The perceived quality of the urban residential environment
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Chapter 2
Residential environmental quality: policy, theory, and empirical research

2.1 Introduction

In this chapter the perceived quality of urban residential environments is discussed at greater length following three different perspectives. Firstly, the policy maker's view on environmental quality is discussed. More specifically, the Dutch national environmental policy for the local area will be considered more closely (section 2.2). This is followed by some theoretical considerations concerning the nature and people's appraisal of environmental pollutants in the residential area, and about the evaluation of the quality of urban residential environments (section 2.3). In section 2.4 an overview of relevant empirical research is presented. In section 2.5 based on the discussion of the three different perspectives a model of urban residential quality is presented. This chapter ends with a recapitulation of the general conclusions drawn from the three perspectives; also the aims of the studies described later in this monograph are described (section 2.6).

2.2 Environmental quality: the policy maker's perspective

In this section the Dutch national environmental policy on the quality of the residential environment is discussed (section 2.2.1). Furthermore, one of the policy instruments for the local area is discussed (section 2.2.2).

2.2.1 The Dutch national environmental policy

In the present decade Dutch environmental policy is guided by a thematic approach. The policy themes were developed on the basis of the system analysis approach of the environment by the RIVM, mentioned earlier (see RIVM, 1988). The analysis indicated that five spatial levels could be identified. They were characterized, amongst others, by specific processes occurring within that part of the system. For instance, at the highest scale-level, the global level, specific processes are climatic change and depletion of the ozone layer. At a lower level, the regional level, characteristic processes are dehydration and accumulation of nutrients (e.g., phosphates, nitrates) and persistent substances (e.g., heavy metals, pesticides) in soil and in ground water. These processes served as key themes for the design of the Dutch environmental policy. In 1989 the Dutch government presented the thematic approach in its National Environmental Policy Plan (NEPP; VROM, 1988-1989). There are eight key themes. These are: climatic change and depletion of the ozone layer, acidification, eutrophication, diffusion, waste disposal, dehydration, squandering, and disturbance. The theme which captures the environmental problems at the local level, i.e., the home and living environment, is called disturbance. Former minister of the Department of Housing, Physical Planning and Environmental Protection (VROM), Pieter Winsemius, paraphrased 'disturbance' as follows:

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1 In the remainder of this monograph, if not explicitly indicated otherwise, the term 'environmental quality' is used to reflect the 'quality of the urban residential environment'.
"The importance of the issue of disturbance caused by for example sound and malodour, is emphasized by the number of people confronted with it on a regular basis. The actual physical harm might be limited at the individual level, but the scale and frequency at which effects occur make this theme a central topic of environmental protection" (Winsemius, 1987; translated from Dutch).

The effects referred to in this quotation are collectively called 'annoyance' (RIVM, 1988). Earlier in this monograph annoyance has been referred to as "... a feeling of displeasure associated with any agent or condition believed to adversely affect adversely an individual or a group" (Lindvall and Radford, 1973). Connotations are constraint, thwart, ugliness, inconvenience, or frustration (Campbell, 1983).

The policy goals for the policy theme of disturbance are to achieve and maintain a good condition of dwellings and neighbourhoods as the immediate habitat of humans. For the residential environment attention is focused on the following factors: noise, malodour, local air pollution, and external safety risks. Problems of interest for dwellings are emission of radon (Rn) and nitrogen dioxide (NO) into the dwelling, indoor noise, environmental tobacco smoke (ETS), volatile organic compounds (VOC), pesticides, and humidity (RIVM, 1988; RIVM, 1991). Dutch environmental policy is aimed at reducing the number of people exposed and/or annoyed by the above factors. This is done by reducing exposure levels and/or diminishing the effects of exposure.

A first remark with respect to this part of the Dutch environmental policy is concerned with the domains the NEPP captures, namely the dwelling and the neighbourhood: the immediate residential environment. Campbell, Converse and Rodgers (1976) have suggested that people's living environments may be best conceptualized as residential environments consisting of the dwelling, the neighbourhood, and the community in which they are located. Thus, next to dwellings and neighbourhoods as relevant aspects, the community may also be considered as a relevant characteristic of residential environments.

A second remark concerns the type of environmental factors considered relevant in the NEPP. Most of the factors mentioned are mainly pollution type of factors or physical factors. This holds for neighbourhoods as well as for dwellings. Assessing the perceived quality of the environment may also involve other types of factors. Several policy objectives indicate that the quality of the local environment is not only determined by physical factors. Apart from physical factors the Advisory Council on Physical Planning (RARO, 1990) underlines the importance of the psycho-social environment as well as the built environment. Furthermore, the Fourth Report on Physical Planning (VROM, 1987-1988) speaks of five basic values which are of concern for the daily habitat: a well-maintained environment, a clean environment, a safe environment, spatial freedom and diversity. Important psycho-social features of residential environments are the (sense of) community (Campbell, et al., 1976), crowding (Baum and Paulus, 1987) and social safety risks (Lewis and Maxfield, 1980). Characteristics of the built environment are the availability and accessibility of neighbourhood facilities and services (Carp, Zawadski and Shokron, 1976; Milbrath and Sahr, 1974). Features that pertain to a poorly maintained or unclean environment and affect the neighbourhood's appearance, will be collectively called litter. For the
dwelling, non-physical features are relevant as well. The financial costs of the dwelling (e.g., rent/mortgage, costs of heating/electricity) or the state of upkeep (indoors and outdoors) may be important (Driessen and Beereboom, 1983). Also the presence and quality of facilities (e.g., central heating, bathroom, kitchen, garden) and the size of the dwelling (e.g., number of rooms, size of the rooms, storage space) may be considered important dwelling characteristics (Davis and Fine-Davis, 1981).

Thus, for neighbourhood quality, physical features (e.g., noise, malodour, (air) pollution, litter) as well as psycho-social features (e.g., crowding, sense of community, social safety risks) and features of the built environment (e.g., facilities and services) may be seen as determinants of environmental quality. Important dwelling features may be: physical aspects (e.g., ETS, VOC, humidity), costs, size, upkeep, and facilities.

