Doctoral Thesis

Places in Transformation
Integrating Residents’ Perspectives and Spatial Characteristics into the Assessment of Urban Quality of Life

Author(s):
von Wirth, Timo

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PLACES IN TRANSFORMATION: INTEGRATING RESIDENTS' PERSPECTIVES AND SPATIAL CHARACTERISTICS INTO THE ASSESSMENT OF URBAN QUALITY OF LIFE

A thesis submitted to attain the degree of

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[Dr. sc. ETH Zurich]

presented by

TIMO VON WIRTH

M.A., RWTH Aachen, Germany
born on July 14th, 1975

citizen of the Federal Republic of Germany

accepted on the recommendation of

Prof. Dr. Adrienne Grêt-Regamey, examiner
Dr. Michael Stauffacher, co-examiner
Prof. Dr. Riklef Rambow, co-examiner

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Summary

Enhancing and securing the quality of life in cities is one of the key challenges in the current global environment of rapid urbanization. In Switzerland, urban areas have expanded substantially over the last decade, and this growth has taken place predominantly in the suburban areas of the Swiss agglomerations. Understanding the beneficial and adverse effects of this persistent urban growth and developing practical coping strategies for sustaining the urban quality of life in Swiss cities are urgent policy demands.

The quality of urban areas is influenced by characteristics of their built, natural and social environments. At the same time, quality also evolves through individuals’ experiences and local perspectives on urban space. Only through this user experience can urban space become a series of places assigned with meaning and function (e.g., for residents). Accordingly, research on the places in transformation entails a coupled understanding of urban quality of life, an approach that has not yet been adopted by the scientific community. Moreover, the current practice of urban studies has often disregarded the effects of rapidly growing suburban environments such as in Switzerland, where urbanization currently accounts for extensive and unwanted ecological and social impacts.

The research of this thesis is conducted in the suburban case study region Limmattal, located within the agglomeration of Zurich. The procedure seeks to answer two guiding research questions: (1) How do context-specific factors influence the urban quality of life in a rapidly growing suburban region in Switzerland? and (2) How can residents’ perspectives and spatial characteristics be integrated to inform urban development? Giving answers to these questions complements the scientific body of knowledge regarding how individuals experience and respond to their urban environments. In so doing, the thesis sheds light on how the urban quality of life may actually be affected by urban planning interventions. The cumulative thesis consists of four main research articles.

The first research article identifies regional impact factors on place quality in the Limmattal region. Based on collaborative analyses by scientists and local planning experts, it reveals important feedback loops among the interrelated factors of the built, natural and social environments. Such regional feedback loops still lack sufficient attention from planning experts. The identified loop structure among five influencing factors describes a mechanism of socio-spatial interrelatedness with demographic development as the emanating factor. It is interpreted as an
additional systemic driver of sprawled and fragmented land use patterns in suburban Switzerland. The set of relevant impact factors is furthermore used to determine four concrete scenarios illustrating the future development options for the region.

The second research article presents the combined modeling of specific, objective characteristics (e.g., accessibility, safety in public space) of the urban environment, as well as perceived, subjective assessments of these characteristics by residents with regard to their influences on urban quality of life. Data from a representative population sample of \( N=1693 \) residents in the cities of Schlieren and Dietikon, together with the objective data, are applied to structural equation modeling. The objective and subjective data are integrated by spatial location using geographic information systems. The study finds that, due to mediating effects and adaptation processes, variations in objective measures do not reliably represent differences as evaluated by residents. Accordingly, immediate inferences regarding changes in the objective urban environment and their effect on residents' urban quality of life are not valid. It therefore appears relevant to further include information on residents' perceptions and evaluations of urban environmental qualities (e.g., through data-based participatory processes of urban monitoring).

The third research article tests the particular influence of urban growth on residents' place relations for a subsample of \( N=746 \) residents from the city of Schlieren. This analysis applies the concept of place attachment as a response measure for residents' perceived urban quality, while controlling for socio-demographic and objective housing factors as further predictors. The findings suggest that place attachment is robust against rapid urbanization. It is not urban growth per se that significantly affects residents' place attachment, but the perceived utility resulting from urban growth effects. That is, if an urban change is perceived as an attractive upgrading and if the resulting urban environment is seen as (still) familiar, even rapid growth may affect place attachment positively.

The fourth research article analyses spatial patterns of residents' place attachment on a neighborhood scale. The study provides an answer to how and why place attachment varies across neighborhoods in the city of Schlieren. Regression models for different, yet statistically comparable neighborhoods are calibrated, and the results are mapped. The study finds significant differences in place attachment between neighborhoods. Neighborhoods also differ with regard to the relative importance of particular predictor variables. The intensity of residents' neighborhood bonds and perceived building aesthetics are found to be positive explanatory factors for place attachment across all neighborhoods.
In conclusion, the four research articles illustrate the influence of context-specific factors on urban quality of life (e.g., safety in public spaces, building aesthetics, intensity of neighborhood bonds and living in cooperative housing). The findings indicate concrete policy options for affecting residential satisfaction and residents’ attachment to places. However, the study results also reveal that immediate inferences regarding the impact of changes in the objective urban environment on residents’ urban quality are not valid.

Accordingly, the residents’ perspectives should be represented more explicitly in procedures for developing future urban living environments. A more frequent representation of residents’ perception and place experiences does not necessarily require greater participatory planning. A more data-driven inclusion of residents’ perspectives based on local, spatially explicit information should be pursued. Such information may for example indicate places with particular meaning or places with a concrete improvement potential and should become an essential element of continuous urban monitoring.

