RUNNING HEAD: ENVIRONMENTAL QUALITY FOR URBAN SUSTAINABILITY

Inhabitants' and Experts' Assessments of Environmental Quality for Urban Sustainability

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Abstract

In the context of sustainable urban development, we discuss the assessment of residential environmental quality and the importance of considering inhabitants' perceptions of natural resources in urban areas. Two series of studies, conducted in Guildford (UK) and in Rome (Italy), addressed the correspondence, or contrast, between inhabitants' and experts' assessment of urban quality concerning two crucial natural resources: air quality and biodiversity. The Guildford study emphasized the *accuracy* of assessment of urban air quality by experts and the public. The Rome study focused on the evaluative *criteria* employed by scientists and the public in assessing the quality of urban green spaces. The results from both studies shed more, albeit complex, light on the simple conventional wisdom about public versus expert understanding and assessment of environmental quality. Study implications are discussed for the support of programs, methods and tools for urban development, particularly with regard to effective communication and better structuring of residents' participation in urban environmental decision-making.

Inhabitants' and Experts' Assessments of Environmental Quality for Urban Sustainability

According to recent projections of the United Nations Population Division, urban population will equal rural population in 2007 (United Nations, 2004). In conjunction with this continuing urbanization, problems such as air and noise pollution, or the lack of access to green spaces and fresh water resources are becoming more serious for large numbers of urban inhabitants throughout the world. As a consequence, the so-called "ecosystem approach", originated in the bio-ecological sciences, is increasingly being adopted as a principal conceptual frame for addressing urban environmental problems (di Castri, Baker, & Hadley, 1984; Celecia, 1996). Thus, the issue of urban sustainability has become a priority on the current environmental agenda, in both the scientific and the political domain (Moser, 2004; Platt, 2004).

Drawing on studies undertaken in Italy and the UK, this paper discusses the application of the concept of environmental sustainability to the perception and use of natural resources in urban areas, and in particular to the assessment of urban environmental quality. In so doing, reference will be made to both the origins of the sustainability concept in the natural-ecological sciences, as well as to its more recent extension to the social and behavioral sciences, and to its application to urban areas.

Urban Sustainability and the Assessment of Urban Environmental Quality

The idea of considering cities as "ecosystems" has been promoted in recent decades by different international agencies. For example, the UNESCO *Man and Biosphere* (MAB) Programme played a substantial role in moving this ecosystem approach from what has been defined as a *partial ecology* paradigm, often typical of the natural sciences, to what was defined as a *full ecology* paradigm, including the social and behavioral sciences (Bonnes & Bonaiuto, 2002; Bonnes, Carrus, Bonaiuto, Fornara, & Passafaro, 2004). Within this framework, multidisciplinary collaboration between the natural, human and technical sciences

was particularly recommended, and the potential contribution of the social and behavioral sciences was stressed in order to better understand environmental processes and changes occurring within urban systems. According to such a *full ecology* perspective, the "natural sphere" (typically pertaining to biological processes), and the "human sphere" (typically pertaining to cultural, social and behavioral processes) are conceived as interdependent and not as conflicting elements. Thus continuity is emphasized between the more nature-dominated ecosystems (e.g., wilderness and rural areas) and the more human-dominated ecosystems, such as urban areas (Bonnes et al., 2004).

Multidisciplinary research approaches to the study of urban ecosystems emanated from considerations about the possible interrelations among three main "urban sub-systems": (1) the "bio-ecological sub-system", (2) the "human technological/architectural sub-system", and (3) the "human perceptual/behavioral sub-system".

In supporting the sustainability of cities from a bio-ecological point of view, particular emphasis is placed on the interdependencies between the bio-ecological sub-system and their human technological and human perceptual and behavioral counterparts.

This latter issue may be understood through studying human perceptions and behaviors toward urban natural resources and thus toward related urban environmental quality and sustainability. Here, the concept of "place", which has been crucial in environmental-psychological research, is particularly important (Uzzell, Pol, & Badenas, 2002). A psychological place-specific approach, and not only an ecological site-specific approach, is indispensable to address the issue of urban sustainability (Bonnes & Bonaiuto, 2002; Uzzell et al., 2002).

Having global environmental concerns or believing in global environmental values at the personal level can be a major driver of individual pro-environmental action, in particular among urban inhabitants (Kaiser & Gutscher, 2003). At the same time, there is a need to take

into account how, at a local level, social-psychological processes can moderate individuals' compliance with environmental policies oriented toward urban sustainability and commitment to environmental protection (Uzzell, 1999). Among these processes is the perception of local environmental quality (Bonaiuto, Breakwell, & Cano, 1996). Individuals are more willing to protect themselves when they think to be personally endangered by something (e.g., Weinstein, 1989) and engage in environmentally friendly activities when they perceive their local surroundings to be deteriorating (Hatfield & Job, 2001).