One more remark relates to the sources considered responsible for the various forms of nuisance by the factors described above. Some factors are represented by various sources, others not at all. For instance, the major noise sources identified in the NEPP are road traffic, trains, aircraft and industrial activity. The annoyance-inducing potentials of noise by road traffic (see, e.g., Knipschild, Meijer and Salle, 1984), aircraft (see, e.g., Droste, Pulles and Roorda, 1991) or trains (see, e.g., Howarth and Griffin, 1990) have been established. However, additional relevant noise sources may be indoor appliances, neighbours, and playing children/youth (see, e.g., De Jong, 1989), animals, nightlife, and shipping. Major malodour-emitting sources mentioned in the NEPP are road traffic, agricultural and industrial activity. Annoying effects of these odour-emitting sources on inhabitants of urban residential environments have been already extensively studied (cf. Cavalini, 1992; Matser, 1989; Miedema and Ham, 1988; Van der Linden, 1990). Typical additional malodour sources in the urban residential environment may be garbage and waste, sewage, open waters, and animal droppings. External safety risks are imposed upon residents by possible risks of the transportation, storage, or processing of dangerous substances. Especially large industrial plants (chemical, nuclear) engage in these activities and therefore are considered to be prominent external safety risk sources (Bachrach and Zautra, 1985; Cook, 1983). Next to industrial hazards so-called social safety risks are mentioned in the literature. Examples are: burglaries, vandalism, assaults, or the presence of junkies in the neighbourhood (see, e.g., Baba and Austin, 1989; Lewis and Maxfield, 1980; White, Kasl, Zahner and Will, 1987). Yet another safety risk source is related to traffic. Finally, apart from the various kinds of air pollution (smog, dust), pollution of water (e.g., tap water, surface water; Carp and Carp, 1982) and soil may be considered.

Thus in addition to the sources already mentioned in the NEPP other sources may be identified that contribute to the nuisance described as noise, malodour, (external, social) safety risks, pollution (air, water, soil), litter, crowding, and (lack of) facilities.

From the above it may be concluded that the quality of the urban residential environment is a hierarchical, multi-attribute concept. This means that environmental quality is characterized by several underlying attributes. Furthermore, these attributes are in turn characterized by more specific underlying attributes, and all attributes may be

The term 'attribute' indicates residential features on which concepts (i.e., environmental quality) or objects (i.e., dwellings or neighbourhoods) may have varying values. In this monograph the term attribute is also used as a synonym for 'feature' or 'characteristic.'
hierarchically ordered. Following the Dutch policy view relevant general attributes of
environmental quality are dwellings and neighbourhoods. In addition, as asserted
above, in this monograph 'the community' is added as a third relevant attribute. Relevant
underlying dwelling attributes may be the mainly physical factors presented above, for
instance, radon, VOC, or humidity. But, as was stated before, the dwelling's costs,
upkeep, and size are considered as relevant attributes as well in this monograph.
Underlying neighbourhood attributes are noise, malodour, external safety risks and air
pollution but also psycho-social attributes and attributes of the built environment. The
aforementioned neighbourhood attributes are in turn characterized by several
underlying aspects, their sources (see above). It may be mentioned here that
behavioural decision theory (see, e.g., Keeney and Raiffa, 1976, Hogarth, 1987; Von
Winterfeldt and Edwards, 1986) provides models and methods for the analysis of multi-
attribute concepts. In Chapter 3 several models and methods to analyze perceived
environmental quality will be discussed at greater length.

2.2.2 A policy instrument for environmental quality assessment in the local area:
Land-use Zoning (IMZ).

One of the policy instruments used in The Netherlands to achieve and maintain
a good quality of the residential environment is 'Land-use Zoning' (IMZ). IMZ is a tool
by which policy measures may be formulated for areas were functions collide, e.g.,
complex industrial areas in the vicinity of residential environments. As is usually the
case these industrial areas accommodate a large number of polluting sources of various
kinds. Attributes considered important are noise, malodour, external safety risks and air
pollution. IMZ tries to assess the overall exposure level for the cumulative exposure of
environmental factors in a certain area. On the basis of exposure levels for the several
environmental factors (noise, malodour, safety risks and air pollution) each area can be
labelled with a quality label for a specific factor. Then, these labels are aggregated into a
so-called zoning index. According to this zoning index subsequent policy measures are
formulated.

Two remarks with respect to IMZ as a policy instrument may be made. Firstly,
IMZ may be considered as an expert-based policy instrument. This means that the
development and application of the instrument is performed on the basis of specific
knowledge held by, for instance, scientists or policy makers. Secondly, IMZ is an
exposure-based instrument. This means that exposure levels, rather than effect
measurements, of the various environmental factors are used as criteria for the
assignment of quality labels.

IMZ is an expert-based policy instrument for the assessment of the quality of a
particular area. Expert opinions are of great importance. Knowledge not easily available,
accessible, or comprehensible to lay persons can be handled by them. However, it is
remarkable that the extent of agreement between residents' appraisals and experts'
opinions is considered to be low by some authors (see, e.g., Koelega, 1987; Lansing and
Marans, 1969). In a study by Lansing and Marans (1969) evaluations on attractiveness
of 97 residential sites provided by residents were compared to the evaluation of the
same sites by one expert. The correlation between the evaluations of residents and the
expert was found to be moderate ($r=0.35$). Studies on the agreement between lay persons
and experts with respect to the evaluation of various sites associated with leisure
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...residents agreed as well (see Koelega, 1987). On the other hand, the results of a study by Milbrath and Sahr (1974) showed a moderately strong relationship between judgements made by experts and residents. In two different residential environments, experts and residents, were asked to evaluate the importance of altogether 11 environmental attributes. Examples of attributes were facilities, aesthetic aspects, clean air, and relationships among community members. Experts were people who held key positions with respect to the environmental policy (e.g., environmental scientists, legislative and executive county governmental leaders). The experts were asked to judge the extent to which residents would consider the attribute to be important. Correlation coefficients between mean ratings of experts and residents in the two areas were moderately high (r_wel .45 versus .56). The correspondence between the ratings of the residents was also reasonably high (r_wel .55), but not exceptionally high. The association between the ratings of the experts was found to be much stronger (r_wel .80).

Thus, IMZ as a policy instrument is an expert-based instrument. However, as yet, the extent of agreement between judgements of the quality of residential environments by experts and residents is still a matter of debate. Further clarification is needed because the extent of agreement between experts' and residents' evaluations is considered to be important. It may influence what is measured and it also may have an influence on the conclusions about the environmental quality (Eyles, 1990).