In so doing, the acceptance and opposition towards changes in the urban environment could be assessed at early planning stages. Thus, the findings from this thesis offer significant support for more evidence-based decisions in local urban development and may contribute to deliberative coping strategies for contested urban growth effects in Switzerland and elsewhere.
Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life
Zusammenfassung


vier konkrete Zukunftsoptionen entwickelt, wie sich die regionalen Ortsqualitäten im Jahr 2030 darstellen können.


**Studie 4** identifiziert auf Ebene der Stadtquartiere räumliche Muster in der Ortsverbundenheit der Bewohner und adressiert damit eine bislang bestehende Forschungslücke der sozialwissenschaftlichen Zugänge. Regressionsmodelle werden für unterschiedliche, aber aufgrund der Teilstichproben vergleichbare,


Note

This thesis is a cumulative dissertation consisting of four research articles being published or under review for publication in peer-reviewed journals and conference proceedings. The four research papers were all written by several authors. The introduction and concluding remarks sections of this thesis were written by myself. To maintain consistency with the main body of the thesis, the personal pronoun ‘we’ is used throughout the thesis, also in the introduction and concluding sections.

For this thesis, few adjustments have been made to the four research articles (e.g., the numbering of paper sections). The content, and the numbering of figures and tables remained identical as in the published versions.

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1. Introduction

The introduction chapter is structured as follows. First, section 1.1 discusses the current challenges of urban living environments in times of rapid urbanization. The section also addresses the specific situation in the Swiss case study region. Section 1.2 specifies the demand for research on urban quality of life, starting from a theoretical embedding, outlining the particular scientific relevance of this study, and resulting in the identified guiding research questions. Finally, section 1.3 describes the concrete research procedure. Based on the procedural rationale, this section concludes with a compact overview on the four main research contributions.

1.1. The urban challenge

The world’s population recently surpassed the seven-billion threshold and the majority are now residing in cities. The urban population is expected to increase to over 70% on a global scale by 2050, with some two billion people moving into agglomerations, especially in China, India, Southeast Asia, and Africa (United Nations, Department of Economic and Social Affairs [UN, DESA] 2014, see Figure 1a). Currently, urban areas have already become the everyday living environment for almost 80% of the Europeans (Haase et al. 2014).

This persistent, ongoing urbanization poses significant challenges in ensuring human well-being in urban living environments and beyond. It is through the urban environments that "mankind is increasingly present in the planet" (Sassen 2009, p. 2). Cities are central nodes of energy and material consumption, significantly driving environmental and social changes on multiple scales (Grimm et al. 2008; Swilling and Annecke 2011), for example, by altering land uses, habitats, and hydro systems, while generating waste discharges and pollutants, as well as social problems such as crimes and diseases (Romero-Lankao and Dodman 2011). At the same time, life in cities has been acclaimed for being humanity’s engine for innovation, cultural evolution, and wealth creation, benefitting from the spatial clustering of human activities (Bettencourt and West 2010, see Figure 1b).
Understanding both beneficial and adverse, unwanted effects of urban systems and how they relate to human activities adds to the general knowledge of socioecological system changes and governance for human well-being (Elmqvist et al. 2013). Despite common scaling effects by city size, each city is a unique, evolving system of significant heterogeneity in its structure, with distinct development patterns (Kourtit et al. 2014). The growth of these urban systems poses major challenges toward a more efficient use of energy and resources, be it in the form of the building infrastructure or of people’s mobility patterns within urban areas. Compact settlement patterns, which Angel (2012) referred to as the sustainable densities proposition, are among the guiding though contested principles for coping with these challenges in urban development strategies.

The envisioned compact city is often characterized by higher population densities and shorter distances in mixed-use environments, while offering high amenity values in public spaces. However, such city patterns demand intense urban transformations in many cities around the globe. The inherent trade-off situations of transforming urban space involve diverse actor interests. Necessarily, the effects of urbanization and the related, diverging preferences and interests call for thorough scientific analysis to overcome the lock-ins of the current urban development patterns and to prevent social conflicts in urban areas (Pullan 2013). Analyzing human activities in urban systems and vice versa (the corresponding effects of urban environments on human life) is particularly required for rapidly growing urban areas. Accordingly, Bettencourt and West [2010] expressed the urgent need “for a science of how city growth affects society and environment” (p. 912) and Angel (2012) recently “detected great reluctance to engage with the prospects of urban expansion” (p. 4).
The ecological, socioeconomic, and health impacts of urbanization have been studied extensively from different disciplinary angles, and indicators are readily quantified and monitored (e.g., Urban Audit in the European Union, Cercle Indicateurs in Switzerland). However, the effects of urbanization on social processes and human interactions with the urban environment are less understood (Slemp et al. 2012), for example, how residents experience and sense the comfort of a place and how this relates to their well-being. Indeed, human well-being is affected if the people’s place perception and relation to places are impaired by urban development (Johnson and Zipperer 2007). Accordingly, the understanding of how urban environments influence life quality and evoke human responses needs to be expanded.

In this context, Jane Jacob’s (1961) seminal work on life in cities appears more relevant than ever. Her critique deemed modernistic urban planning as widely rejecting the perspectives and demands of human beings living in and using city space (Jacobs 1961). Contrariwise, Jacobs outlined the possible qualities of livable and lively cities. Such livable city environments consequently integrated user demands, for example, dense, mixed-use city blocks with a high pedestrian permeability. More recently, Gehl (2010) reemphasized that the “human dimension has been overlooked and haphazardly” ignored in urban planning (p. 3). As a result, many social and cultural functions of “city space as meeting place and social forum for city dwellers were reduced, threatened and phased out” because market forces and urban design trends “gradually shifted focus from the interrelations” between the built urban environment and people’s perspectives on these urban environments (p. 3).