However, people may have difficulties in detecting many unsustainable environmental changes. Human sense organs may be unable to perceive certain environmental conditions (e.g., nuclear pollution, or certain forms of air pollution). The slowness of some environmental changes (e.g., loss of biodiversity, global warming) sometimes makes their direct sensory detection very difficult. In these cases, human knowledge and perception of environmental conditions, and thus their behaviors, can become very dependent on social and communicative processes that create socially shared perceptions and views of the environments (Graumann & Kruse, 1990; Uzzell, 2000). This has convinced various authors of the importance of the communicative and socio-cultural processes involved in residents' assessment of urban environmental quality, assuming it to be one of the factors driving environmentally committed behaviors (Bonnes & Bonaiuto, 1995; Uzzell, 2000).

The Perspective of Experts versus Laypersons

These arguments highlight the possibility of different, or even opposite, perceptions and evaluations of the same environmental features by different actors, for example, experts or technicians *versus* inhabitants or laypersons. There is a substantial research literature on expert versus lay assessments of environmental conditions and in particular of environmental threats or risks.

Judgments of Environmental Risk.

Slovic, Fischhoff and Lichtenstein (1986) reported that, when comparing technical estimates for annual fatalities with laypersons' estimates, experts' mean judgments were very closely related to the statistical or calculated frequencies. However, the judgments made by laypeople showed only a moderate relationship to annual fatality frequencies. Slovic et al. (1986) argue that laypeople do not possess statistical information and thus rely on inferences drawn from observation or comment. The authors conclude that, unlike experts, laypeople's risk perceptions were affected by qualitative characteristics, such as dread and catastrophic potential. Rowe and Wright (2001) noted that such types of findings have been used to infer that expert judgments are more veridical than those of the public. In cases such as nuclear power, toxic waste, genetic engineering, food additives and other, experts tend to judge risks to be minor or even non-existent, whereas the public on the other hand remain quite concerned about the risks and perceive them to be high (Sjöberg, 1999). Evidently, people's reactions to risks take centre stage in policy-making, and as a result researchers have identified the need to "bridge the gap" between scientific and expert knowledge.

Criticisms regarding psychological perspectives on risk, particularly the psychometric paradigm have questioned the enduring distinction between 'actual' and 'perceived' risks, particularly with reference to the fact that 'objective' data is often used as markers against people's perceptions. Kemp (1993) noted that in the case of technical approaches to risk it is important to take into account the practical context of the hazard being assessed. For example, the exact age and amounts of hazardous material within a particular landfill site may be poorly recorded, or the geology under the site may not be well understood. Thus, calculating the probabilities associated with the exposure of a local environment or population to toxic materials from a landfill site may lack precision.

Jantunen (2001) noted that although differences have been identified between expert and lay groups, the public uses *broader* definitions of risks. Slovic (1987) observed that

although laypeople may lack certain types of information about given hazards, their basic conceptualisations of risks are richer than those of experts, and may reflect legitimate concerns that expert assessments typically omit (Slovic, 1987). Likewise, the lay public are said to define risks by using a number of qualitative variables, which differ considerably from those used in expert estimations of risks (Clift, Burningham, & Lofstedt, 1995). For Jantunen (2001), the public's broader definitions may be more rational than the "narrow" ones used by experts.

Experts' and Inhabitants' Assessment of Urban Environmental Quality

In order to promote urban sustainability, congruence between inhabitants' and experts' assessment of urban environmental quality is crucial. On the one hand, it is generally accepted that a more inclusive and participatory approach to the governance of urban systems is likely to be more successful in securing their long-term social, cultural, environmental and economic sustainability. Many scholars in this field assume that resident-based environmental policies should receive a higher degree of consensus and support among the public and should thus be more sustainable and efficacious on the longer term (e.g., Churchman & Sadan, 2004). As studies about public participation have shown, policy decisions that are more socially shared and accepted are also more likely to provide stable frames of reference for driving urban dwellers' everyday behaviors and decisions (Uzzell, 2003). On the other hand, policy-makers' resistance to more inclusive and participatory processes in environmental governance is sometimes based on their assumption that laypersons do not always have the capacity or the knowledge necessary to assess environmental quality in an "objective" or reliable fashion (Churchman & Sadan, 2004).

Overview of the Guildford and Rome Studies

The two studies to be reported, one in Guildford (UK) and one in Rome (It.), share a common theme in terms of their basic theoretical assumptions and aims, but they diverge in

terms of methods, procedures and, in part, the findings they reveal. Both studies have a specific concern for the bio-ecological components of the urban system: air quality in the Guildford study, and the availability and biodiversity richness of urban green areas in the Rome study. Furthermore, both studies share the aim of assessing the possibly different evaluations of these natural resources. The key question of both studies is: what is the degree of correspondence between the evaluations provided by scientists and experts (usually defined as "objective") on the one hand, and the evaluations provided by urban inhabitants, or laypersons (usually defined as "subjective") on the other?

