

On the Necessity of an Integrated, Participative and Adaptive Approach to Sustainable Urban Environmental Quality Planning

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ABSTRACT

Based on a review of recent literature, this paper addresses the question of how urban planners can steer urban environmental quality, given the fact that it is multidimensional in character, is assessed largely in subjective terms and varies across time. A novel perspective of urban environmental quality is proposed, simultaneously exploring three questions that are at the core of planning and designing cities: ‘quality of what?’, ‘quality for whom?’ and ‘quality at what time?’. The dilemmas that urban planners face in answering these questions are illustrated using secondary material. This approach provides perspectives for action. Rather than further detailing the exact nature of urban quality, it calls for sustainable urban environmental quality planning that is integrated, participative and adaptive. Copyright © 2017 John Wiley & Sons, Ltd and ERP Environment

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Introduction

SUSTAINABLE URBAN DEVELOPMENT IS NOT A GOAL IN ITSELF; IT IS AIMED AT MAINTAINING AND INCREASING QUALITY OF URBAN LIFE, without compromising the conditions for this process to continue, here and elsewhere (Fischer and Amekudzi, 2011). The design and functioning of a city’s physical environment are meant to contribute to this quality of life (Ogneva-Himmelberger *et al.*, 2013; Silva and Mendes, 2012; Velázquez and Celemín, 2014). Yet, it is not fully understood *how* this contribution comes about. A review of recent scientific literature on ‘quality of life’ and ‘urban environmental quality’ reveals three promising lines of inquiry.

The first of these is the multidimensional nature of ‘quality’. Quality can be conceptualized taking perspectives on different domains and sub-domains of life: e.g., city life, economic life, social life etc. (Pacione, 2003; Van Kamp *et al.*, 2003). Each domain has multiple and only partly distinct dimensions: in the urban sub-domain, for example, the environmental quality, the availability of facilities and the amount of green space (Moore *et al.*, 2006; Silva, 2015). The focus of this paper is on urban environmental quality (UEQ), defined here as the physical sub-domain of urban quality of life. Like quality of life, UEQ has a multidimensional character. Interventions in the physical domain affect distinct quality dimensions in different and often opposite ways. Better understanding exactly *how*

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these dimensions are related may help urban planners in making sensible trade-offs among these quality dimensions.

The second line of inquiry is into the relationship between objective and subjective aspects of UEQ. Quality can only partly be gauged from objective conditions. It is the subjective perception and evaluation of these objective conditions that ultimately determines how quality is perceived (Felce and Perry, 1995; Moore *et al.*, 2006). Objective and subjective measures of quality are generally considered to complement one another and, jointly, to well represent quality (Marans, 2003, 2015; Pacione, 2003; Perlaviciute and Steg, 2012; Santos and Martins, 2007). The question remains how urban planners should handle differences in quality preferences among stakeholders in order to optimally and equitably stimulate UEQ.

The third line of inquiry is how people's preferences – and, consequently, quality – vary over time, both within and across generations (Ruth and Franklin, 2014). Pacione (2003) suggests that people accommodate to conditions over time. Furthermore, satisfying a specific set of needs in the short term (e.g. an increase in private car use) may well compromise other needs in the long term, such as diminishing fossil fuels (De Haan *et al.*, 2014). Quality issues themselves also vary across time. There has been a tremendous increase in urban quality – as measured by objective indicators – in most Western countries (UNEP, 2012). However, new quality issues arise, mirroring changing concerns in society (UNEP, 2012), e.g. climate change or endocrine-disrupting compounds (Rudel *et al.*, 2003). Therefore, urban planners cannot be certain when, to what extent and at what cost UEQ issues must be addressed.

The aim of this study is to present novel perspectives for planning UEQ in the pursuit of sustainability. This paper therefore contributes to a theoretical foundation of planners' choices regarding UEQ.

Method

A literature search was performed, using three consecutive strategies (Bilotta *et al.*, 2014). The first was a general search on 'quality of life' and 'urban environmental quality'. As evidenced by a special issue of *Landscape and Urban Planning* on UEQ, the topic attracted increased scholarly interest at the beginning of this century. The literature search was limited to post-1999 contributions. In September 2016, the search was performed in Scopus, using the string ('quality of life' AND 'environmental quality' AND urban) OR 'urban environmental quality' in title, key words and abstract. It yielded 153 unique documents in the social and environmental sciences that were published in the year 2000 or later. The supporting information (Table A1) provides the complete bibliography.