If cities are consequently conceived as dynamic, “geographically concentrated systems of human beings” (Kourtit et al. 2014, p. 1), then the essential questions involve a better understanding of how spatial characteristics of the urban environment evoke social responses and how human perception and evaluation relate to the assessments of these urban environments. Thus, the qualities of urban environments need to be studied from a coupled perspective. An in-depth understanding of these relations may then be used to inform adaptation strategies toward improving or sustaining the quality of urban environments. However, implementing both spatial city characteristics and related human responses in procedures of assessing urban quality of life is still rare in current research. Adapting to urban growth and mitigating the unwanted effects that urbanization deploys on the quality of city life are familiar challenges (Myers 1988) yet more than ever, they constitute fundamental tasks toward securing livable and lively urban environments (Kourtit et al. 2014). Consequently, this thesis contributes to
both aspects: closing concrete knowledge gaps in the relation between urban environmental characteristics and their human evaluation, as well as discussing the procedural implications of these findings, based on a case study in Switzerland.

1.1.1. Contested urbanization in the Swiss case study region

Switzerland had been one of the fastest growing populations in Europe over the last decade (Swiss Federal Statistical Office (BFS) 2009). The population growth predominantly occurred in the Swiss agglomerations, for example, in the Basle-Lucerne-Zurich triangle and the Lake Leman region of Geneva and Lausanne. Today, 75% of the population reside in urban and suburban areas of these agglomerations (Swiss Federal Office for Spatial Development (ARE) 2014).

Urban development in Switzerland has shown an intense process of re-urbanization in recent years (ARE 2014), that is, the central urban areas of the large cities have regained attractiveness as residential locations. However, the substantial growth has occurred in the suburban areas, at the fringes of the Swiss cities. Housing demand has increased rapidly in suburban locations due to rising real estate prices in the central city areas, intensifying gentrification effects in these central locations.

An increasing requirement for living space per person has further enforced the demand for housing development. Thus, suburban areas in Switzerland are the current hotspots of urban transformation, where cities are expanding significantly and where urban life and ecosystems are facing intense changes in the built, natural, and social environments (Grêt-Regamey 2012). One such rapidly growing suburban region is Limmattal, one of the two major growth corridors within the agglomeration of Zurich, as displayed in Figure 2.
Situated along the Limmat River, the Limmattal extends over 24 km in a western direction from the city of Zurich. With lower (but rising) land prices and rental rates for housing and office space (compared to the central areas of Zurich), the region currently attracts migration. The Limmattal region has an important position as a gateway to Zurich, with major road and railroad transport axes and comprising 15 communities. The two communities of Schlieren and Dietikon were selected as the focus areas for local analyses in this study.

Both cities had witnessed significant changes in their urban realm due to the rapid growth in population and workplaces and the subsequent urban infrastructure in recent years. For example, the city of Schlieren had a 24.2% increase in population over the last five years (2009–2013), a much faster growth rate than the 6.3% in the city of Zurich for the same period, as illustrated in Figure 3a (Statistical Office Canton Zurich 2014).
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Figure 3. Growth rates of (a) population and (b) built housing units in the study region on a five-year basis. (Source: Statistical Office Canton Zurich 2014).

The building stock for residential use expanded likewise. The growth in built housing units in Schlieren was 23.1% on a five-year basis (2008–2012), compared to 4% in Zurich for the same period (see Figure 3b, Statistical Office Canton Zurich 2014). A recent forecast for the Limmattal region expected further population growth by 17% from 2012 until the year 2025 (Zürcher Planungsgruppe Limmattal (ZPL) 2012). The regional projections also predicted a 29% increase in workplaces and a 100% growth in the subsequent mobility demand (for public transport rides per day) by 2025 (ZPL 2012).

The observed growth pattern in the study region has resulted in persistent land consumption and intense urbanization, now posing considerable challenges in diverse aspects of the local quality of places and residents’ lives. For example, the rising demand for mobility, which has resulted in increased commuting and leisure traffic, has led to unwanted effects (e.g., an increase in noise emissions and traffic congestion). To counter these consequences, urban planning in the region currently aims for compact city development, with further densification in central zones. Former industrial sites are now being transformed into new, large-scale housing areas in the two focus areas of Schlieren and Dietikon.

Particular concerns persist about the impacts of the cities’ transformation on residents’ well-being, their relatedness to places, and the local identity of communities in the Limmattal region. Residents and local policymakers have expressed their concerns about the unclear consequences of the current development. For example, residents made the following statements (translated into English) as survey comments, which were evaluated in a report for the city of Schlieren (von Wirth et al. 2014):
We perceive the development in the city of Schlieren as positive in principle; however, we are discontented that Schlieren is neglecting the local population during the prevalence of new building constructions. (translated comment 1 from a survey participant in Schlieren).

Schlieren is more and more packed with buildings; there are solely huge building blocks and only few or no green spaces. (translated comment 2 from a survey participant in Schlieren).