IMZ also is an exposure-based instrument. One of the advantages of the IMZ is that it attempts to quantify environmental quality in case of simultaneous exposure to environmental factors. Especially in urban residential areas people may be exposed to various environmental factors at the same time. A major disadvantage of the IMZ is its reliance on exposure measurements. As already briefly discussed in the previous chapter, at an individual level the relationship between exposure levels and effect, i.e., annoyance, is rather weak.

At an aggregate level the relationship between exposure and effect is found to be strong. Cavalini and Pulles (1990) found a high correlation coefficient (r_wel .70) for the relation between odour concentrations and annoyance. Miedema and Ham (1988) found a very high correlation coefficient (r_wel .90) between odour concentrations and the number of people annoyed. However, at the individual level the association between exposure to environmental factors and annoyance is much weaker. For example, Cavalini and Pulles (1990) studied the relationship between odour concentrations (in odour units) and annoyance by malodour. The malodour-emitting source was a sugarbeet refinery near the Dutch city of Groningen. Odour concentrations at the respondent's dwelling were calculated by means of a malodour dispersion model. Respondents were asked whether they were bothered by malodour at a particular point in time. Next they rated the extent to which they were annoyed by malodour on a subjective scale. The correlation between odour concentrations and annoyance scores was positive and significant (r_wel .39) yet much lower than the correlation found at an aggregate level. Van Kamp (1990) investigated the relation between noise from two different sources and noise annoyance. The two noise sources were traffic noise and noise caused by airplanes. The relationship between sound pressure levels (in dB(A) and 'Kosten' units, KE) and

1 'Kosten' units is a Dutch measure especially developed to express the sound pressure levels of aircraft (Verberk, 1991).
noise annoyance was positive yet weak ($r = .25$). With respect to air pollution Hohm (1976) found a weak relationship ($r = .16$) between smog levels and the perception of air pollution. Furthermore the condition of the indoor air is considered to be of more influence on human health than the condition of the outdoor air (RIVM, 1988; Samet, Marbury and Spengler, 1987). Gates and Rohe (1987) and Baba and Austin (1989) concluded in their studies on the relationship between crime levels and perceived fear that crime levels are not good predictors of fear of victimisation. Finally, on the basis of the results of empirical studies Stokols (1972) argues that a fundamental distinction must be made between population density and its subjective counterpart: crowding.

To assess the quality of the environment the IMZ heavily relies on exposure levels. But the results of the above studies show that the negative effects of environmental factors can only partly be explained by the level of physical exposure. In addition to exposure levels, personal, temporal or situational factors (see, e.g., Evans and Cohen, 1987) may influence the relationship between environmental degradation and the perceived quality of the residential environment (see below).

Altogether it is concluded that the expert-based and exposure-based view on the assessment of the quality of the residential environment that originates from the Dutch environmental policy is not without difficulties. First, the extent of agreement on the judgement of environmental quality between experts and residents may be rather low. Second, the assessment of the quality of the residential environment through objective measurements, that is, exposure-based measurements, suffers from the generally weak relationship between exposure levels and annoyance.

2.3 Environmental quality: theoretical considerations

In the previous sections various environmental factors have been presented that are considered relevant to the quality of the residential environment. Furthermore the expert-based and exposure-based view on the assessment of the quality of the residential environment has been discussed. Finally, some aspects other than exposure levels have been mentioned that may influence the relationship between exposure levels and effect, i.e., annoyance. In section 2.3.1 the person-environment relationship is examined more closely. Other aspects than the exposure level that may affect the perceived environmental quality are presented. Some of these aspects are closely tied to personal or personality characteristics. Others are typical for a given source or evolve from the interaction between an individual person and a source. Their implications for the assessment of environmental quality is discussed. In section 2.3.2 the research view adopted in this monograph is presented.

2.3.1 The person-environment relationship factors

From an interactional point of view the person-environment relationship is influenced by characteristics of both the person and the environment (Altman and Rogoff, 1987). The relationship may best be characterized as a mutual influential one. People act upon their environment and, nowadays, this usually leads to environmental degradation. On the other hand, a poor condition of the environment negatively affects the residing population. In this section some of the relevant environmental and personal characteristics are discussed in more detail. After this discussion it should be clear why an effect-based view is adopted in this monograph and why it is worthwhile to study the effects of environmental factors at source level.
Characteristics of environmental factors. Environmental factors like those mentioned above may be conceived of as ambient stressors.4 'Ambient stressors' are chronic, global conditions of the environment that, in a general sense, represent noxious stimulation, and which, as stressors, place demands upon an individual to adapt to or cope with (Campbell, 1983). In general, 'ambient stressors' may be perceived; but their intensity is usually low. They are chronic in terms of duration and pattern and have a negative tone, that is, they are annoying. Usually they are non-urgent: imminent harm is not imposed by them and therefore they do not require direct action. A fifth characteristic of ambient stressors is their intractability which means that an individuals' practical response will not easily alter their nature (Campbell, 1983).

Thus, environmental factors may be characterized as chronic, usually passing unnoticed. They have a negative tone, are non-urgent, and are intractable. Relevant environmental stressors are, for instance, noise, malodour, pollution, litter, crowding, and safety risks.

Personal and personality characteristics. Several personal characteristics have been identified in perceived environmental quality research that affect the person-environment relationship. Among these characteristics are age, gender, socio-economic status (SES), and type of ownership of the dwelling. In the following section research on personal characteristics are discussed in more detail.

According to Evans and Cohen (1987) environmental influences, that is cataclysmic events, life events, daily hassles, and ambient stressors, may be categorized along eight dimensions. These dimensions are: perceptual saliency, type of adjustment required, value or valence, degree of controllability, predictability, necessity and importance of the source, ties to human behaviour, and, finally, duration and periodicity. Some of the above dimensions are closely tied to personal or personality characteristics (e.g., type of adjustment, controllability) others are characteristic for a given source (value or valence, predictability, duration and periodicity) or evolving from the interplay between person and source (saliency, necessity and importance, ties to human behaviour).