A more qualitative focus was followed in the Guildford case, while a more quantitative approach was adopted in the Rome study. Furthermore, whereas the focus of the Guildford study was on the potential *accuracy* of inhabitants' assessments of one specific environmental quality (i.e., air quality assessed by experts in the chemistry domain), the emphasis in the Rome study was placed on understanding the possibly different evaluative *criteria* employed by (plant) ecologists and the public in assessing urban environmental quality.

The Guildford Studies: Evaluating Polluted Areas

The Guildford studies examined the relationship between inhabitants' and experts' evaluations of traffic-generated air pollution (Kelay, 2004). Nine studies were conducted to investigate whether scientific and lay accounts of air pollution were complimentary or contradictory. These drew upon scientifically generated air pollution data and the 'perceived realities' of air pollution, as held by members of the public and experts. The studies reported in this paper applied an interpretative approach to exploring lay and expert understandings of the environment, as opposed to traditional survey-orientated approaches that tend to emphasize public misperceptions about the environment or risks, and the 'gulf of understanding' between laypeople and experts (e.g., DeGroot, 1967; Hohm, 1976).

The utilization of an interpretative approach reflects the gradual shift in research emphasis, whereby environmental issues and risks have been addressed within wider conceptual and methodological frameworks (e.g., Forrester, 1999; Yearley, Cinderby, Forrestyer, & Rosen, 2003). This reorientation has primarily been due to the realisation that environmental phenomena are socially and culturally constructed. Accordingly, there has been a progression toward more qualitative approaches to measuring and understanding environmental phenomena (e.g., Bush, Moffatt & Dunn, 2001; Wakefield, Elliot, Cole, & Eyles, 2001). Interpretative approaches have served to emphasize the importance of addressing "naturally occurring" lay accounts by means of *in situ* studies, embedded in people's everyday life, rather than via laboratory or survey investigations.

Bickerstaff and Walker (2001, p. 143) argue that "if policy and communication frameworks are to achieve durable changes in public attitudes, and in turn behaviour, they must move beyond a top-down model of assumed public ignorance". Bailey, Yearley, and Forrester (1999) demonstrated that the public can meaningfully contribute to air quality policy development, owing to their sophisticated knowledge based upon local expertise. However, whilst references to "the local context" and "local issues" have become increasingly salient, there have been few attempts to account for the processes through which lay knowledge comes to be embedded within the public's perception and understanding of the local environment.

Method

In order to allow for a systematic and balanced exploration of scientific and lay knowledge systems, a novel approach was developed to identify correspondences and disparities between these two groups drawing on methods from the natural and social sciences. The natural scientific component involved measured NO_2 air pollution data and modeled estimations of spatial trends and variations. Assumptions regarding the deployment

of NO_2 measurement devices, and the use of modeling packages were fulfilled by criteria developed through close collaboration with local policy experts and natural scientists, including mathematical modelers, who specialized in the field of air pollution. The social-scientific component involved qualitative and quantitative methods including a large-scale survey, mapping exercises and in-depth interviews. The interdisciplinary nature of the research was reflected in the development of an innovative multi-method approach involving the cross application of methods and Geographical Information System (GIS) analysis. This paper reports the qualitative findings (Kelay, 2004).

Lay and Expert Knowledge about Air Pollution

In order to investigate the nature and extent of knowledge about air pollution, the qualitative component of the study comprised a series of in-depth interviews in conjunction with mapping exercises that were analysed using GIS. These methods were used with the lay public as well as with air pollution experts. The study was conducted in Guildford, Surrey. The county of Surrey has the highest car ownership in the UK, with 63 cars per 100 people but only 39 per 100 people in the UK. The average daily traffic on A roads (non-motorway highways) in Surrey was 78% higher than the UK average in 2002. The interviews were conducted with residents who lived within 1 km of the A3, the principal highway which links London to Portsmouth. Guildford has very few industrial emissions, so air pollution is largely attributable to motor vehicles. The highest levels of air pollution follow the main roads, particularly the A3, with dispersion and some penetration into the adjacent neighborhoods.

Ten residents were interviewed (5 females and 5 males). The residents had previously taken part in a large-scale questionnaire survey. In addition, ten professionals and experts who belonged to various relevant organizations in Surrey took part in the study: seven university scientists who specialised in the field of air pollution, a health practitioner, and two local

authority environmental health officers who were responsible for monitoring air pollution within the Borough of Guildford. Six of the experts were male and four were female.

At the beginning of the interview sessions all participants were asked to carry out a mapping exercise task in the presence of the interviewer. The map featured residential areas of Guildford, and was superimposed with an 8 x 6 grid, featuring 48 grid-squares. In the instructions participants were asked to allocate numerical values (1 = low, 2 = medium, 3 = high) for each of the grid-squares, in order to denote whether they perceived air pollution to be high, medium or low within that particular grid-square. Participants were asked to explain their evaluations whilst performing the exercise. Not only did the task provide functional data on perceived levels of air pollution, which in turn generated data for GIS interpolation, but it also allowed for an in-depth analysis of the basis of lay and expert knowledge, thus providing detailed discursive accounts that were elaborated upon as the interviews progressed. All interviews were tape-recorded and transcribed for analytical purposes.