Rapidly growing communities such as Schlieren and Dietikon are influenced by substantial changes, not only in the physical, but also in the social environment. For example, residents reported safety concerns in public spaces and a potential loss of social interactions in neighborhoods. Accordingly, urban policymakers from the region requested to gain more knowledge about the influencing factors of residents’ place perceptions and their sense of belonging (von Wirth et al. 2014). During a focus group workshop, specific place-related challenges in the region were framed by comments such as:

For this city, the integration of new inhabitants and the maintenance and development of places, creating a sense of identity, are important to strengthen persons’ local belonging. (translated oral statement by the head of building department, Schlieren, workshop on July 3, 2012).

Coping with such challenges always occurs within an economic context and a legislative framework such as spatial planning regulations. The prosperous development of the Swiss economy not only attracts migration, but also leads to a continuous increase in the individual demand for housing space. Given the limited land resources in Switzerland, this increase, together with building height restrictions in city areas, is an additional driver of extensive settlement growth and land consumption. Recent adaptations of the legal context have responded to this development, including the acceptance of two political initiatives: first, the revision of the spatial planning law on the federal level and second, the approval of the Kulturlandinitiative within the Canton of Zurich. Both adaptations aimed at limiting significant urban growth to the currently existing settlement boundaries to prevent further sprawling land consumption. More compact city structures with higher built densities in central and suburban settlement locations shall be the consequence.

This densification leads to trade-off situations. For instance, the significant increase in housing space in a neighborhood may reduce the quality of other
amenities in the area, such as sufficient provision of kindergarten places - in other words, the beneficial and adverse effects of urban growth need to be traded off across disparate actor values. This case is even truer when regions cope with an immense growth, as in the communities of the Limmattal region. A better understanding of the affected residents’ perspectives, combined with information on the objective urban conditions, may lead to an improved knowledge base for discourses and solution finding for such trade-off situations.

Assuring people’s quality of life is a key policy goal in Switzerland (Marti et al. 2011), with a particular emphasis on the local conditions in the Swiss communities (Bundesamt f. Raumentwicklung 2013; Tobler and Huber 2001). Bringing communities and regions such as the Limmattal in line with living environments that positively contribute to the quality of life remains a complex and challenging task. It demands an integrated research on the local factors influencing the urban quality of life, as well as evidence on how to make this knowledge available to those actors implementing urban development.

1.2. Demand for integrated research on urban quality of life

Research on urban quality of life encompasses several perspectives on the urban living environment. Such research needs to be based on clear definitions of the applied concepts and guiding research questions. Thus, section 1.2.1 defines the theoretical and conceptual scope, whereas section 1.2.2 lays the basis for the first guiding question. Section 1.2.3 describes current procedural challenges in urban quality research and leads to the second guiding question.

1.2.1. Theoretical and conceptual scope

1.2.1.1. Quality

When analyzing quality aspects of the urban living environment, the concept of quality should first be defined. However, quality remains an elusive concept, defined according to the scientific context, the measures applied, and the person defining it (Wicks and Roethlein 2009). Originally derived from the Latin word qualis, which translates to ‘of what kind,’ the term quality is defined in the Oxford dictionary as “the standard of something as measured against other things of a similar kind” (Oxford Dictionaries 2014), indicating the relative character of quality descriptions. A widely accepted definition across contexts stems from the International Organization for Standardization (ISO), which refers to quality as “the degree to which a set of inherent characteristics fulfills requirements” (2014). This
definition uses a multidimensional perspective on quality that includes both the inherent characteristics (e.g., of a building) and the fulfillment of requirements (e.g., of residents).

There are diverse scientific approaches to defining quality, mainly from engineering, management, and education sciences (e.g., Harvey and Green 1993; Reeves and Bednar 1994). Summarizing the existing quality definitions leads to three common factors (Wicks and Roethlein 2009). First, quality is conceived as a value-free, measurable variable. The bases for the measurements are observable characteristics of the entity itself (e.g., the total floor space of a building). Second, quality is perceived as evolving through the fulfillment of (user) needs. This fulfillment is often described as an attributed response, for example, a person’s satisfaction with an object’s characteristics in use. Third, the process-based aspect is common to definitions of quality. It relates to the principles and procedures of how the inherent characteristics and the user’s satisfaction are met (e.g., the way a participatory process for city development is designed). In their set of quality definitions, Harvey and Green (1993) included the procedural aspect of transformation, building on the idea of quality as an “enhancing and empowering process of qualitative development” (p. 13). Considering the three identified commonalities leads to an integrated understanding of quality, which is adopted for the conceptualization of urban quality in this thesis.

1.2.1.2. Urban quality (of life)

Urban quality is a multidimensional concept, far from being clearly defined. Notions related to urban quality exist, such as urban quality of life, quality of places, and urban environmental quality, which are often used as synonyms (van Kamp et al. 2003).

The understanding and application of urban quality are manifold in different scientific domains. For example, urban design and engineering recognize urban quality as predominantly evolving from the interplay of infrastructure, buildings, and open spaces (Baum 2008). Urban sociology and environmental psychology conceive urban quality based on activities and characteristics of individuals and social groups in their urban living environment (e.g., the length of residency and lifestyle), for example, by analyzing their perception and behavioral acquisition of urban space and participation in place making (e.g., Häusssermann and Siebel 2004; Siebel 1994). These disciplines similarly refer to the concept as the urban quality of life. On the other hand, spatial economics describes urban qualities by the monetary valuation of urban amenities and location characteristics (Krätke 1996).
Research on urban quality has mainly focused on measurement procedures and the influencing variables, often without initially defining the concept itself. For example, Talen (2002) referred to urban quality as being assessed either “subjectively or objectively, using data that are quantitative, qualitative, or a combination of both” (p. 258). Nonetheless, a thorough clarification of the applied concept is an essential element of scientific work. A common aspect among the diverse concepts of urban quality is the idea of indicating conditions of urban living environments to understand and manage their future development for human well-being (van Kamp et al. 2003). Hence, assessing qualities in the urban environment claims to have practical implications for the urban future. Given the integrated definition of quality in general, analyzing and developing urban quality should principally combine both spheres of the spatial characteristics and people using and responding to their urban environment. The spatial characteristics can be described with physical, objective measures (e.g., built density in a neighborhood, public transport provision, and accessibility via the road infrastructure). The objects themselves are perceived as offering a functional potential for usage by people.