Of the personal and personality characteristics type of adjustment refers to ways in which individuals may deal with environmental conditions. Some may act upon the problem-causing source or diminish its consequences directly (problem-focused coping) while others deal with the resulting effects caused by the source (emotion-focused coping; Folkman and Lazarus, 1985). The manner of coping is dependent on both the type of problem and personal disposition. As was mentioned above

4 In addition to ambient stressors, three other types of environmental influences are distinguished in the stress literature. These are: cataclysmic events, life events, and daily hassles. Cataclysmic events typically involve disastrous events that affect large numbers of people or large areas. The nuclear power plant disaster in Chernobyl is an example of a man-made cataclysmic event. Earthquakes (e.g., Kobe, Japan; 1995) and volcano eruptions are examples of natural cataclysmic events. Life events usually affect a small group of people or individuals only. Yet their impact on one's life may be quite severe. Examples are the loss of a loved one and getting unemployed, but also pleasant events like marriage or the joy of becoming a parent. Daily hassles are minor events occurring on a day-to-day basis that are annoying or frustrating. A quarrel at work or Charles Bukowski's famous breaking shoelace while under time pressure are examples of daily hassles.

5 Strictly speaking the term perception is used to describe sensory phenomena with respect to light, sound, smell, taste, and the sense of touch. In this sense, for instance, safety risks or air pollution by carbon monoxide can not be perceived. To include those environmental conditions that can not be perceived by sensory experience the term environmental stressors will be used instead of ambient stressors.
environmental stressors are intractable. From this it could be concluded that a problem-focused coping effort to deal with an environmental stressor would be deemed to fail. But some stressors may be less intractable than others. For example, an individual resident may stand-up successfully against noise by neighbours, but not easily so against noise caused by night-life. Coping abilities may depend on a person's intellectual, social or economical skills (Holroyd and Lazarus, 1982). Therefore the way in which different individuals react to the same source may vary. Other personality characteristics that have been found to affect the perceived environmental quality are, for instance, neuroticism, anxiety disposition, and locus of control (Rotton and White, 1996).

Environmental factors have a negative tone, that is they are usually negatively evaluated. However, it is reasonable to assume that they are not equally valued and that different sources may be rated differently by the same person. Also, the temporal aspects (e.g., periodicity or predictability) of environmental factors may vary. Compare, for instance, the chronic nature of traffic noise with the impulse nature of aircraft noise. Furthermore, the noise of by-passing aircraft is usually not known in advance whereas street noise occurs on a day-to-day basis, again and again.

As indicated before, environmental stressors may be perceived but are of low intensity and usually pass unnoticed. However, they may vary in motivational saliency, that is the extent to which they interfere with one's activities like study, work, leisure or sleep (Campbell, 1983). Traffic noise, usually staying unnoticed, may become very annoying when someone is preparing for an exam. Nearby night-flights in relation to sleep disturbance is another typical example. Noise by military aircraft may be considered less annoying to people who have a positive attitude towards the army than to people who have not. The former may see it is a necessary activity and therefore are more willingly to accept its consequences. Air pollution due to a car driver with his car's throttle wide open may be more irritating than the smoke plume above an industrial plant. In the first example the resulting air pollution can be attributed to the drivers behaviour whereas in the second case the polluter is rather anonymous.

The above illustrates that the person-environment relationship is affected variously. Some aspects are closely related to personal characteristics, others to characteristics of the source, and yet others evolve from the interaction between a person and a source. Following this, it may be obvious that exposure levels are just one of the many aspects that influence the person-environment relationship. In the effect-based view on environmental quality, which is adopted in this monograph, it is assumed that the influence of all these aspects are reflected in one's evaluations of the environment. Thus, evaluations of the residential environment are thought to depend on not only exposure levels but also on personal characteristics and characteristics of the source other than emission strength. Furthermore, it is assumed that different sources of the same environmental factor may vary on a number of dimensions (see above), that is, they may be differently valued on the various dimensions. Therefore it is concluded that it is worthwhile to analyze the quality of the urban residential environment not just at the level of environmental factors (e.g., noise, malodour, air pollution and so on) but also at the level of their respective sources.

2.3.2 Evaluation of environmental quality

As already mentioned in the previous chapter and in contrast to the view
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adopted by the Dutch government, in this monograph an effect-based view on the perceived quality of the environment is adopted. To be more specific, the effects that will be studied are the cognitive and affective reactions of residents evoked by various environments and environmental assets. This view is referred to as a cognitive-psychological view (Daniel and Vining, 1983).

The cognitive and affective reactions mentioned are the perceived amounts of satisfaction and annoyance residents experience by the prevailing condition of the environment. Satisfaction is a common measure for perceived environmental quality (see, e.g., Baba and Austin, 1989; Campbell, et al., 1976; Christensen and Carp, 1987; Davis and Fine-Davis, 1981; Fine-Davis and Davis, 1982; Gruber and Shelton, 1987; Ha and Weber, 1994; Jelinkova and Picek, 1984; Jirovec, Jirovec and Bosse, 1985). In section 2.4 these studies are discussed in more detail.

In an early definition of environmental quality by Lansing and Marans (1969) 'satisfaction' is one of the key criteria by which the extent of environmental quality may be specified:

>'An environment of high quality conveys a sense of well-being and satisfaction to its population through characteristics that may be physical, social, or symbolic.'

In this monograph satisfaction with the residential environment is used as measure of perceived environmental quality.

Annoyance has been defined earlier in this monograph. It may be considered to be the most widespread effect of exposure to environmental factors such as noise, malodour or pollution (Winsemius, 1987). Annoyance is a frequently used measure for the negative, affective consequences of exposure to a variety of environmental factors (e.g., noise, malodour, (social) safety risks, crowding; see section 2.2.1). According to Dravnieks and O'Neill (1979) the extent of annoyance due to a given source is influenced by, for instance, the frequency of occurrence of a source, its intensity, and its duration. The extent of annoyance people experience then may be measured either directly or indirectly. Directly, this may be done by asking people to what extent they are annoyed. Indirectly, by asking residents to evaluate a source according to, for instance, its frequency, intensity, and duration. Subsequent aggregation of these evaluations would yield an indirect estimate of perceived annoyance. In Chapter 4 this issue is discussed at greater length.