The mapping exercises were used to abstract the subjective reality of air pollution, generating functional data. The data was used to construct GIS maps in order to represent experts and lay residents' perceptions of spatial variations and severity levels of pollution in digital form. The GIS analysis of perceived air pollution data involved two phases: data pre-processing and the calculation of perceived air pollution, using spatial analytic techniques.

The in-depth interviews were analysed using Interpretative Phenomenological Analysis. IPA is committed to exploring how individuals construct meaning and engage in sense-making in order to comprehend objects, events and in the present case, phenomena such as air pollution. The IPA method is based upon the assumption that all knowledge is necessarily contextual and standpoint-dependent, which suggests that different perspectives generate insights into the same phenomenon (Willig, 2002).

Results

Residents indicated that they had not gained prior knowledge about actual air pollution from educational or other sources such as the media, newspapers or the internet. Rather, they felt they did not need to seek out such information as they thought it was common sense or intuitive. The analysis, therefore, aimed to establish the basis of these types of 'common sense' or intuitive assessments. With regards to causes of air pollution, traffic-related pollution was commonly cited. When talking about their local area, images were closely linked with the volume of traffic in the town. Lay linkages were made between traffic levels and air pollution levels, citing heavy traffic, congestion and fumes emitted from vehicles. Unknown to the residents, their views were corroborated by official estimations of air pollution in their locality, and matched by experts. The quoted extract below (R1) exemplifies how residents expressed their knowledge about the high density of traffic levels.

> R1: *"Well, it's my perception; I really don't have the knowledge whatsoever. It's highly populated, there's a lot of traffic and a lot of people living around…I don't know official ratings but uh I don't think [air quality] is very good when it's busy."*

It is important to note that residents demonstrated a lack of confidence when articulating their views. This was a constant theme: residents did not believe they had the prerequisite knowledge to make judgments about the subject. The inclusion of mapping exercise tasks within the interview enabled residents to overcome initial reservations in articulating their knowledge. GIS manipulation and the analysis of the mapping exercise data provided visual representations of how residents envisaged air pollution in their locality, whilst concurrently enabling direct comparisons with modeled scientific estimations of air pollution.

Analysis of the interviews also revealed that Guildford inhabitants possessed knowledge about the corollaries and consequences of pollutant emissions in their local area. They believed that air pollution trends would vary according to time and space. Residents also demonstrated knowledge about diurnal trends in air pollution, whereby pollutants rise and fall

according to particular times of the day (e.g., higher in the morning and evening rush hour traffic). Again, their views coincided with the measured diurnal patterns of air pollution, whereby NO_2 levels rise and peak during morning and evening rush hour traffic, indicating strong correspondence with travel behaviour patterns.

With regards to the severity of air pollution and its spatial variations, residents were able to apply their knowledge of the characteristics and attributes of the area they inhabited. They talked about local topography in order to estimate where they thought pollutant concentrations would be higher (or lower). They also linked such examples of local knowledge with understandings about environmental processes and meteorological conditions. Lay accounts of air pollution dispersion, distance decay associations and canyon effects were also mentioned. It is important to note that although the lay public did not articulate such knowledge using scientific terminology, residents' descriptions coincided directly with scientific assumptions and theoretical principles. Although residents acknowledged that such environmental processes could not actually be seen, they were aware of their occurrence.

R2: *"The town's the worst, because the buildings, they contain it [air pollution] a bit, don't they? You can't see it, but it's there."*

There was a consistent belief amongst experts that the public would lack awareness about air pollution. On the contrary, local inhabitants displayed a comprehensive knowledge about local air quality causes, consequences and severity. Whilst lay estimations of air quality mirrored official scientific estimations, by contrast, when air pollution scientists and experts were subjected to the same interview format and mapping exercises, they were much more likely to over- or under-estimate the severity of air pollution across the area. As an example, consider how a scientist (a university professor) expressed his knowledge in the following quoted extract:

E1: *Air pollution will be high around all the major trunk roads, around the road corridors its going to be relatively high. It will drop if you move away and be only about medium levels. if you get far enough away from all the roads there might be some low levels in the countryside, but we are in the South East of England, so we can hardy get away from the roads, especially with the M25 up here...*

Unlike members of the public, experts displayed very little hesitation or lack of confidence in expressing their knowledge. They based the rationale for their estimations of air pollution severity on quantitative criteria, referring to the key parameters involved in air pollution modeling (traffic flow, time of day, background concentrations, dispersion processes, wind speed and wind direction).