Integrating people’s perspectives relates to their perceptions, evaluations, and behavior in their spatial environments (e.g., frequency of using public gardens, perceived safety in public spaces, and satisfaction with public transport). Thus, quality assessments of urban space reflect personal values and demands (Siebel 1994), necessarily including cognitive and affective processing and behavioral responses (Scannell and Gifford 2010). Different people show varying demands for using the potentials in urban space (e.g., an urban park offers the potential for recreation). To secure or develop urban quality according to people’s requirements, evaluating their demands (also referred to as ‘needs’) may offer an initial starting point for scientific analyses. Using the concept of needs (e.g., contact with nature, social interaction, and safety in public spaces) to describe qualities of the urban environment was proposed by different scholars (Maderthaner 1995; Matsuoka and Kaplan 2008; Pacione 2003).

However, measuring human needs and their degree of fulfillment is challenging. Needs are theoretical concepts and not directly observable. Moreover, the concept of human needs is limited in its ability to inform the domains steering urban development (such as urban management, urban design, and real estate development). These domains mainly rely on concrete, observable characteristics of the urban environment (e.g., building dimensions and proximity to green spaces).
Nevertheless, integrating both dimensions, the spatial characteristics (and their inherent potential for usage) and people’s perception, evaluation of and behavior in urban space need to be considered in quality assessments, even if their relation is not immediate. In other words, the physical urban environment (e.g., buildings and street traffic) both directly and indirectly affects people, mediated by perception, experience, and social comparison (e.g., perceiving and evaluating one’s own building in comparison to the neighbor’s house). Perceptions and affective evaluations of concrete elements in the urban environment are feasible if reliable measurements from social science domains are applied (e.g., measurement scales for place attachment from the field of environmental psychology). However, combining measurements from people’s individual responses with the objective information on environmental characteristics of places is still rare (McCrea et al. 2011), particularly when their use should be of practical relevance for city development.

Consequently, the understanding of urban quality presented in this thesis follows a coupled perspective. Specifically, both the objective potentials of the physical and social environment and people’s perceptions, evaluations, and usage are included in the conceptualization of urban quality. Urban quality thus evolves from the interaction of these domains within particular spatial contexts. The coupled understanding of urban quality offered in this thesis shares similarities with the concept of urban quality of life presented by some scholars in human geography (Marans and Stimson 2011a; Pacione 2003).

Marans and Stimson explained it as the “quality of life (QoL), particularly as it relates to place” (p. 1). In this case, place means “the geography or environments of individuals and groups of individuals such as households, neighborhoods and communities,” whereas QoL is described broadly as “the satisfaction that a person receives from surrounding human and physical conditions, conditions that are scale-dependent and can affect the behavior” (p. 1). Consequently, Marans and Stimson pointed out that the “quality of any entity has a subjective dimension that is perceptual as well as having an objective reality” (p. 4).

The particular focus of this thesis is on the perceptual and evaluative aspects of urban quality. Thus, the terms urban quality and urban quality of life as described by Marans and Stimson (2011a) are applied synonymously throughout this thesis, referring to the same conceptual understanding, as illustrated in Figure 4.
To guide research on urban quality of life, Pacione (2003) suggested a theoretical framework. The framework entails five dimensions: spatial scale, indicator type, level of specificity, social group characteristics, and change over time. Indicator type refers to the choice of observable conditions of the urban environment (‘objective’) and people’s perception and evaluation of these conditions (‘subjective’), whereas level of specificity denotes the level of thematic detail of the applied indicators. For example, assessing the quality of a specific local bus service is more detailed than evaluating a person’s overall quality of life. Figure 5 illustrates the framework and is consequently used as a structuring rationale behind the chosen research procedure (see section 1.3).

Figure 5. Five-dimensional structure for research on urban quality of life [Source: Pacione 2003].
1.2.1.3. Space, place, and urbanization

Two important definitions are inherently linked to Marans and Stimson’s (2012a) work, as well as to Pacione’s (2003) framework. First, Marans and Stimson emphasized the significant role of place, whereas Pacione referred to the relevance of space and the spatial scale for urban quality. This work follows Pacione (2005) and Tuan (1977) in their understanding of the space and place concepts. Place is part of but different from space (Pacione 2005). Places are unique locations in space, notable for the regular activities of human beings occurring there. As they are sites of such activities, together with all elements that they entail, “places may furnish the basis of our sense of identity as human beings, as well as for our sense of community with others” (Pacione 2005, p. 28). Hence, space will eventually be transformed into a place as it acquires definition and meaning (Tuan 1977), for example, by people creating positive experiences in certain spatial environments. Moreover, considering the relation of human subjects and urban space, this work follows a reciprocal understanding. In Massey’s (1984) words, “just as there are no purely spatial processes, neither are there any non-spatial social processes” (p. 52).

