provide amenity effects although at lower levels than permanently protected open space. Third, there is a limit to how far the externalities from parks extend. Again, the results from US studies suggest that the externalities do not extend much beyond 450 m suggesting that a larger number of smaller open spaces may be more valuable than a single, large open space.

CONCEPTUAL APPROACHES TO VALUING QUIET AND QUIET AREAS

Three possible approaches to valuing quiet and quiet areas were considered:

- using values for urban green spaces as a proxy for "quiet areas" to identify an upper range estimate of the value of quiet areas. Drawing on recent initiatives (e.g. by CABE 2005; CLG 2006, etc.) and valuation studies on green open space to estimate, through the process of benefits transfer, the economic value of urban open spaces, studies to assess the impacts or opportunity costs of proposed (or actual) developments on greenfield sites and how these may impact on 'quiet' and/or the types of activities (e.g. recreation, reading, meditation, etc) that take place in these spaces;
- estimating the opportunity costs of maintaining undeveloped sites; and
- making use of existing values for noise disturbance in the home (i.e. based on the webTAG values). This would, however, only be applicable to a change in the level of noise/quiet and would not therefore reflect the value of those 'quiet spaces' that are actively sought. While such an approach could at least provide a starting point, it is important to note that it would be open to criticism.

The first approach is conceptually preferred as it is based on values for spaces that exhibit quiet characteristics. Once the method is established it may be refined as evidence on the relative contribution of quiet and other attributes to the overall value becomes available. In the absence of such evidence any results derived are necessarily heavily caveated and may well over-value quiet.

CASE STUDY

Using information from noise mapping, the literature review and primary research, the benefits transfer approach was applied to estimate an economic value for Westbourne Green, an open space in west London that exhibits clearly discernible changes in noise level from the centre of the open space to the surrounding area.

It is estimated (on the basis of a short observational survey) that around 2,000 people visit Westbourne Green each day. This includes both those for whom the Green is a destination in itself and those who use it as a thoroughfare. In addition to the users, there are also a number of non-users who may nevertheless value the space. These include people who live in the vicinity of the space and may therefore benefit from increased property values as a result of having a nice outlook or a quieter envi-

ronment, as well as people who simply value the existence of the open space. The case study is limited to use values only.

Under a baseline scenario, and using adjusted monetary estimates from studies on the value of public parks in Australia and the US (Lockwood & Tracy 1995; The Trust for Public Land 2001), the use value of Westbourne Green is estimated to lie between £1.18 and £7.40 per visit, or between £861,400 and £5,402,000 per year. This could reasonably be considered as an upper bound for the use value of the park.

A hypothetical change scenario is then introduced to examine the impact of the development of a new road scheme to the south of the Green which will result in a substantial increase in traffic flows along a major traffic artery (the A40) and an associated increase in noise levels within Westbourne Green.

A field survey of visitors to Westbourne Green indicated that one third of users would move away if subjected to continual loud traffic noise. Assuming a complete loss of utility to these users, the resulting welfare loss is estimated to lie between £284,130 and £1,782,660 per year. This estimate does not, however, account for those users who simply relocate to alternative quiet spaces nearby (with little or no change in utility) and those who continue to use Westbourne Green (perhaps because there are no convenient alternatives or choose instead to spent time in quieter parts of the space) but whose use values have been reduced as a result of the increase in noise.

The case study is a necessarily crude illustration of one approach to valuing quiet using available information on the value of urban open spaces. It ignores non-use values and does not account for those users who may continue to use the space but whose WTP to use the space is diminished by the increase in traffic noise, or those who are able to make use of alternative open spaces.

Using a similar approach, it is possible to derive an aggregate estimate for the value of quiet in England as a whole. An ICM poll conducted in 2009 found that 31 % of the population regularly visits quiet areas. Without a definition of 'regular' two scenarios are assessed: the first assumes one visit per person per year giving a total of 16.12 million visits per year nationally. The second assumes one visit per person per month giving up to 193.44 million visits per year. There is, however, a high degree of uncertainty around the number of visits specifically motivated by a desire for quiet, not excluding of course those trips made for other reasons but where quiet is a critical component of the package of experiences. Once again employing the use values of £1.18 to £7.40 per visit (which are themselves highly caveated and reflect the use value of green space in its entirety), the total use value for visits to quiet areas for England as a whole is estimated to lie somewhere between £19.02 million and £1.4 billion per year.

This estimate covers a wide range and includes only those who visit open spaces expressly for the purpose of experiencing quiet. These estimates do not include the value held by those users who visit open spaces for other reasons but gain added utility from the quiet and the non-use values held by those who may not necessarily visit quiet areas but derive benefit from knowing that quiet areas exist and/or from a premium on the value of properties located in or near to quiet areas.