In the second step, the contributions found were clustered into two main groups. In the first, the literature found was restricted to only those contributions that deal with *dimensions of quality* and *quality indicators*. Limiting search results using the string *indicator OR dimension*, 84 out of the original 153 documents remained. Inspecting the documents, those that only superficially mention quality indicators or dimensions were discarded. The remaining 49 documents all deal with 'indicators' and/or 'dimensions' of urban or environmental quality or quality of life in an urban context. In the supporting information, these contributions are lightly shaded.

The second group of contributions deals with the *perception* of (urban) environmental quality and/or quality of life. These documents were identified by refining the original search by adding an additional search term (also in title, key words and abstract): *perception OR (subjective AND objective)*. This yielded 17 out of 154 documents, shown more heavily shaded in the supporting information.

These two clusters of literature pertain to the questions of 'quality of what?' and 'quality for whom?', respectively. The third question, 'Quality at what time?', was inspired by Pacione (2003), who argues that people's perceptions and preferences change over time and by contributions relating quality to sustainability, particularly its temporal aspects (De Haan *et al.*, 2014; Marans, 2015).

The third step in the literature search was aimed at the *relations between dimensions* of UEQ and the *relationship between objective and subjective indicators* of quality. Searches were performed in all fields using the following strings: ('urban environmental quality' AND (dimension* OR multidimension*) AND relations) and ('urban environmental quality' AND (dimension* OR multidimension*) AND subjective AND objective), limited to environmental sciences and published after 1999. The full bibliography of the resulting 51 documents is given in the supporting

information (Table A2). On inspection of the abstracts, only a few of these were found to pertain to the relations between UEQ dimensions or between objective and subjective quality indicators.

Based on the assembled literature, dilemmas were identified that urban planners face when specifying UEQ in terms of 'what', 'for whom' and 'when'. Drawing on previous research, practical examples are presented to illustrate these dilemmas. For analytic reasons, the dilemmas are treated separately, although in practice they are frequently connected.

Quality of What? Multiple Dimensions and Interactions

UEQ: Dimensions and Indicators

Building on earlier work by Van Kamp *et al.* (2003) and Opschoor and Reijnders (1991), UEQ is defined here as the ability of the physical environment to satisfy the needs of human beings, ecosystems and artefacts in cities. Thus, it is a sub-set of quality of life, pertaining to only those needs that are related to the physical environment. With no pretensions to completeness, Table 1 lists different quality dimensions encountered in the literature review.

In order to grasp UEQ, scholars have suggested a wide range of indicators. These may be based on objective as well as subjective data, and either focus on one or two dimensions, or aim to be quite comprehensive. With respect to objective indicators, the literature search yielded various examples of one-dimensional quality assessments: ambient air quality (e.g. Braniš, 2009; Mendes and Silva, 2007), noise (e.g. Seidman and Standring, 2010; Weber and Driessen, 2010), metal concentrations in soil (e.g. Hamzeh *et al.*, 2011) and abundance and quality of green space (e.g. Pereira *et al.*, 2012).

Several authors combined distinct aspects of UEQ in a two- or more-dimensional assessment of e.g. air quality, sanitation and noise (Silva and Mendes, 2012; Stossel *et al.*, 2015; Yu *et al.*, 2014). More comprehensive methods combine objective indicators of multiple dimensions into a single index (see, e.g., Silva, 2015; Wan *et al.*, 2009). Often, geographic information systems (see, e.g., Hamzeh *et al.*, 2011; Joseph *et al.*, 2014; Velázquez and Celemín, 2014) and/or satellite data (Nichol and Wong, 2009; Rodríguez *et al.*, 2010) are used to map quality aspects or indices.

Statistical methods are used to find correlations between observed variables and latent variables that predict (urban) quality of life. Bonaiuto *et al.* (2003) found 19 perceived quality indices for residential environmental quality; Tu and Lin (2008) identified six. All in all, it is well known which dimensions constitute UEQ and related measures of quality, yet there has been little research into how these dimensions interact.

Interrelationships Between Quality Dimensions – Empirical Findings and Theory

Recent research demonstrates that distinct dimensions of UEQ influence one another. Irvine *et al.* (2009) find a relationship between the perception of sound and the attributes of the greenery. There is also some empirical evidence that quality dimensions interact in a hierarchic fashion. Johnston *et al.* (2002) elaborated an econometric model of a watershed management program consisting of several combinations of measures. Willingness to pay for surface water quality was found to be dependent upon other qualities inherent in the plan. This suggests that some dimensions of quality outweigh other dimensions. The actual nature and shape of this relationship, however, remain obscure.