Second, Pacione’s framework uses distinct concepts for the urban context and the process of urbanization over time. The process of urbanization can denote the physical growth of urban settlement areas (‘Verstädterung’ in German), whereas urbanization can also be understood as the “effect of the urban milieu on people’s lifestyles” (2005, p. 26) (‘Urbanisierung’ in German). However, both processes may occur simultaneously in the same spatial context and refer to different aspects of research on urban quality of life. Hence, this thesis makes use of the first concept, for example, by studying the effects of urban growth on people’s place relations.

1.2.1.4. User-centered theory of people-place studies

Urban environments are places or more precisely, “conglomerations of interrelated places,” (Pacione 2005, p. 29) and place qualities matter in their impact on human well-being (Marans and Stimson 2011a; van Kamp et al. 2003). Indeed, as Vischer (2008) argued, human behavior is obviously influenced by the built and natural environments in urban areas, “however, it is not determined by it” (p. 233). Her user-centered theory of the built environment emphasizes the need to study person-place relations distinctively from either environmental determinism or social constructivism. While the former assumes direct causal relationships between the urban environment and users’ behavior in space, the latter deems behavior solely as a result of the social context and norms, independent from the physical, environmental context in which it occurs (Vischer 2008).
Contrary to both extreme positions, the user-centered theory builds on the user’s experience in the urban environment, with mutually interactive effects. According to Vischer (2008), the experience with urban space provides information about the functional valuation of both the “product” (that is, how urban spaces affect human comfort, mediated by social and psychological factors) and the “process.” Thus, the evaluation of the urban environment (for example, by residents’ judgments) also inherently links to the processes of envisioning, developing, and managing it. Accordingly, this thesis aims at capturing both the quantitative assessment of specific quality aspects of the urban environment and the procedural implications for their future adaptation.

1.2.1.5. Measurement concepts of the urban quality of life

A conceptual approach to measuring the urban quality of life as perceived by residents comes from Fenster (2004). Her definition of urban quality uses three dimensions: comfort, belonging, and commitment. Comfort refers to the assessable degree of satisfaction resulting from the individuals’ experiences of the built and natural environments, whereas belonging describes the affective and cognitive aspects of persons’ place attachment. While some scholars consider satisfaction as an attitudinal measure of the urban environment (Francescato 2002), attachment is perceived as a comprehensive measure going beyond a mere affective response (Scannell and Gifford 2010). However, the distinction between “satisfaction and attachment rests more on empirical results than on a theoretical basis” (Giuliani 2003, p. 149) and both measures regularly appear highly correlated (Stoiser 2008). Finally, the dimension of commitment entails place-related engagement, describing behavioral consequences in response to place qualities, which are not the focus of this thesis. Consequently, this study applied both concepts of residential satisfaction and place attachment as response variables in separate models.

1.2.2. Residents’ perspectives on urban quality in Switzerland

Understanding the residents’ perspectives on urban quality is relevant to science and practice. As Francescato (2002) concluded, research on residents’ satisfaction and sense of place allows for detailed analyses of the urban characteristics contributing to the human quality of life in order to create conditions congruent with its inhabitants’ aspirations. Such analyses deliver meaningful insights, particularly when using “multivariate analyses to identify aspects of the residential environment more likely to predict residential satisfaction” (Francescato 2002, p. 19). Quantitative evaluations of residents’ judgments on their environmental
settings can be perceived as performance measurement aiming to evaluate the social effects of these environments (Marans and Stimson 2011a). Thus, such evaluations may provide empirical evidence on social effects, which remains lacking in many relations between specific urban characteristics and individuals’ responses (Krizek et al. 2009; Nguyen 2010) and which is still challenged by the multidimensional and reciprocal effects between the urban environment and human feedback.

In terms of practical implications, studying the influence of urban environmental characteristics and people’s perceptions of the urban quality may lead to the identification of current shortcomings and future options for practical interventions in urban space. Thus, the underlying demands for public action may be identified (Lu 1999). For example, obtaining evidence that safety in public space has a significant influence on residents’ well-being, combined with information on objective hotspots of safety threats in public space, may lead to further investigations on how to mitigate these dangerous aspects in the urban realm. At the same time, the nondeterministic and reciprocal relatedness of persons and places must be kept in mind when drawing inferences from such results.

Previous research on residential satisfaction and place attachment identified diverse influencing factors from three main categories (see e.g., Amerigo and Aragones 1997; Giuliani 2003; Lewicka 2011; Lovejoy et al. 2010; Marans and Stimson 2011a). The first comprises influencing factors from built and natural urban environments such as the residential density, distance to the next public transit stop, and amount of recreational green spaces. For example, the availability or accessibility of recreational green spaces was identified as a positive predictor of residential satisfaction (Bonaiuto et al. 1999). The second category consists of factors from the social environment such as the intensity of neighborhood relations, safety, and affordability of housing. For instance, Lewicka (2005) found evidence of a positive relationship between the intensity of neighborhood relations and residents’ place attachment. The third group of related factors entails human characteristics such as socio-demographic and psychological factors (e.g., age, attitudes, and personal standards of comparison). A brief overview on personal predictors was presented by Kahana and colleagues (2003), who reported the positive association between age and residential satisfaction, for example, which also held true for place attachment (Lewicka 2011).

Studies testing the influence of such factors from both objective environmental characteristics and residents’ subjective domains hardly exist in Switzerland, though such studies may be particularly meaningful in the current context of the
case study region, as the Limmattal was identified for its continuous lack of urban quality (Wissen Hayek 2013). Additionally, due to the currently intense urbanization process, many large-scale changes in the built environment and the social context of the city take place over a comparably short period (5–10 years). More detailed knowledge of the influencing factors may provide meaningful support in managing and evaluating these transformations.