E1: *Air pollution will follow the major roads, so the A35 and obviously the A3…I mean, you've got…60,000 vehicles running along the A3 in twelve hours, every single day. Pollution comes out of cars in Surrey, that's undeniable".*

When compared to official air pollution measurements, the public's estimations were not dissimilar. The combined findings challenge the notion that expert evaluations are more accurate than public knowledge. Given that local residents' perceptions and knowledge regarding air pollution were similar to the scientific estimations and as well as theoretical predictions, it would appear that experts' views of the public were misinformed. Thus, the results, contrary to the expectations of scientists, demonstrated that public estimates of air pollution are not unlike scientific accounts and therefore challenge what is often perceived to be a gulf of understanding between experts and the public. Although experts articulated their knowledge in a confident and assured manner, providing facts and figures to validate their rationale, they nonetheless lacked the valuable insights possessed by local residents. Furthermore, the public's interpretation and understanding of air quality and pollution were firmly grounded in knowledge about the environment and affective facets of place.

The Rome Studies: Evaluating Green Urban Areas

A series of studies, drawn from the long-term multidisciplinary UNESCO-MAB Project in the city of Rome (1981-2004), examined various aspects of residents' perceptions of urban environmental quality, paying particular attention to the issues of biodiversity conservation in urban areas, and thus of quality of green areas in the city. A more detailed description of the theoretical backgrounds, materials, methods, procedures, and statistical analyses used across these studies can be found elsewhere (e.g., Bonnes et al., 2004; Sanesi, Lafortezza, Bonnes, & Carrus, 2006).

The environmental-psychological literature has extensively documented how humans positively evaluate the natural environment and the positive outcomes of contact with nature (see Van den Berg, Hartig, & Staats, this issue). This has been shown in different domains, such as environmental preference (e.g., Kaplan, 1987), stress recovery and psychological restoration (e.g., Hartig, 2004); environmental attitudes and concern (e.g., Fransson & Gärling, 1999), residential satisfaction and attachment (e.g., Bonaiuto, Aiello, Perugini, Bonnes, & Ercolani, 1999; Kyle, Mowen, & Tarrant, 2004), interpersonal relations and community ties (Coley, Kuo, & Sullivan, 1997).

Despite this generalized positive pattern, it has been suggested that the relation between people and nature can in some cases be ambiguous or even ambivalent (e.g., Bixler & Floyd, 1997). In particular, studies conducted in Rome have shown that residents' evaluation of nature in the city can involve a consideration of both positive and negative aspects at the same time (Carrus, Passafaro, & Bonnes, 2004). When asked to express their opinion about their residential urban green space, people refer to positive aspects such as the benefits of contact with nature, or the augmented possibilities for social interaction afforded by urban green spaces. But, at the same time, people may refer to negative aspects such as the perceived

danger within urban parks, or personal discomforts deriving from badly maintained vegetation.

Usually, the less positively judged or preferred green spaces are those less well-maintained and appearing more similar to wilderness areas, such as dense woods, shrubs, or urban forests. Various authors have argued that factors such as perceived environmental control, perceived danger, and fear of crime might hamper people's preference for these kinds of natural scenes, in particular in urban settings (e.g., Herzog & Miller, 1998; Nasar & Jones, 1997). It is noteworthy, however, that such kinds of urban green spaces are also those highly valued according to natural and bio-ecological scientific criteria. Experts in the plant ecology domain place a high value on these kinds of green spaces: in particular, their richness in terms of biodiversity makes them more important for ensuring the long-term sustainability of any ecosystem, including urban ones (Cignini, Massari, & Pignatti, 1995).

A worthy issue for exploration is therefore whether (and how) differences in inhabitants' evaluations of residential green spaces could be related to different 'objective' properties of residential green, such as their overall quantity and their biological quality (i.e., biodiversity richness). This aspect is related to the more general question of whether evaluations of residential green areas provided in turn by experts from the bio-ecological field and by residents themselves, may or may not converge. The study presented here is concerned in particular with these issues.

Aims and Research Design

The study presented here is the environmental-psychological component of a wider research project involving two disciplinarily distinct research teams: an environmental-psychology research group and a plant-ecology research group (see Bonnes et al., 2004). The study aimed to explore how urban inhabitants' satisfaction for, and frequency of use of their residential green areas varied according to the different characteristics of these residential

natural spaces (such as, e.g., their relative availability and biodiversity richness), as assessed through natural scientists' criteria. To this end, residents of neighborhoods characterized by different amounts and qualities of green areas, as assessed through experts' criteria, were compared according to a 2 (high vs. low availability) x 2 (high vs. low biodiversity) between-subjects quasi-experimental factorial design, where satisfaction with and use frequency of residential green areas were the dependent variables. Given the multidisciplinary nature of the wider project, the suggestions of other research groups were used to identify and classify Rome's various neighborhoods with respect to the availability and biodiversity richness of their green areas.