CONCLUSIONS

As is evident from the review findings, very little research has sought to evaluate the benefits of quiet, taking 'quiet' or 'relative quiet' as the starting point. Rather, studies

have typically focused on the effects of noise or the impacts of changes in environmental noise levels above a 50 dBA threshold.

More broadly, it is clear from both the review and study findings that much more effort is needed to ensure that acoustic factors (including noise, soundscape, quiet and tranquility issues) are included on the agenda when considering open space. While 'quiet' does not explicitly feature as one of the most highly ranked attributes of urban open spaces amongst users, it is an implicit feature of other benefits that are considered very important including 'an escape from hustle/bustle' and a place for 'rest and relaxation'. This suggests too that quiet areas are valuable and need to be protected and enhanced. There is a clear need for empirical research to establish the specific value of "quiet" in open areas.

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REFERENCES

Babisch W (2006). Transportation noise and cardiovascular risk: review and synthesis of epidemiological studies, dose-effect curve and risk estimation. WaBoLu-Hefte 01/06. Berlin: Umweltbundesamt [online] available at http://www.umweltdaten.de/publikationen/fpdf-l/2997.pdf.

Bateman I, Day B, Lake I et al. (2001). The effect of road traffic on residential property values: a literature review and hedonic pricing study. Report to the Scottish Executive.

Bateman IJ, Day BH, Lake I (2004).The valuation of transport-related noise in Birmingham. Department for Transport [online] available at http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/economics/rdg/birmingham/ (accessed 28 January 2011).

Berglund B, Lindvall T (1995). Community noise. Arch Center Sensory Res 2: 1-195.

Berglund B, Kihlman T, Kropp W et al. (2004). Soundscape support to health. Final Report Phase 1, Chalmers University, Gothenburg, Sweden.

Berry BF, Flindell IH (2009). Estimating dose-response relationships between noise exposure and human health impacts in the UK. Final Project Report, BEL 2009-01, report to DEFRA [online] http://www.defra.gov.uk/environment/quality/noise/igcb/documents/project-report.pdf (accessed 13 January 2011).

Bruce N, Davies B, Adams M (2009). Expectation as a factor in the perception of soundscapes. Paper presented at Euronoise 2009. [online] available at http://usir.salford.ac.uk/2466/1/Bruce_et_al_soundscape_expectation_euronoise_2009.pdf (accessed 31 January 2011).

CABE (2005). Does money grow on trees? CABE Space, London [online] available at http://www.cabe.org.uk/files/does-money-grow-on-trees.pdf (accessed 31 January 2011).

Chu A, Thorne A, Guite H (2004). The impact on mental well-being of the urban and physical environment: an assessment of the evidence. J Mental Health Prom 3(2): 8-17.

Clark C, Stansfeld S (2007). The effect of transportation noise on health and cognitive development: a review of recent evidence. Int J Comp Psychol 20: 145-158.

Clark C, Martin R, van Kempen E et al. (2006). Exposure-effect relations between aircraft noise and road traffic noise exposure at school and reading comprehension: The RANCH project. Am J Epidemiol 163: 27-37.

CLG (2006). Valuing the external benefits of undeveloped land [online] available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf (accessed 31 January 2011).

Day B, Bateman I, Lake L (2006). Estimating the demand for peace and quiet using property market data. CSERGE Working Paper EDM 06-03 [online] available at http://www.cserge.ac.uk/sites/default/files/edm_2006_03.pdf (accessed January 2011).

Defra (2008). An economic valuation of noise pollution – developing a tool for policy appraisal. First report of the Interdepartmental Group on Costs and Benefits, Noise Subject Group [online] available at http://www.defra.gov.uk/environment/quality/noise/igcb/documents/igcb-first-report.pdf (accessed 28 January 2011).

Defra (2010). Valuing the human health impacts of environmental noise exposure [online] available at http://www.defra.gov.uk/environment/quality/noise/igcb/documents/igcn-noise-health-response-tables100721.pdf (accessed 15 March 2011).

Department for Transport (2011). The noise sub-objective, Webtag Unit 3.3.2 , Transport Analysis Guidance, April 2011, Department for Transport, London [online] available at http://www.dft.gov.uk/webtag/documents/expert/unit3.3.2.php (accessed 25 May 2011).

Environmental Protection UK (2010). Quietening open spaces: towards sustainable soundscapes for the City of London. Report prepared for the City of London Corporation [online] available at http://www.environmental-protection.org.uk/assets/library/documents/Quietening_Open_Spaces_july2010_lower_res).pdf (accessed 12 January 2011).