The term 'residents', as used before, refers to (a) lay-people as in contrast to experts and to (b) on-site residents in contrast to, for instance, visiting panels. Residents' cognitive and/or affective evaluations of the residential environment, collected by means of questionnaire or interview techniques, are thought to reflect the various effects attributed to environmental degradation. They can be reflected in the degree of residential satisfaction residents experience. In turn, residential satisfaction is negatively affected by the degree of annoyance residents experience. Annoyance can be either a direct or an indirect result of exposure to environmental factors. Direct, at least to some extent, by annoyance due to the ambient condition of one or more environmental factors themselves. Indirect, by annoyance due to, for instance, diminishing property value or disturbed activities as a consequence of exposure to environmental factors.

Data on residential satisfaction and annoyance can be relatively easily
collected by means of interview or questionnaire. One of the disadvantages already mentioned in the previous chapter is the subjective, that is observer-based, nature of these assessments. However, if sound methodological procedures are followed, observer-based assessments can be sufficiently reliable and valid.

In summary: in this monograph a cognitive-psychological perspective on the assessment of the quality of the urban residential environment is adopted. It essentially is an effect-based view. Key criteria are experienced satisfaction with the residential environment and perceived annoyance by environmental factors. Throughout this monograph, 'residential satisfaction' is used as an overall measure of the perceived quality of the urban residential environment. The perceived environmental quality will be assessed by asking residents for their opinions about it. Assessments of 'residential satisfaction' and 'annoyance' are collected by means of questionnaires and interviews. This view is different from the view adopted in the Dutch environmental policy, in which exposure levels and expert opinions are the main criteria for the assessment of environmental quality.

2.4 Environmental quality: overview of empirical research

In the following sections an overview is presented of empirical research on the perceived quality of the urban residential environment. In section 2.4.1 research on the perceived environmental quality of urban residential environments is presented. In section 2.4.2 possibly relevant personal and household characteristics for the evaluation of environmental quality are discussed.

2.4.1 Environmental quality research

In this section an overview of empirical research on the perceived environmental quality is presented. This overview is restricted to studies (a) that concentrate on the perceived quality of the urban residential environment, (b) in which residential satisfaction is the dominant evaluation criterion, (c) in which observers are on-site residents, and (d) in which residential environments are evaluated on a large set of possibly relevant residential attributes. In these studies, residents were asked to evaluate their present residential situation on a set of quality attributes by means of a written questionnaire or in a face-to-face interview. Statistical analysis of the respondents' responses is aimed at identifying indices of environmental quality (by means of factor analysis) and/or assessing the relative importance of indices or residential attributes (by means of multiple regression analysis) with respect to perceived environmental quality. The main aim of this overview is to inventory important attributes of the residential environment.

Overview of relevant empirical research. Prior to the introduction of the Bay Area Rapid Transit system (BART), a large urban transportation system in San Francisco, Carp, Zawadski, and Shokron (1976) conducted an interview study among 2,541 residents. The residents were all living in the vicinity of the BART. The respondents were asked to evaluate their present residential situation in terms of up to one hundred residential attributes. Evaluations were asked in terms of the extent to which residents were bothered, satisfied, or concerned. Respondents rated by means of scales which varied from three to seven points. Scores were analyzed by means of factor analysis. The factor solution resulted in no fewer than twenty interpretable factors, which accounted for 60% of the total variance. From these twenty factors several
clusters could be identified on face-validity. For instance, noise turned out to be a prominent residential characteristic. Five factors emerged that were represented by attributes associated to noise: disturbance of indoor activities, disturbance of outdoor activities, noise in one's own dwelling and the neighbours dwelling, noise from aircraft and trains, and noise from outside noise sources (e.g., traffic, construction work, industry/business). Another set of factors could be identified as aesthetics. These factors were: aesthetics of the residential area, air quality, maintenance by residents, maintenance services, and environmental correlates of alienation (e.g., evaluations of a neighbourhood block as close versus open, cold versus warm, busy versus tranquil). A third cluster was designated as neighbours although 'sense of community' may be a better description. It was characterized by factors labelled as follows: feelings about living in this area, the people in the area, and alienation among residents. Fourthly, a safety cluster could be identified consisting of two factors. One factor contained attributes related to safety risks by traffic, the other contained attributes representing safety risks with respect to persons or property. Finally, a mobility cluster was identified which referred to two types of mobility: automobile (e.g., public transportation) and non-automobile (e.g., distance to family or friends).

In a nation-wide study in eight European countries Fine-Davis and Davis (1982; see also Davis, Fine-Davis and Meehan, 1981) evaluated respondents' satisfaction with the dwelling, the neighbourhood, health services and life in general. Satisfaction was measured by using a four-point scale. Predictor variables were demographic characteristics, objective aspects of the residents' dwelling, and perceptions of attributes of the respondents' dwelling and neighbourhood. Data were analyzed by means of multiple regression analyses. The scores of satisfaction with the dwelling, the neighbourhood and life in general were regressed on the scores of their underlying determinants and attributes (e.g., demographics and objective and subjective evaluations). In general satisfaction with housing in the eight countries was largely predicted by satisfaction with the facilities in and properties of the dwelling, such as the kitchen, bathroom, heating, and dwelling size. The predictive power of the dwelling attributes across different countries was found to be moderate to reasonably high (range of the proportion of explained variance: 41% to 56%). Satisfaction with the neighbours was the most important predictor of satisfaction with the neighbourhood in seven of the eight countries. Other important predictors of neighbourhood (dis)satisfaction were: dissatisfaction by vandalism and noise, satisfaction with public transportation, the condition of property and personal safety. However, these findings were less consistent across countries. The proportion of explained variance in satisfaction with the neighbourhood by the neighbourhood attributes was found to be low to moderate across the eight countries studied (range: 16% to 33%). Personal characteristics on the other hand showed less predictive value and were found to be less consistent across countries. The authors suggest that personal characteristics may mediate other attitudinal variables and may do so differently in different countries due to varying social structures.

Jelinkova and Picek (1984) examined the relation between objectively determined dwelling attributes and their subjective evaluation in terms of satisfaction. In a sample of 450 Prague inhabitants it was found that dissatisfaction with the dwelling increased with lesser indoor space, smaller number of rooms, and higher noise levels.