Availability was operationalized as the amount of public green spaces *per capita* within a given neighborhood on the basis of the official statistical database of the Rome Municipality. Neighborhoods having more than 10 m^2 per capita of public green spaces were categorized as "high availability", while neighborhoods having less than 3 m^2 per capita of public green spaces were categorized as "low availability".

Biodiversity richness was operationalized as the different location of a given neighborhood with respect to Rome's *biological corridors* (i.e., within vs. outside). According to plant and animal ecologists' studies, at least two principal biological corridors can be identified in the Rome area, connecting the outside with the internal parts of the urban system. These corridors contain a high biological diversity of plant and animal life so that the green areas therein are characterized by a higher degree of "naturalness" and by a higher biodiversity richness compared to those outside (e.g. Cignini et al., 1995).

Method

Participants, tools, procedures and statistical analyses

A total of 547 residents of Rome participated in the study, balanced according to the main socio-demographic characteristics (e.g., age, education, income). Some subjects (n = 64)

were not included in the final database because of the uncertain amount of green areas in their neighborhoods of residence. The final sample (N = 483) comprised 250 females and 233 males; 82 participants (17%) lived in "high quantity/high biodiversity of green" neighborhoods; 183 participants (38%) lived in "high quantity/low biodiversity of green" neighborhoods; 43 participants (9%) lived in "low quantity/high biodiversity of green" neighborhoods, and 175 (36%) participants lived in "low quantity/low biodiversity of green" neighborhoods.

Data were collected through a paper-and-pencil questionnaire, which comprised, amongst other questions, self-reported measures of satisfaction with the neighborhood's green areas, and frequency of use of intra-neighborhood green areas. Questionnaires were collected in the period February-March 1999 by trained interviewers who directly approached the participants in informal places (e.g., shops, city streets, malls, squares).

Data were analyzed by means of a series of factorial ANOVA models, where the availability and biodiversity richness of participants' neighborhood green areas were the independent variables, and participants' scores of satisfaction with, and use frequency of their residential green areas were the dependent ones.

Main Results

Satisfaction with neighborhood's green areas

The mean scores of satisfaction for neighborhood's green areas ranged between 1 and 3 (extremely low and high satisfaction, respectively). Scores were 2.52 (S.D. = .78) in the *low biodiversity/high availability* condition; 1.63 (S.D. = .79) in the *low biodiversity/low availability* condition; 2.11 (S.D. = .83) in the *high biodiversity/high availability* condition; 1.79 (S.D. = .74) in the *high biodiversity/low availability* condition.

A significant 2-way interaction was detected ($F_{(1, 479)} = 11.27$; $p < .01$; $\eta^2 = .02$). Post post-hoc comparisons revealed that in both neighborhoods with low-biodiversity ($F_{(1, 356)} =$

115.7; $p < .001$) and high-biodiversity green areas ($F_{(1, 123)} = 4.5$; $p < .04$), subjects provided with a high availability of green expressed higher satisfaction than subjects provided with a low availability of green; the size of this effect is much greater in the former case ($\eta^2 = .24$ and .04, respectively). This interaction is graphically represented in Figure 1. In other words, high availability of green matters more when biodiversity richness is low.

Insert figure 1 about here

A main effect of the 'availability' of green areas in the neighborhood was also detected ($F_{(1, 479)} = 50.52$; $p < .001$; $\eta^2 = .09$): respondents living in neighborhoods with a greater availability of green space express higher levels of satisfaction (M = 2.4; S.D. = .82) compared with respondents living in neighborhoods with less green space (M = 1.67; S.D. = .78). No main effect of the 'biodiversity richness' of green areas in the neighborhood was detected ($F_{(1, 479)} = 2.31$; $p = .13$).

Frequency of use of green areas in the neighborhood

The mean scores of self-reported use-frequency of intra-neighborhood green areas ranged between 0 (no use) and 3 (extremely high use). Scores were 2.09 (S.D. = .94) in the *low biodiversity/high availability* condition; 1.73 (S.D. = 1.04) in the *low biodiversity/low availability* condition; 1.82 (S.D. = .97) in the *high biodiversity/high availability* condition; 1.63 (S.D. = .95) in the *high biodiversity/low availability* condition.

A main effect of the availability of green areas in the neighborhood was detected ($F_{(1, 479)} = 6.87$; $p < .02$; $\eta^2 = .01$): respondents living in neighborhoods where a greater amount of green space is available report a more frequent use of it (M = 2.01; S.D. = .95), compared with respondents living in neighborhoods with less green space (M = 1.71; S.D. = .1.02). The effect of “biodiversity richness” of green areas in the neighborhood was rather weak and only

marginally significant ($F_{(1, 479)} = 3.1$; $p < .08$; $\eta^2 = .006$). No 2-way interaction effect was detected ($F < 1$).

As with satisfaction, the frequency of use of one's neighborhood green spaces seems therefore to be positively related to their availability, but relatively independent of their biodiversity richness.