Silva and Mendes (2012) developed a model allowing for a trade-off between two distinct dimensions of UEQ, namely city noise and air quality. Here, concentrations of five pollutants and noise were given equal weight. In a later modification, weights for air pollutants were derived from their dose–response relationships (Silva, 2015). These models illustrate the difficulty of weighing quality dimensions and making trade-offs between them.

From a theoretical viewpoint, dimensions of quality have been, since Maslow (1954), envisaged to have a hierarchical relationship. Perlaviciute and Steg (2012) acknowledge that quality aspects are likely to be perceived as not being equally important, a perception that may vary across different groups. Building on theories from social psychology, De Haan *et al.* (2014) suggested three hierarchically dependent levels of societal needs in a dynamic model explaining how needs that are met – or not – on one level influence expression of needs at other

Dimension	Relevant sources
<i>Psychical/metaphysical</i>	
Architectural building quality	Farah and Jouny, 2016; Reginster and Goffette-Nagot, 2005
Neatness; upkeep	Bonaiuto <i>et al.</i> , 2003; Farah and Jouny, 2016
Noise	Berry-Chikhaoui <i>et al.</i> , 2014; Farah and Jouny, 2016; Seidman and Standring, 2010; Silva and Mendes, 2012; Silva, 2015; Weber and Driessen, 2010
Odour	Farah and Jouny, 2016
Urban blue spaces	Deilmann <i>et al.</i> , 2015; Völker <i>et al.</i> , 2016
Urban climate; thermal comfort	Acero and Herranz-Pascual, 2015; Berry-Chikhaoui <i>et al.</i> , 2014; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014
Urban green and open spaces; public green space per person	Bonaiuto <i>et al.</i> , 2003; Deilmann <i>et al.</i> , 2015; Farah and Jouny, 2016; Marco <i>et al.</i> , 2016; Pereira <i>et al.</i> , 2012; Rostami <i>et al.</i> , 2016; Stossel <i>et al.</i> , 2015
<i>Social</i>	
Accessibility; road connectivity	Bonaiuto <i>et al.</i> , 2003; Cao, 2016; Reginster and Goffette-Nagot, 2005
Diversity of shops and services; number of public services	Bonaiuto <i>et al.</i> , 2003; Conde and Pina, 2014; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014
Housing	Seifollahi and Faryadi, 2011
Mobility; transportation	Bonaiuto <i>et al.</i> , 2003; Conde and Pina, 2014; Seifollahi and Faryadi, 2011
<i>Biological</i>	
Air pollution	Berry-Chikhaoui <i>et al.</i> , 2014; Braniš, 2009; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014; Silva and Mendes, 2012; Silva, 2015; Stossel <i>et al.</i> , 2015
Biodiversity	Marco <i>et al.</i> , 2016; Wan <i>et al.</i> , 2009; Wang and Lin, 2012
Drinking water supply; drinking water use	Darkey and Visagie, 2013; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014
Health; health care services	Darkey and Visagie, 2013; Reginster and Goffette-Nagot, 2005; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014
Safety; security	Conde and Pina, 2014; Reginster and Goffette-Nagot, 2005; Seifollahi and Faryadi, 2011
Sanitation	Darkey and Visagie, 2013; Fobil <i>et al.</i> , 2010; Stossel <i>et al.</i> , 2015
Soil quality; soil pollution	Hamzeh <i>et al.</i> , 2011; Seifollahi and Faryadi, 2011; Sharifianpur and Faryadi, 2014
Solid waste disposal	Darkey and Visagie, 2013; Fobil <i>et al.</i> , 2010; Stossel <i>et al.</i> , 2015
Storm water infrastructure	Hager <i>et al.</i> , 2013
Water quality; water pollution	Hager <i>et al.</i> , 2013; Seifollahi and Faryadi, 2011; Stossel <i>et al.</i> , 2015

Table 1. Various dimensions of UEQ mentioned in the literature reviewed

levels. In this model, basic societal needs such as sustenance, health, safety and shelter must be met before higher-level needs, which include social cohesion, healthy ecosystems and convenience, are in order. Moreover, Jacobs (2000) theoretically distinguished four different levels of urban quality – biological, social, psychical and metaphysical – that each are contingent upon satisfaction of the underlying levels. At the basic level, phenomena and processes belong mainly to the domain of the natural sciences (Jacobs, 2000). Once basic needs are met and other, higher-level quality aspects come into play, subjective judgments about that quality are introduced (Ruth and Franklin, 2014).