In a study by Jirovec et al. (1985) 100 urban elderly men (age range 60-81 years)
were asked to evaluate their present residential situation on 25 dwelling and 25
neighbourhood attributes. Furthermore, general evaluations were asked on satisfaction
with the present dwelling and the present neighbourhood. The combination of the
scores of the latter two measures was used as a measure of residential satisfaction.
Regression analyses revealed that 56% of the observed variance in residential
satisfaction could be explained by four of the neighbourhood attributes and one of the
dwelling attributes. Neighbourhood attributes that contributed significantly were:
beauty, safety, interest level (i.e., boring - interesting), and quietness. Only one of the
housing attributes contributed significantly, namely ventilation. On the basis of these
results the authors concluded that the influence of satisfaction with neighbourhood
attributes on residential satisfaction is of more importance than satisfaction with
dwelling attributes.

Gruber and Shelton (1987) aimed at identifying neighbourhood attributes
affecting residents' perceptions of their neighbourhood. In addition they tried to relate
these attributes to overall assessments of neighbourhood satisfaction. In an interview
study urban residents (N= 305) were presented with two sets of variables. For the first
set respondents were asked to evaluate their neighbourhood on characteristics and
features in terms of satisfaction. For the second set respondents were asked to evaluate
their neighbourhood on selected attributes by means of a semantic differential scale.
Factor analysis on the first set of variable scores resulted in a factor solution of three
factors: attractiveness of the neighbourhood, public services, and facilities services.
The same analysis on the second set of variable scores resulted in six factors:
pleasant/friendly, traffic/noise, good parking/maintenance, closed space, poor
exterior lighting/maintenance, and good recreation. Both factor solutions were used in
separate regression analyses with overall neighbourhood satisfaction serving as the
dependent variable. For the first set of factors the proportion of explained variance was
moderate (37%); 'attractiveness' of the neighbourhood appeared to be the most
important factor. Attributes representing the factor labelled 'attractiveness' were:
amount of open space, quietness, good place to raise children, nearness to
neighbours, greenery, and friendliness of people. The proportion of explained variance
for the second set of factors was higher (46%). The most important factor turned out to
be the factor labelled 'pleasant/friendly'. The factor labelled 'pleasant/friendly' contained
the following attributes: friendly, friendly neighbours, safe, good place to live,
convenient, attractive, and, finally, people are like me.

In a questionnaire study, Pulles, Steg, and Koeter-Kemmerling (1990) aimed at
identifying relevant residential attributes and assessing their relative importance with
respect to residential satisfaction. Respondents (N= 487) were residents of the Dutch
city of Groningen. They were presented with altogether 43 residential attributes on
which they were asked to evaluate their present residential situation. In addition they
were asked to express the extent to which they were satisfied with their present dwelling
and neighbourhood. In general the most annoying residential attributes were malodour
annoyance by animal droppings, social safety risks (crime), noise annoyance by
neighbours, litter by waste and garbage, noise annoyance by traffic, and poor
maintenance of the neighbourhood. By means of factor analysis on the annoyance
scores of the residential attributes five interpretable factors emerged: annoyance by
traffic, litter/upkeep of the neighbourhood, annoyance by noise, social safety risks, and
annoyance by malodour. In two multiple regression analyses the overall satisfaction
scores (dwelling and neighbourhood evaluations) were regressed on the scores of the five identified factors. The analyses revealed that most of the proportion of explained variance in satisfaction with the dwelling (which was rather low: 17.6%) could be explained by the factors labelled as annoyance by noise and annoyance by traffic. Satisfaction with the neighbourhood (proportion of explained variance: 24.9%) depended mainly on annoyance by litter/upkeep of the neighbourhood and annoyance by noise.

In a study by Ha and Weber (1994) 1,041 residents were asked, by means of a written questionnaire, to evaluate their present (P) residential situation on 77 residential attributes in terms of satisfaction. Furthermore, they were asked to indicate for each attribute the importance with respect to an ideal (I) residential situation. From these scores a quality measure (Q) was obtained for each attribute that was represented by the difference between the ideal situation and the actual residential situation. Factor analysis of these quality scores revealed seven residential factors: housing quality, planning/landscaping, sociocultural quality, public services, environmental safety, housing policy, and housing economics. Regression of general scores of residential satisfaction on the seven residential factors revealed that the factor labelled 'housing quality' contributed most to the proportion of explained variance (29%). Attributes representing this factor could be summarized as follows: space (e.g.: storage, personal), insulation (e.g., sound, energy), structural soundness (e.g., plumbing, fire-retardant materials), and design (e.g., kitchen, bathroom, ceiling height, sunlight).

From the studies discussed above, only the most important findings have been presented. The results reveal that a large number of attributes may be relevant for the assessment of the residential environment. Altogether these studies dealt with at least a hundred different environmental attributes. However, the results also demonstrate a diverse pattern of different (groupings of) attributes considered to be important. The results are not conclusive with respect to a circumscribed set of attributes or indices that may be designated as the most important attributes or indices of environmental quality.

The differences in the results may be partly due to the use of different sets of attributes in the different studies. Furthermore, in most of the studies these sets of attributes were prespecified by the researchers. It is therefore considered important to inventory all residential attributes that possibly affect perceived environmental quality. Also, this should be done not only on the basis of, for instance, a review of the literature but also by asking residents themselves. This issue is addressed in more detail in Chapter 3 of this monograph.

Also important is the fact that the attributes are defined at various levels of concreteness, which implies a hierarchical structure, whereas the multi-attribute structure of the concept of environmental quality is a flat one in most of the studies. In section 2.2.1 it was concluded that environmental quality may be seen as a hierarchical multi-attribute concept in which the various relevant attributes may be structured on more than one level. In section 2.5 this conclusion is made explicit by the presentation of a hierarchical multi-attribute model of perceived environmental quality. It will be interesting to observe whether the aforementioned representation of environmental quality is adequate in terms of relevant residential attributes and predicting perceived environmental quality.
Another issue is the proportion of explained variance (predictive power) of the various sets of attributes. The predictive power appeared to be low to reasonably high (range: 16% - 56%). In some of the above studies only residential attributes were examined whereas other studies also analyzed the influence of personal characteristics. Adding personal characteristics in the analysis may improve the predictive power. The influence of personal characteristics is examined below. This should indicate which personal characteristics are relevant in the assessment of environmental quality.