Discussion of the Rome Findings

On the whole, findings from the Rome study suggest that physical properties of urban green areas, such as their availability and biodiversity richness are differently related to inhabitants' satisfaction and use-frequency.

Inhabitants' satisfaction with urban green areas is greater among residents of neighborhoods with a high quantity of green spaces. This could be explained by those aspects of green spaces that are specifically related to their quantity (e.g., accessibility, closeness to the home, etc.). Furthermore, residents' satisfaction seems not necessarily predicted by the overall biodiversity richness of urban green areas, a parameter that is commonly taken by experts in the plant ecology domain as an indicator of green areas' quality. Quality might, however, be a 'moderator' of the relation between satisfaction and availability. This last factor, in fact, seems much more capable of predicting satisfaction when residents are provided with green spaces that are poor in terms of biodiversity richness.

Similarly to satisfaction, frequency of use of green areas is significantly higher among residents of neighborhoods with a high quantity of green spaces. Again, the overall 'biodiversity richness' of urban green areas does not seem to play a substantial role in promoting inhabitants' frequentation of their residential green space.

Concerning the 2-way interaction, the relatively poor usability of highly "natural" green areas could explain why having a high quantity of green spaces is a stronger predictor of satisfaction when quality is low. This is a post-hoc explanation, as usability was not directly

measured in our studies. Nevertheless, an indirect indication in favor of such an argument comes from the relationship between availability, satisfaction and use-frequency. Satisfaction could in fact act as the psychological 'mediator' of the relationship between availability and frequency of use of green spaces. Indeed, a mediation analysis conducted through Hierarchical Multiple Regression confirms this idea. The positive relation between availability of green space and frequency of use ($\beta = .15$; $p < .01$) disappears when controlling for satisfaction. This in turn, positively predicts frequency of use ($\beta = .30$; $p < .001$). In other words: high availability leads to higher satisfaction, which in turn leads to more frequent use.

The more general implication of the Rome study results for urban sustainability will be discussed in the next section.

General Discussion and Conclusions

According to the ecosystem approach, changes in one part of the system will have implications for the quality of other parts of the system. Thus, discussing the environmental aspects of urban sustainability necessarily implies taking into account its behavioral, social, cultural and economic aspects, and requires combining different disciplinary domains, methodologies and levels of analysis (cf. Bonnes et al., 2004). The findings from both the Rome and Guildford studies demonstrate the importance of pursuing multidisciplinary multi-method, and multidimensional approaches to the assessment of urban environmental quality, as also pointed out by Vlek & Steg (this issue).

The studies carried out in Rome and Guildford employed different approaches and methods (i.e., qualitative and quantitative) to the study of urban residents' environmental perceptions and evaluation of environmental quality. Different methods were also used for measuring experts' and inhabitants' assessments of urban quality. Whereas in the Rome study the focus of the analysis was on the *evaluative criteria* employed by scientists and the public in assessing the quality of the urban environment, in the Guildford study the emphasis was

placed on the relative *accuracy* of public assessments of one specific environmental (air) quality by experts and the public.

As the Rome study shows, sometimes laypersons and experts may not share common criteria as the basis of their environmental perceptions and assessments. This implies that urban planners and decision makers would also need to consider residents' point of view when making decisions about the development and management of green areas (Gatersleben & Uzzell, 2003). The Rome findings also show how field research programs may be helpful in revealing residents' more articulated views in comparison to experts' ones. For example, the often-implicit idea, shared by many experts in the natural-ecology field, that nature in the city is always appreciated positively by urban dwellers, is not empirically supported by the Rome data. Whereas urban inhabitants seem to positively evaluate the availability of greater amounts of green space in their residential surroundings, providing residential areas with green spaces that are qualitatively superior from a bio-ecological point of view may not lead to increased satisfaction and use by residents.

Environmental policies based only on experts' criteria might run the risk of being misunderstood and eventually opposed by urban inhabitants if their frames of reference are too different from the expert ones. At the same time, involving laypersons in environmental decisions is often considered with suspicion by scientists and policy makers; it is claimed that laypersons do not have an adequate competence in judging environmental phenomena, and that their environmental perceptions and evaluations often are biased and inaccurate (Churchman & Sadan, 2004).

The results of the Guildford study show that this is not always the case: laypersons do possess detailed knowledge when assessing specific environmental phenomena such as air pollution. A comparative analysis of environmental quality assessed by experts and the public highlighted in fact that lay knowledge is *not* necessarily dissimilar to expert knowledge.