UEQ Dimensions and Spatial Scale

UEQ is not only multi-dimensional, but multi-scalar as well (Cash *et al.*, 2006; Cumming *et al.*, 2006). The size of environmental impacts at any of the multiple dimensions is determined by bio-geochemical processes that play out at a certain spatial scale level. In addition, the social processes that influence these impacts may

occur at distinct scale levels. Noise from road traffic, for instance, has a rather limited spatial scale. Regional economic growth, leading to increased road transport, occurs at a much wider scale, as do the policies aimed at either stimulating such economic growth or abating traffic noise. Conversely, climate change entails biogeochemical processes at a global scale, whereas the consequences must also be dealt with on a local scale. The analysis of UEQ therefore requires a multilevel and multi- and trans-scalar approach (Bulkeley and Betsill, 2005).

Quality for Whom? Objective and Subjective Measures and their Relationship

Felce and Perry (1995) argue that quality of life is determined by objective life conditions as well as an individual's satisfaction with these conditions (see also Fischer and Amekudzi, 2011; Howley *et al.*, 2009; Lee, 2008; Marans, 2003; Moore *et al.*, 2006). Furthermore, the individual's assessment of both *objective* conditions and *subjective* satisfaction with these conditions is influenced by personal values and aspirations, determining the relative importance of each of these conditions. These elements – conditions, satisfaction, values and aspirations – influence one another. They may vary over time (see also the next section) and may be culturally determined (Felce and Perry, 1995).

Recently, several scholars have looked into the *relationship* between objective quality determinants and their subjective evaluation. Overall, there appears to be very little correlation between the two. Housing prices in the centre of Madrid, for instance, were found to negatively correlate with subjective measures of air quality and noise but – unexpectedly – positively with objective measures of air pollutants (Chasco and Le Gallo, 2013). Okulicz-Kozaryn (2013) found only moderate correlation between cities' Mercer¹ liveability index and residents' satisfaction with the city. McCrea *et al.* (2006) found only weak correlation between objective measures of population density and subjective perception of overcrowding, and between objectively assessed and subjectively perceived access to facilities. Subjective urban quality of life could be predicted well from the subjective variables, but showed no significant correlation with the objective measures.

Von Wirth *et al.* (2014) also found that residents' satisfaction with the city correlated well with subjective measures of accessibility of city centre amenities and safety in public spaces. Contrary to McCrea *et al.* (2006), they did find a strong link between objective and subjective access, the discrepancy being attributed to differences in spatial scale and typology of the areas under study. Lotfi and Koohsari (2009) found that the subjective assessment of accessibility of public spaces is dependent not only upon objectively measured distance, but also upon feelings of safety and perceived quality of the (pedestrian) route.

Surprisingly, Santos and Martins (2007) did find a fair correlation of objective conditions and their subjective evaluation by Porto's residents. For only three out of 14 indicators they found little agreement between objective and subjective measures.

The relationship between objective measures for and subjective perception of UEQ was shown to depend on knowledge and awareness. Karatzas and Lee (2008) found that perception of air quality was dependent upon information about objective pollutant concentrations. Moore *et al.* (2006) brought together objective and subjective assessments of UEQ, making residents reflect on their perceptions.

In sum, people's experiences and values strongly influence their perceptions of quality. UEQ then, is to a large extent 'in the eye of the beholder'. Relations between objective indicators and subjective perceptions of UEQ have been researched for only a handful of indicators, and generally appear to be weak. Therefore, a full assessment of UEQ should comprise both objective indicators and subjective evaluations thereof.

¹<http://www.imercer.com/content/quality-of-living.aspx> [April 2015].

Quality at What Time? Urban Planning in the Face of Uncertainty

UEQ is derived from notions about quality of life and liveability, which *per se* have no temporal dimension. However, as De Haan *et al.* (2014, p. 126) point out, from the perspective of sustainable urban development, UEQ should meet societal needs in a way that can be sustained over time, thus introducing a temporal dimension.

UEQ is not constant in time in any case. Along with changing patterns of social activity, objective conditions change and so do the perceptions of these conditions in society. Examples range from local problems with untreated industrial emissions in the 1960s, via higher scale problems such as ‘acid rain’ during the 1980s, to climate change in our day. These environmental problems have reached the political agenda, often resulting in effective pollution control. As a result, UEQ has improved considerably since the beginning of the 20th century; health levels and life expectancy are higher than ever before (De Hollander and Staatsen, 2003).² However, new issues may influence the current quality level (EEA, 2014), either in a negative (e.g. climate change) or a positive (e.g. technological developments in transport and industry) way. The magnitude of these changes is not easily forecasted.

The environmental and statistical models encountered in this literature review can be used to predict future impacts in modelled scenarios. Climate change induced heat stress (Acero and Herranz-Pascual, 2015), storm water runoff (Van Mechelen *et al.*, 2014), traffic-related pollution (Silva and Mendes, 2012) and municipal waste flows (Oyoo *et al.*, 2011) are a few examples. As the outcome of a model assessment is only as good as its input, it is here that uncertainties about future economic and social activities or the effect of mitigating measures come in.