Evans GW, Maxwell L (1997). Chronic noise exposure and reading deficits: The mediating effects of language acquisition. Environ Behav 29: 638-656.

Gensler and the Urban Land Institute (2011). Open space: an asset without a champion? [online] available at http://www.gensler.com/uploads/documents/Open_Space_03_08_2011.pdf (accessed 9 March 2011).

Gidlöf-Gunnarsson A, Öhrström E (2007). Noise and well-being in urban residential environments: the potential role of perceived availability to nearby green areas. Landscape Urban Plann 83: 115-126.

Green Space (2010). Understanding the contribution parks and green spaces can make to improving people's lives. Full Report [online] available at http://www.green-space.org.uk/resources/GreenLINK/index.php (accessed 15 March 2011).

Health Protection Agency (2010). Environmental noise and health in the UK. A report published by the Health Protection Agency on behalf of an ad hoc Expert Group on the Effects of Environmental Noise on Health [online] available at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1279888026747 (accessed 28 January 2011).

Klæboe R (2005). Are adverse impacts of neighbourhood noise areas the flip side of quiet areas? Appl Acoust 68: 557-575.

Kull RC (2006). Natural and urban soundscapes: the need for a multi-disciplinary approach. Acta Acust Acust 92: 898-902.

Lawton MP, Nahemow L, Tsong-Min-Yeh (1980). Neighbourhood environment and the wellbeing of older tenants in planned housing. Int J Aging Hum Dev 11: 211–227.

Lockwood M, Tracy K (1995). Nonmarket economic valuation of an urban recreation park. J Leisure Res 27: 155-167.

McConnell V, Walls M (2005). The value of open space: evidence from studies of non-market benefits. Resources for the Future, January 2005 [online] available at http://www.rff.org/Documents/RFF-REPORT-Open%20Spaces.pdf (accessed 15 March 2011).

Memoli, G, Bloomfield A, Dixon M (2008). Soundscape characterization in selected areas of Central London. Paper presented to Acoustics 08, Paris [online] available at http://intellagence.eu.com/acoustics2008/acoustics2008/cd1/data/articles/002704.pdf (accessed 13 January 2011).

Navrud S (2002). The state-of-the-art on economic valuation of noise. Final Report to European Commission DG Environment.

Nelson JP (2004). Meta-analysis of airport noise and hedonic property values: problems and prospects. J Transport Econ Policy 38: 1-28.

New Economics Foundation (2005). Well-being and the environment [online] available at http://www.neweconomics.org/sites/neweconomics.org/files/Well-being_and_the_Environment.pdf (accessed on 14 March 2011).

Nilsson ME (2007). Soundscape quality in urban open spaces. Inter-noise 2007, Istanbul.

Öhrström E, Skånberg A, Svensson H et al. (2006). Effects of road traffic noise and the benefit of access to quietness. J Sound Vibr 295: 40-59.

Prochnik G (2010). In pursuit of silence: listening for meaning in a world of noise. New York: Doubleday.

Scott Wilson Ltd. (2009) Westminster open spaces noise study 2008. Final Report for Westminster City Council [online] available at http://www3.westminster.gov.uk/docstores/publications_store/Westminster%20Open%20Spaces%20Noise%20Study%202008.pdf (accessed 24 March 2011).

Sørensen M, Hvidberg M, Andersen ZJ et al. (2011). Road traffic noise and stroke: a prospective cohort study. Eur Heart J 32: 737-744.

Stansfield S, Head J, Marmot M (2000). Work related factors and ill health: The Whitehall II Study. Health & Safety Executive [online] available at http://www.hse.gov.uk/research/crr_pdf/2000/crr00266.pdf (accessed 7 June2011).

The Trust for Public Land (2001). Economic benefits of open space index. New York, The Trust for Public Land [online] available at http://www.tpl.org/tier3_print.cfm?folder_id=727&content_item_id=1147&mod_type=1 (accessed 14 March 2011).

The Trust for Public Land (2009). Measuring the economic value of a city park system [online] available at http://www.8-80cities.org/Articles/Measuring%20Economic%20Value%20City%20Park%20System.pdf (accessed on 14 March 2011).

Tomkins J, Topham N, Twomey J et al. (1998). Noise versus access: The impact of an airport in the urban property market. Urban Stud 35: 243–258.

van den Berg MMHE, van den Berg GP (2006). Quiet areas: health issues and criteria. In: Proceedings of Euronoise 2006, Tampere, Finland.

van Kamp I, Davies E (2008). Environmental noise and mental health: five-year review and future directions. In: 9th International Congress on Noise as a Public Health Problem (ICBEN).

Wardman M, Bristow AL (2008). Valuations of aircraft noise: experiments in stated preference. Environ Resource Econ 39: 459-480.