Moreover, its qualitative expression is particularly significant. Lay understandings about air pollution were not expressed in the same assured, confident manner as expert understandings. Expert accounts were firmly established in the scientific and mathematic tradition, with reference to the main parameters involved in air pollution assessment (i.e., traffic throughput, meteorological conditions, wind direction and speed, topography, degree of urbanism). Although the public did not use the same terminology as air pollution experts, they made reference to the same concepts. In the Guildford case, for example, experts believed that the public would lack knowledge about issues related to air pollution, and that they would encounter difficulties in understanding scientific details related to the subject. On the contrary, residents made quite accurate judgments, on the basis of their local knowledge. One of the main conclusions from the Guildford and Rome findings is that experts and decision makers could benefit from insights from lay-local knowledge. Indeed, research has acknowledged the importance of involving the public in local air pollution assessment, through citizen participation projects (Forrester, 1999).

Both the Guildford and Rome studies make the case that communication and participation processes in urban environmental issues are important. The last four decades have seen a growing emphasis in Europe and North America on more participatory forms of governance (e.g., Renn, Weber, Rakel, Dienel & Johnson, 1993). An assumption of scholars in this field is that inclusive and participatory approaches should more likely be successful in securing the long term environmental sustainability of urban systems (e.g., Churchman & Sadan, 2004).

The findings of the two studies presented above seem to demonstrate, on the one hand, the need for scientists and decision-makers to embrace multidisciplinary, multi-method and multidimensional approaches, and thus of assuming a multi-actor perspective when assessing urban environmental quality. On the other hand, the studies point to the importance of

encouraging dialogue between these different actors: between experts from various scientific domains (especially natural and social scientists); between experts and the public; and between both of these groups and policy decision makers (see Schoot Uiterkamp & Vlek, this issue).

The results of the two case studies also show the importance of paying attention to the multidimensional character of any evaluation processes performed by various environmental actors, and the place-specific character of residents' environmentally relevant perceptions. In particular, the value of residents' understanding of their physical-ecological environment is important since it is embedded within the context of their actual places of living (Uzzell et al., 2002). Day-to-day experience and use of the environment, local knowledge, and social networks might allow urban communities to develop their own specialized competencies in the judgment of urban environmental quality, which might not necessarily be similar to, but no less relevant than experts' assessments.

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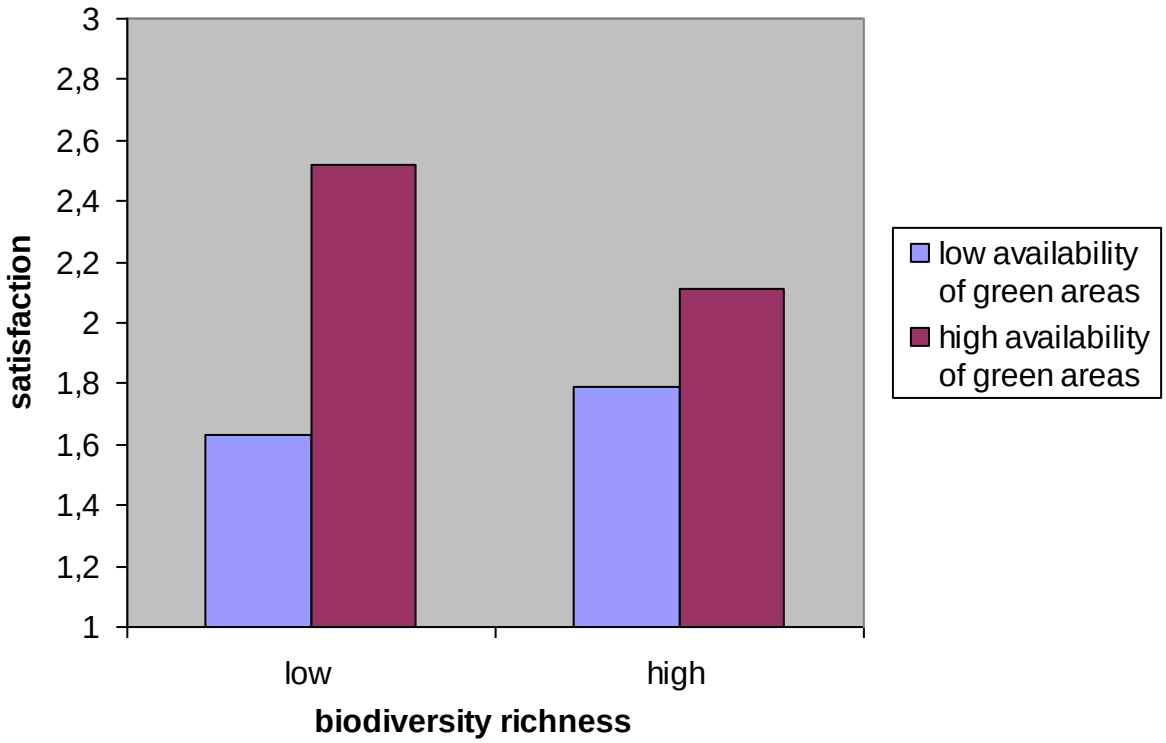
Figure 1: Satisfaction for neighborhood's green areas as a function of their *availability* and *biodiversity richness*



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