People’s preferences also change across different life phases and as a result of societal developments (Ruth and Franklin, 2014); the same holds for UEQ. Therefore, demographic changes can be expected to change the perception of and demand for UEQ. A well-known example is the impact of climate change on the elderly (see, e.g., Carter *et al.*, 2014). Another is that some middle-class families with young children decide to stay in the city centre, rather than moving to the suburbs (Karsten, 2003).

A Threefold Perspective on Planning Sustainable Urban Development

The above discussion of the literature about UEQ suggests that UEQ planning for sustainability requires a threefold perspective, encompassing the questions ‘quality of what?’, ‘quality for whom?’ and ‘quality at what time?’ (see Figure 1). In this section, these three perspectives are elaborated and illustrated.

Trade-offs Between Quality Dimensions: Integrated Urban Planning

Improving one dimension of UEQ may either improve or deteriorate another, respectively presenting a win–win situation of co-benefits (Puppim de Oliveira *et al.*, 2012) or a necessary trade-off between related quality aspects. Theoretically, this relationship is hierarchical, meaning that loss of quality in some dimension somewhere down in the hierarchy is not straightforwardly compensated by an excess of another quality aspect at a higher level. As a consequence, planners must first meet societal needs at the basic level; in terms of UEQ this means assuring compliance with at least all legal environmental standards.

In practice, dilemmas often occur. Sustainable land use through compact development often comes at the expense of UEQ (Howley *et al.*, 2009). Manoeuvring space for making trade-offs is often limited by (supra-) national standards protecting residents’ health and safety and the unimpeded functioning of ecosystems (Van Stigt *et al.*, 2013a). It may prove difficult for urban planners to comply with these standards. Protective measures, such as acoustic screens or remediation of polluted soils, are not always feasible: they are often costly and may create disadvantages that negatively impact other aspects of urban quality. In addition, a new development is planned precisely *because* it increases urban quality as a whole. Should a plan then be abandoned just because it fails to meet legal requirements concerning one single aspect of urban quality?

²Such is not the case in many newly industrializing countries (UNEP, 2012).

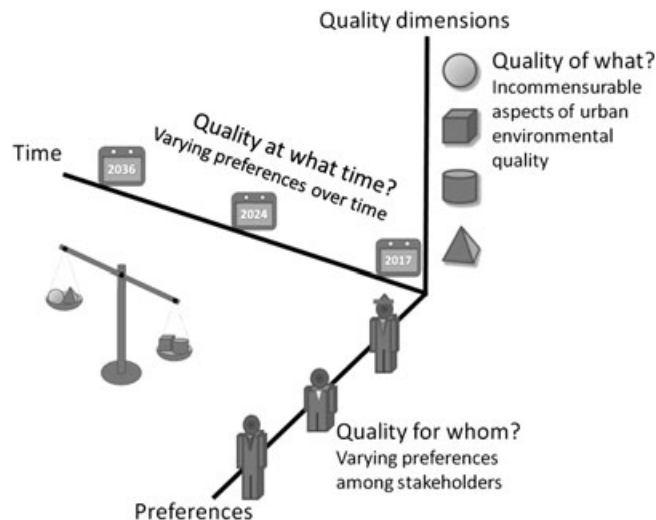


Figure 1. Planning for UEQ as an act of balancing incommensurable quality aspects, guided by distinct sets of preferences among the stakeholders involved (developers, financiers, users, residents etc.), which also vary across time, both autonomously and influenced by emerging quality issues. At each time and with each configuration of stakeholders, the resulting balance may differ

An illustration of such a troublesome trade-off is the transformation of a partly derelict industrial estate in the Dutch town of Roosendaal into a high density mixed-function area (Gemeente Roosendaal, 2008). The impact on environmental quality resulting from the remaining industry was severe. Even after optimally positioning the residential buildings, some could not be made to comply with industrial noise regulations. Noise reduction had been accomplished earlier, and further reduction was deemed unrealistic. An obvious solution would have been to fit the buildings with a so-called ‘deaf façade’.³ The view from the buildings, however, was thought to contribute much to the area’s quality. Therefore, a deaf façade was rejected (Gemeente Roosendaal, 2008). Instead, the small excess of noise was compensated for by an increase in other qualities – the view, but also the vicinity of amenities and public transport.