2.4.2 Personal characteristics

Carp and Carp (1982) examined the influence of age and gender on the evaluation of one's neighbourhood on fifteen dimensions of environmental quality. These dimensions were a result of a factor analysis on the scores of one hundred residential attributes on which residents had evaluated their neighbourhood. In a statistical analysis the effect of age on each of the fifteen dimensions was examined. In technical terms, univariate analysis of variance was performed on the fifteen dimensions serving as criteria and age (12 categories; range 18 - 70 years) as classifying variable. For fourteen of the fifteen dimensions a significant positive, linear relationship was found, that is, with increasing age neighbourhood evaluations became increasingly positive. Gender differences were only observed for three of the 15 dimensions. It appeared that women were less dissatisfied with noise from the neighbour's home, less positive about their safety, and less satisfied with their privacy than men. Combined effects of age and gender were analyzed as well. Puzzling results were found for men and women under the age of 21 and above the age of 70 years. In general, younger women were more satisfied with their residential situation than younger men, whereas for the older age group the situation was reversed. No interaction effect between sex and age could be detected for men and women in the age groups between 21 and 69 years.

In the study by Jelinkova (1984; see above) an age effect was found in relation to general satisfaction with the dwelling. Elderly people (over 50 years) appeared to be more satisfied with their dwelling than younger people.

Davis et al. (1982) studied the influence of demographic variables on three global measures of perceived well-being, one of which was general satisfaction with housing. They interviewed over twelve thousand people in eight European countries. Satisfaction with housing was rated on a four-point scale (very satisfied-very dissatisfied). Predictor variables for satisfaction with housing were: ownership of the dwelling (owner/tenant), income (quartiles), age (18-24, 25-39, 40-54, 55+ years), and location of dwelling (urban/rural). Analyses of variance revealed that ownership was the strongest predictor of satisfaction with housing across the eight countries, showing tenants to be less satisfied than owners. Income and age were found to be somewhat less powerful predictors of satisfaction. The analyses revealed that people in higher-income categories or older people were more satisfied than people in lower-income categories or younger people. Location of the dwelling was not found to be a significant predictor of satisfaction with housing.

In a study by Baba and Austin (1989) the role of, amongst others, physical attributes of the neighbourhood on perceived neighbourhood safety was examined. The physical attributes were the neighbourhood's appearance, litter, open space, and the amount of peace and quietness in the neighbourhood. The results on the personal characteristics studied indicated that the residents' socio-economic status (SES), age,
and ownership of the dwelling (tenant versus owner) affected the evaluation of the neighbourhood. People high in SES, older people, and homeowners were more satisfied with the physical attributes of their neighbourhood than people low in SES, younger people, and tenants, respectively. Other personal characteristics studied (race, length of residence) showed no statistically significant relationship with satisfaction with the neighbourhood.

Pulles et al. (1990; see also above) also assessed the influence of personal characteristics (i.e., age, gender, and SES) on the evaluation of satisfaction with the dwelling and the neighbourhood, respectively. A multiple regression analysis revealed that age was an important predictor variable of satisfaction with the dwelling and the neighbourhood. Again older residents appeared to be more satisfied than younger residents. On the other hand, the influence of SES and gender was found to be very low.

Several personal characteristics have been found to affect the perceived quality of the residential environment as expressed by residential satisfaction. In general age and SES appeared to be important personal characteristics. Older people and people high in SES appeared to be more satisfied with their residential situation than younger people or people low in SES. Homeownership also affected satisfaction with the residential situation. In general tenants appeared to be less satisfied with their residential situation than homeowners. Gender, also an important personal characteristic in psychological research, does not appear to be an important personal characteristic in this context. What remains unclear from these studies, however, is why, for instance, older people, people high in SES, or homeowners are more satisfied than younger people, people low in SES, or tenants. Maybe, older residents have been living for a longer period in the same residential situation and are therefore habituated or adapted to negative aspects of the residential situation. People high in SES may have more and better choice options available when renting or buying a dwelling than people low in SES. Homeowners make a strong, financial, commitment towards a given residential situation when buying a dwelling. Perhaps they are inclined to search longer to find a satisfying residence. Nevertheless, in the empirical research to be presented in this monograph personal characteristics (e.g., age, gender, SES, and homeownership) will be studied only to control for their possible influence on perceived environmental quality.

2.5 A theoretical model of urban environmental quality

In section 2.2 it was concluded that environmental quality may be best conceived of as a hierarchical multi-attribute concept. An outline of this idea was presented. Relevant attributes were satisfaction with the dwelling, the neighbourhood, and the community. In turn, for the dwelling and the neighbourhood specific dwelling and neighbourhood attributes were identified. Finally, the neighbourhood attributes could be characterized by various sources. In section 2.3 the relevant environmental factors were characterized as environmental stressors. Environmental quality in general was defined in terms of satisfaction with the residential situation. The perceived effects of the environmental stressors were defined as the extent of satisfaction or annoyance residents experience from these stressors in their residential situation. Furthermore it was argued that it not only was worthwhile to assess the perceived quality on the level of environmental stressors but also on the, lower, level of their respective sources. This
is so because different sources of the same environmental factor may be evaluated differently on the various dimensions discussed in section 2.3.1. Finally in section 2.4 an overview of relevant empirical research was presented. A rather large number of relevant residential attributes were found to have an influence on perceived environmental quality. However, these attributes were defined at diverse levels of concreteness whereas the multi-attribute structure of the concept of environmental quality was flat in most of the studies discussed.

Altogether this has led to the design of the hierarchical multi-attribute model of perceived quality of the urban residential environment, depicted in Figure 2.1. It is considered to be a preliminary, theoretical model. According to this model environmental quality is represented by the amount of residential satisfaction (level 1 in

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**Figure 2.1** Hierarchical multi-attribute model of urban residential quality.
Residential environmental quality

Figure 2.1) residents experience. Residential satisfaction is thought to depend on the residents' satisfaction with the neighbourhood, the dwelling and the community, respectively. Satisfaction with the neighbours is used as a key-indicator of satisfaction with the community (cf. Carp et al., 1976; level 2). The first two attributes are assumed to depend on the residents' satisfaction with specific dwelling and neighbourhood attributes (level 3). 'Satisfaction with the neighbours' may also be decomposed into several 'neighbours'-attributes but this will not be done here. Relevant dwelling attributes are satisfaction with the dwelling's costs, facilities, upkeep, and size. Neighbourhood satisfaction is expected to depend on satisfaction with seven attributes labelled as follows: annoyance by noise, malodour, air/water/soil pollution, litter, safety risks, crowding, and lack of neighbourhood facilities.