The few previous studies in the Swiss context include work by Hunziker and colleagues (2008; 2010) on the human response to natural landscapes. Acknowledging both the objective landscape characteristics and individual perceptions, as well as the subsequent effects of landscape changes, the authors identified influencing landscape characteristics and social group differences and drew implications on the spatial scale’s influence on these coupled studies. According to Hunziker and colleagues, the smaller the spatial scope of a study region, the more significant it would become to include analyses of people’s perceptions, evaluations, and responses. The reason was that with smaller scales and more concrete development options, the study found greater differences in preference judgments among different social groups and between experts and laypersons. However, the study focused solely on natural landscapes in rural areas of Switzerland. Hunziker and colleagues concluded that “when focusing on the landscape development of small areas, such as single municipalities or neighborhoods, specific investigations will be needed, which will certainly be more reliable than (sole) expert evaluations” (2010, p. 41).

Previous work by Buchecker (2008) on agglomerations in Switzerland elaborated on people’s demands toward their local residential environment. The study revealed the people’s requirements that were relevant to their residential environment; however, these results remained on a general level (e.g., diversity, safety, and privacy), neither specific nor spatially explicit enough to divulge the relevance for the domains of urban planning. However, Buchecker emphasized the insufficient availability of knowledge about the residents’ requirements regarding their immediate urban surroundings. The study also called for additional insights into the “conditions under which residents are prepared to express their requests and ideas of enhancing their residential environment” (2008, p. 54), which referred to procedural implications and challenges, as outlined in section 1.2.3. Finally, Felber Rufer (2006) found that residents generally perceived different transformation rates of landscapes, such as slow or fast. Her qualitative study in four Swiss districts analyzed the public perception and evaluation of landscape changes. However, the author concluded that the transformation rate itself had no effect on the individual evaluation of a landscape change, which was rather
influenced by the perceived personal benefits of a change and in some cases, by symbolic functions of landscapes.

In essence, scientific approaches identified several influencing factors on residents’ urban quality of life. Such factors may refer to different spatial scales such as neighborhood, city, and region. Previous research predominantly used either measures of residents’ perceived quality aspects or objective measures for the urban environment. Studies on rapidly growing suburban regions in Switzerland are nonexistent. When considering the particular situation in the Limmattal region, empirical studies on specific beneficial versus adverse effects of urban growth are needed. Based on the aforementioned research gaps, the first guiding research question (RQ) is formulated as follows:

**RQ1:** How do context-specific factors influence the urban quality of life in a rapidly growing suburban region in Switzerland?

1.2.3. Integrated research on urban quality of life: procedural challenges

1.2.3.1. Methodological challenges for scientific procedures

When accounting for the integrated understanding of urban quality of life, research procedures have to include both dimensions: the “objective” characteristics of the physical and social urban environment (e.g., the built density, accessibility, and population characteristics), as well as the “subjective” perspective of place users such as residents. Objective refers to the environmental features that can be “observed and measured within the public domain through such properties as physical quantities and frequencies,” whereas subjective means the affective and cognitive domains that “exist only within the private consciousness of each individual, only verified through responses provided by the person concerned” (Cummins 2005, p. 700). Combined empirical studies are relevant because urban planning and design seek to impact the urban quality of life. However, as outlined in the previous section, empirical evidence is rare and combined analyses have mainly been theoretically conceptualized to date (Marans 2003, van Kamp et al. 2003).

The measurement and practical application of existing approaches using either objective indicators for urban quality or solely subjective assessments have shortcomings. For instance, rankings of cities according to indices of living quality (e.g., Mercer index) based on objective indicators have minimal implications for
rigorous decision making in urban planning domains and mainly focus on city marketing. On the other hand, simplified surveys’ outcomes on citizen satisfaction with urban living in general are often of little validity. Particularly, such satisfaction surveys implicitly assume an environmental determinism, that is, environmental changes may be fully reflected in satisfaction measures, which is an inadequate assumption (Francescato 2002).

There is a long tradition of empirical research on either objective characteristics or subjective perceptions and evaluations of urban qualities (objective: e.g., Savageau and Boyer 1993; Stover and Leven 1992; subjective: Dahmann 1983; Sirgy and Cornwell 2002), due to distinct disciplinary backgrounds. While the measurement of objective dimensions is rooted in domains such as urban engineering and spatial planning, the assessment of affective and cognitive perspectives is traditionally assigned to fields such as urban sociology and environmental psychology. However, research on urban design and spatial planning has often neglected measuring human responses, whereas the social science domains have mostly ignored the explicit spatial context as an influencing dimension. Using spatial information for the study of the objective and subjective perspectives on urban quality is particularly important, as their interrelation differs in the socio-spatial context. In turn, the availability of social concepts such as place attachment by spatial locations (i.e., as spatially explicit, digital maps) could then imply the usability of such data in urban planning and design domains, which had only been done occasionally in previous research (Brown and Raymond 2007).