In Vlaardingen, another Dutch city, a planned water front development could only be realized when locally accepting industrial noise levels exceeding national standards. Compensation was thought to come from the fine river view. Urban design included flood protection with a time horizon of 50 years. The plan met with resistance from both regional industry and national climate officials, illustrating the interdependence of UEQ aspects – noise, view, flood safety – as well as the role of spatial scale and foresight.

An integrated approach holds the promise of efficiency: leaving decisions about quality in separate silos – urban design, environmental policy, health care, social and economic policy – will most probably result in serious clashes between incompatible quality dimensions (Davidson and Venning, 2011). This is why the European Commission issued guidance on integrated environmental management (European Communities, 2007). There is a continuous debate within the scientific community about strategies and instruments for environmental policy integration (e.g. Jordan and Lenschow, 2010; Persson, 2004; Runhaar *et al.*, 2014) and for considering wellbeing, health and environment in an integrated, systemic and interdisciplinary way (Carmichael *et al.*, 2012). There may be gains in considering urban quality as an integrated whole. However, the inherent question is how individual quality aspects may be ‘merged’ into an integrated one. If quality dimensions are conditional upon some basic dimension – which Jacobs (2000) terms ‘biological’ and Lynch (1984) ‘vitality’, comprising adequate and safe food and water, and absence of disease, pollution and hazard, as well as an adequate fit of noise levels to human requirements of sensory input – this would imply a crucial role for environmental quality aspects in the more strict sense.

When such basic-level dimensions of UEQ cannot be straightforwardly compensated for by qualities at higher levels in the hierarchy, optimal reduction at the source of this quality loss is in order. In the Dutch compensation

³I.e., a façade that has no open windows or is equipped with an external transparent screen; under Dutch noise regulations, a deaf façade does not have to comply with noise standards.

approach (Glasbergen, 2005; Korthals Altes and Tambach, 2008; Simeonova and Van der Valk, 2010), this is in fact a process requirement.

Quality for All or Individual Preferences? Participative Urban Planning

The second of the three perspectives concerns the extent to which government needs to actively steer urban quality. It entails the dilemma between a right-wing market paradigm and a left-wing governmental one. The outcome, obviously, depends on the political agenda and on the distribution of political power within the city council, which wields political power at this particular point. If the plan results in UEQ levels that do not live up to the expectations of the constituency, local politicians committing themselves to it risk losing votes at the next elections. Urban development projects occur over several years. Changes in the political (e.g. government elections) or economic (e.g. financial crisis) context during this time may change the political agenda as well as the composition of the city council.

This is illustrated by a case in Woerden, The Netherlands (Van Stigt *et al.*, 2013a), where private parties took the initiative to convert an office building situated near a railway into apartments. However, the transformation did not meet municipal safety regulations regarding transport of dangerous substances, based upon a previous high risk estimate. The actual risk was well below the national standard. The responsible alderman, of liberal signature, took the stance that he would have willingly allowed the initiative, provided that the future residents would consciously agree to the – very low, but not zero – risks present. This illustrates that legal requirements often pertain to objective indicators of UEQ that, as a rule, are bad predictors of subjectively perceived quality (see earlier). It also highlights the importance of awareness of environmental risk and the availability of up-to-date information about these risks.

More generally, proper planning involves informed decision-making, usually based upon expert knowledge. Experts' objective assessment of urban quality, however, may not match local stakeholders' perceptions. Knowledge co-creation among authorities, businesses, science and civil society (Edelenbos *et al.*, 2004; Hegger *et al.*, 2012; Van Buuren and Edelenbos, 2004; Van den Hove, 2007) and knowledge brokerage (Bielak *et al.*, 2008; Partidario and Sheate, 2013; Sheate and Partidario, 2010; Van Enst *et al.*, 2016) have been suggested as solutions to such mismatches. Yet, decisions about urban plans appear to be only partly informed by systematic analysis of UEQ (Brown, 2003; Van Stigt *et al.*, 2015; Vonk, 2006).

Controversies surrounding noise barriers illustrate the importance of subjective versus objective quality assessment. A Dutch municipality, in compliance with national railway noise standards, planned a 2.7 m high noise barrier along the railway. A majority of residents objected, as they would rather keep the view they have of the trains and the surroundings beyond (Gemeente Zwolle, 2011). The district council in Bakewell, UK, responded to complaints about noise from the cattle market and came up with plans for a barrier, which would be 180 m long and rise to a height of 5.5 m. Residents claimed the barrier would ruin the historic character of the market town (Berardi, 2012).

Most states have public environmental policies in place that guarantee a certain level of UEQ. In some cases, however, complying with environmental standards may turn out to be very costly and some form of trade-off is required. Three important considerations apply for making trade-offs in an informed and equitable way.