At the lowest level of the model (level 4), each of these seven features is decomposed into specific sources. The neighbourhood attribute annoyance by noise was expected to depend on annoyance by the following eleven sources: noise by indoor appliances, by neighbours, by animals, by youth, by nightlife, by cars and mopeds, by buses, metro, or lorries, by trains, by ships, by airplanes, and by industrial activity. The attribute annoyance by malodour was expected to depend on annoyance by the following five sources: malodour by animals, by garbage or waste, by traffic, by industrial activity, and by surface water or sewage. The attribute labelled annoyance by pollution was expected to depend on annoyance by the following six sources: smog, dust in the air, soil pollution, water pollution, pollution of drinking water, and vibrations due to traffic. The attribute labelled 'annoyance by litter' was expected to depend on annoyance by the following five sources: garbage or waste, animal droppings, demolition, unaesthetic buildings, and graffiti. The attribute 'annoyance by safety risks' was expected to depend on annoyance by the following seven sources: traffic, vandalism, burglary or theft, hold-up or robbery, industrial activity, youngsters, and junkies or prostitution. The attribute 'annoyance by crowding' was expected to depend on annoyance by the following six sources: number of people in the neighbourhood, available parking space, time spent waiting in shops, busy streets, encountering unfamiliar faces, and dense developments. Finally, the attribute 'annoyance by lack of neighbourhood facilities' was expected to depend on dissatisfaction with the following eleven sources: schools, shops, primary health care facilities, sport facilities, nightlife, play grounds, walks, greenery, illumination at night, public transportation, and arterial roads. Altogether, fifty-one specific sources of annoyance were included in the model.

It should be noted that the model represents the researcher's cognitive representation of the multi-attribute nature of the concept of environmental quality. It would be interesting to see what the residents' representation of this concept looks like and to what extent it matches with the researcher's view. This issue is discussed at greater length in Chapter 3.

The above-presented model will serve as a theoretical framework on which the empirical studies in this monograph are built. In the next chapter the multi-attribute evaluation of the perceived quality of the urban residential environment is discussed.

2.6 Research hypotheses and research questions

In this chapter the quality of the urban residential environment has been discussed (a) from the policy maker's view, (b) on the basis of theoretical considerations, and (c) according to the relevant empirical research. Several conclusions
have been drawn. In this section these conclusions are presented as research hypotheses together with the general research questions.

Hypothesis 1:

- The 'perceived quality of the urban residential environment' can be usefully considered to be a hierarchical multi-attribute concept.

Research questions:
- Which are the relevant attributes with respect to the perceived quality of the urban residential environment (neighbourhood attributes and dwelling attributes)?
- What is the residents' cognitive representation of the concept of environmental quality?
- What is the relative importance of these attributes?

Hypothesis 2:

- Urban environmental quality does not only depend on physical environmental attributes (e.g., noise, malodour, air pollution) but also on various other types of environmental attributes, e.g., psycho-social attributes and attributes of the built environment.

Research question:
- How important are the physical residential attributes (e.g.: noise, malodour, air pollution, external safety risks) in comparison to the other types of residential attributes?

Hypothesis 3:

- Experts' perceptions of environmental quality differ from residents' perceptions of environmental quality with respect to relevant environmental attributes, the cognitive representation of the concept, and the relative importance of attributes of environmental quality.

Research questions:
- To what extent do the cognitive representations of the concept of environmental quality of experts and residents match?
- What is the extent of (dis)agreement between experts' and residents' evaluations of relevant residential attributes and their relative importance?

In addition to the above hypotheses one methodological hypothesis is addressed in the research presented in this monograph. In Chapter 3 the following hypothesis is discussed in more detail.

Hypothesis 4:

Behavioral decision theory provides a fruitful methodological framework for modelling the perceived quality of the urban residential environment. Applying different decision-theoretical methods and techniques to study the concept of environmental quality will lead to comparable results. These results may be used for the development of a tool that is capable of assessing perceived environmental quality.

Research questions:
- What is the extent of convergence between the results of the 'top-down' and
What is the extent of agreement between constructive and reconstructive modelling the respondents’ preference structure for the perceived environmental quality?

In the next chapter (Chapter 3) the general research methodology is presented. On the basis of methods and techniques from behavioural decision theory a multi-attribute evaluation procedure is discussed. Three evaluation approaches are introduced: a 'Hierarchical Multiple Regression' approach, a 'Multi-Attribute Utility' approach, and a 'Conjoint Analysis' approach. The advantages and disadvantages of the three approaches are discussed. This is followed by the presentation of four empirical studies (Chapters 4 through 7) that were conducted to test the research hypotheses and to answer the research questions. In Chapter 4 a questionnaire study is presented. In this study the 'Hierarchical Multiple Regression' approach is used. Residents evaluated their present residential situation on the attributes of the theoretical model of 'environmental quality'. This was done by means of a written questionnaire. Respondents provided both overall evaluations as well as single-attribute evaluations. By means of several multiple regression analyses the relative weights of the residential attributes were estimated. Relative weights of the residential attributes were estimated on group-level data, since each respondent only evaluated one object: his or her own residential environment. In Chapters 5 and 6 two studies are presented in which the Multi-Attribute Utility ('MAU') approach will be used. Respondents made an inventory of 'value-relevant' residential attributes and structured these attributes according to a 'bottom-up' approach into a 'value-tree'. The various individual value trees were combined into a so-called empirical model of environmental quality. For each respondent relative attribute weights were assessed. This was done directly by using a 'ranking and rating' method. Weight assignment was carried out irrespective of the present residential situation of the respondent but with respect to the quality of dwellings and neighbourhoods in general. The main difference between the two studies presented in Chapter 5 and 6 is the type of respondent. In one study (see Chapter 5) the respondents were residents. In the other study municipal civil servants (experts; see Chapter 6) were interviewed. Both groups followed the same procedure.

Finally, in Chapter 7 a study is presented in which a Conjoint Analysis experiment was performed. In a standard Conjoint Analysis experiment respondents are presented with a number of representations of objects (e.g., representations of neighbourhoods), so-called profiles. The profiles were experimentally designed on the basis of predetermined attributes and attribute levels. Respondents were presented with the profiles and were asked to judge them holistically, for instance, by ranking them according to their attractiveness. From the rankings the relative importance of the attributes can be obtained.