First, it is uncertain what exactly UEQ is (Glasbergen, 2005). If urban quality is understood as the extent to which the physical environment supports the needs of its residents and users and these needs are to a large extent subjective, then obviously trade-offs can be made only by the people concerned, rather than by professionals acting in the public interest. Quality must, therefore, be discussed in an open, participatory process involving mutual learning (Golobic and Marusic, 2007). The role for science is to inform this learning process and it is vital that all stakeholders trust the scientists involved (Bickerstaff, 2004). Scientific knowledge should be available and accessible, but many other psychological and socio-cultural factors play an important role in perception (Bickerstaff, 2004).

Second, if compensation of quality is in order, the question arises how to allocate the compensation costs. Sticking to the *polluter pays principle*, one could argue that the cost of compensatory measures should be borne by those causing the problem. In many cases, however, the loss of quality cannot be attributed to a single polluter (for instance traffic noise). In cases where polluters have been given a permit, it would be unjust to present them with the costs of compensating for something that had previously been allowed, but that is now detrimental to

the plan at hand. In such cases, the costs tend to be borne by the buyers of the real estate, which becomes more expensive because of the extra measures taken. In the Roosendaal case (see previous sub-section), this would – both literally and proverbially – amount to a *Dutch treat*. Another approach would be to allocate the remediation cost to the parties that are expected to gain from the plan. This could be either the municipality, whose assets rise in value, or the developer, who receives the proceeds of the real estate. It could even be all of the new users and residents, who benefit from the high overall urban quality and agree to bear the cost of the compensation for the few who suffer from an unacceptably low level of only one quality dimension.

Third, environmental problems manifest themselves at higher spatial scales than the local one on which an urban plan focuses, and human activities at this local scale are very much intertwined with socio-economic processes at a global scale. Devolving the authority to decide about urban quality through a deliberative process in which only local stakeholders participate holds the risk of turning a blind eye to these larger scale social and environmental problems. To prevent this, the planning process can be designed to include these interests, either through (supra)national regulations or through providing advocacy from individuals or groups representing social and environmental interests that transcend the local.

Take Action Now or Later? Adaptive Urban Planning

The third perspective proposed here is whether to take measures to improve UEQ now, in the face of many uncertainties, or postpone action until more is known about the nature and seriousness of the problem at hand and about how it will evolve over time. Urban planners cannot know how quality will develop in the future – either in objective or in subjective terms. Furthermore, new quality issues may present themselves, and issues that *are* known today may gain weight on the political agenda. European air quality standards, for example, are well above WHO guidelines, and exposure levels below these standards have been reported to be associated with adverse outcomes (Pedersen *et al.*, 2013; Beelen *et al.*, 2014; Pope *et al.*, 2002). There is also firm evidence that environmental noise has impacts on health, such as heart disease, cognitive impairment, sleep disturbance and annoyance, even at sound levels that are common in busy cities and towns (World Health Organization, 2011).

In the example of Vlaardingen (see earlier), UEQ is expected to decrease over time. Conversely, in Zutphen, it is expected to improve. Here, a newly built residential area was planned to be shielded from railway noise by a block of office buildings (Van Stigt *et al.*, 2013a). However, market conditions for offices were unfavourable at that time and therefore the realization of the buildings was postponed, leaving a large number of the houses in the area exposed to noise levels above national environmental quality standards. A recently passed law (Verschuuren, 2010) was invoked allowing for a temporary exemption under the condition that, within a period of 10 years, the original quality standards will be complied with.

Thus, uncertainties call for adaptive planning, with planners acknowledging that sustainable urban development is not a static end-point, but a process of continuous prudent experimentation, monitoring the results and learning to make cities resilient to future changes (Ahern, 2011).

Relations Between ‘What’, ‘for Whom’ and ‘When’

The three questions raised here are related in several ways. First, ‘quality of what’ relates to environmental standards that also reflect the issue of ‘quality at what time?’, because they were designed in the past and merely reflect the quality that was deemed acceptable at that time. Increasing knowledge may cause these norms to become more demanding in future.

Second, the questions ‘Quality of what’ and ‘quality for whom?’ are related. High-density, mixed-use redevelopment of an industrial area has been shown to exclude low-income tenants (Poitras, 2009). Lower-income groups may receive a relatively large share of the environmental burden, while having less access to those qualities that are distributed through market forces (Kruize *et al.*, 2007). Conversely, the well-off have been found to favour residential areas that are highly burdened by noise and risk (Chasco and Le Gallo, 2013), but have a nice view or a lively atmosphere (Kruize *et al.*, 2007).

Discussion

This literature review has highlighted three characteristics of UEQ. First, it has multiple dimensions that can interact across spatial and temporal scales in various ways, including co-benefits and trade-offs. Although theory about a hierarchy of needs is well established (see, e.g., Maslow, 1954; Jacobs, 2000), it is not well understood *how* these interactions play out in practice. The literature does not provide any means of weighing quality dimensions with respect to one another, or for balancing the distinct aspects within each dimension.

Second, UEQ is determined not only by objective conditions, but also to a large extent by subjective – individual or societal – perception and evaluation thereof (see, e.g., Fischer and Amekudzi, 2011; Felce and Perry, 1995; Moore *et al.*, 2006). No straightforward relation exists between the two. However, it is far from understood what factors shape this subjective assessment, a possible line of inquiry being the correlation between subjective valuation of quality and socio-cultural typology. Moreover, scientists are only beginning to grasp the inter-subjective processes such as knowledge co-creation, co-design and knowledge brokerage that can contribute to optimal balancing of quality dimensions.

Third, preferences underlying UEQ change over time, while new quality issues emerge. Careful monitoring is necessary to assess which issues deserve urban planners' prolonged attention and which emerging topics must be newly addressed.

Urban planners, then, face three types of uncertainty: about dimensions and aspects of quality, about the subjects for whom to design and realize quality and about the time-dependence of this desired quality. Several authors have suggested approaches to remedy these uncertainties *independently*. First, *integrated* planning can align policies and stimulate actors to cooperate in (re)framing and executing them (Healey *et al.*, 2006; Vigar, 2009), allowing for different UEQ aspects to be addressed across spatial and administrative scale levels. Second, *participative* planning aims to involve the public in planning decisions (Rydin and Pennington, 2000), assuring at least some representation of subjective assessment of UEQ. However, representation cannot be complete and is known to stall decision-making (Kaza, 2006; Rydin and Pennington, 2000). Third, *adaptive* planning, commonly associated with resilience to disturbing events, has a pro-active connotation as well (Boelens and de Roo, 2014): the need to foresee future planning challenges and take appropriate action beforehand. By posing the three questions central to this paper *concertedly*, urban planners find an approach to sustainable UEQ that is integrated, participative and adaptive *at the same time*.

Such an approach helps underpin the balancing of quality entailed in sustainable urban planning. However, it does have some obvious disadvantages, which can be overcome to a certain extent by carefully designing and conducting the process. Cumbersome negotiations or even stalemate as a consequence of having to strike a balance between a myriad of incommensurate quality aspects can be avoided by discussing *types* of urban environment representing a holistic combination of qualities, rather than considering all individual quality aspects one by one. Broad participation may result in endless discussions (Kaza, 2006), yet involvement of the public in the early stages of planning in a genuine bottom-up way is known to produce very satisfying results (see, e.g., Van Stigt *et al.*, 2013b). Finally, adaptive plans risk losing spatial coherence as a result of fickle spatial policies. Therefore, they must be based upon sound scenarios.

Urban planners' role in such a process is not merely that of mediators. Rather, they are the experts pointing at quality dimensions that are being overlooked. They warn if a basic-level quality dimension is traded off against some higher-level quality. They inform local decision-makers with knowledge about UEQ consequences at higher spatial scale levels. They monitor UEQ across time and acknowledge emerging quality issues. And by doing so in a reflective professional way, they can contribute to scientific knowledge about environmental quality in the context of sustainable urban development.

Conclusion

Sustainable urban environmental quality planning requires an approach to urban planning that is *integrated*, *participative* and *adaptive* at the same time. Much like a process approach, this approach acknowledges the largely

subjective nature of UEQ, defining it in a participative and deliberative process with all relevant stakeholders. Beyond this inter-subjective way of dealing with quality, it creates an awareness of the multiplicity of quality dimensions and aspects, the spatial scale levels at which they occur and the relations among them. In addition, it foresees how quality aspects and their subjective perceptions and valuations might change over time.

Further research is needed into how much distinct quality dimensions and aspects are valued in the presence or absence of others and whether this reflects any hierarchic relation among them. It is also necessary to more completely understand the conditions for success of these processes and the methods needed to successfully conduct them.

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Supporting information

Additional Supporting Information may be found online in the supporting information tab for this article.

Table A1. Results of literature search (“quality of life” AND “environmental quality” AND urban) OR “urban environmental quality”

Table A2. Results of literature search (“urban environmental quality” AND (dimension* OR multidimension*) AND relations) OR (“urban environmental quality” AND (dimension* OR multidimension*) AND subjective AND objective)