1.2.3.2. Relevance for urban development procedures

Integrating residents’ perspectives on urban quality into the domain of urban development is necessary because citizen participation in urban planning is increasingly required in Switzerland (Rat für Raumordnung 2012). However, so far, participatory planning has often been limited to few engaged citizens, not fully representing the population perspectives. Hence, an appropriate legitimization is often missing. Additionally, information and interests discussed during participatory processes lack an appropriate integration into subsequent planning procedures. Using representative samples of residents’ perceptions and evaluations of urban characteristics may be a beneficial supplement to support citizen inclusion in urban development. In this context, Hölbling and colleagues (2006) argued that the structured inclusion of local residents’ perceptions in decision support could lead to significant increases in the acceptance of those spatial planning decisions. Nonetheless, such procedural aspects have not yet been elaborated for the Swiss context.
Urban quality of life is not only the result of diverse factors from the built, natural, and social environments; it is affected as well by the preferences and interests of different actors in urban space. For example, urban planning professionals, real estate developers, landowners, residents, and other stakeholders may define quality differently. Thus, trade-off situations occur in urban development processes, in which different perspectives on spatial development oppose one another. For the study context in Switzerland, Eisinger and colleagues (2013) emphasized the lack of procedural knowledge to guide the appropriate representation of these actor interests toward strategy building in urban design. They doubted whether the available literature on urban participation sufficiently reflected the complexity of influencing factors and actor perspectives and recommended a stronger role of scientific evidence to inform new collaborative formats of participatory processes.

In essence, the research to date has not yet provided an integrated approach for the quantitative assessment of objective and subjective evaluations of urban quality of life. A promising yet understudied aspect for this integration is accounting for the spatial context. Analyzing the spatial context has been ignored by most social science research to date. The inclusion of perspectives on urban quality from different actors may also contribute to higher degrees of acceptance of urban development. According to these methodological and procedural research gaps, the second RQ is formulated as follows:

**RQ2:** How can residents’ perspectives and spatial characteristics be integrated to inform urban development?

It is important to note that some of the procedural findings are drawn from discussing the implications of the four main research contributions in the concluding remarks chapter.

### 1.3. Research procedure

This thesis follows two guiding research questions as defined in sections 1.2.2 and 1.2.3. To answer these research questions sufficiently, a stepwise approach is chosen. It accounts for the diverse actor perspectives on urban space, different spatial scales, and measurement approaches, following Pacione’s (2003) guiding theoretical framework.
1.3.1. Procedural rationale

The procedure of this study followed three rationales. The first involved embedding the scientific research in the particular context of the study region. The second entailed proceeding from regional to local scales, that is, from a larger scope to smaller spatial units of study. The third dealt with representing experts’, stakeholders’, and residents’ perspectives on urban quality accordingly.

First, the research procedure started with a systematic analysis of the spatial context in the study region of Limmattal. This contextualization followed the theoretical rationale of solution-oriented research on real-world problems, for instance, as presented in the context of transdisciplinary (TD) case study research (Stauffacher and Scholz 2013). A theory of TD research procedures proposes to depart from a solid understanding and representation of a real-world problem, before even formulating research goals and subsequent research questions (Pohl and Hirsch Hadorn 2008). Consequently, a systematic analysis and experience of the current urban challenges in the Limmattal region included on-site observations and workshops with diverse regional stakeholder and planning experts. As outlined in Figure 6, the study started with an in-depth analysis of current strengths and weaknesses of the Limmattal region. As a result, the characteristics of the urban environment affecting the settlement quality and life quality in the region were identified and applied to generate regional development scenarios.

Second, the analyses proceeded from the regional scale level to the city and neighborhood scopes. Influencing factors on urban quality of life interrelate but also change with the spatial scale. Quality aspects at a particular spatial scale (e.g., the neighborhood) are nested in a larger context. Individual communities and their characteristics are nested within regional networks and region-wide, land-use patterns. Accordingly, neighborhoods are located within their surrounding city structures. Likewise, in the legal planning regulations of the study region, the more general policies for larger administrative units (e.g., Kantonaler Richtplan) define the framing conditions for specific local regulations in Limmattal.
Based on the findings from the first research phase, two focus group workshops were conducted. The workshops aimed at identifying relevant local factors that influenced urban quality. The first workshop was conducted with local city planning experts (N = 5) from the study region and focused primarily on the objective characteristics of quality in the urban environment.
During the second workshop, representative residents (N = 7) from the city of Schlieren identified key determinants of residential well-being with respect to perceived local qualities. As a result, the attributes identified in both focus group workshops were operationalized in a questionnaire.

A survey was conducted in the two communities of Schlieren and Dietikon, aiming at place-specific evaluations of existing local qualities. The residents’ responses were assigned a spatial reference, based on the household address of each survey participant. The objective spatial characteristics for the two communities were analyzed by using Geographic Information Systems (GIS) (e.g., accessibility, safety, and density values). The objective data and the residents’ survey responses were then analyzed in a combined statistical model. Residential satisfaction was used as the response variable for this analysis, whereas the subsequent analysis tested the concept of place attachment to assess the effects of socio-demographic factors and urban growth characteristics. Finally, distinct models for place attachment by neighborhoods aimed to identify spatial variations in the residents’ place relations.

Third, as argued in the previous section, several procedural challenges of facilitating urban quality of life are apparent, due to the diversity of influencing factors and actor perspectives. Accordingly, the first research phase on regional quality aspects started with a collaborative research setting that integrated the perspectives of stakeholders from urban planning and design. Their regional knowledge and professional expertise contributed substantially to the selection of impact factors and a sufficient spatial analysis. The next aim was to integrate the residents’ perspectives. Thus, the study first integrated knowledge from experts and proceeded to include the residents’ perspectives on the city and neighborhood scales.

1.3.2. Overview on the four main research contributions

The first research article (Chapter 2 of this thesis) identifies the impact factors relevant to urban quality for the Limmattal region and analyzes their intraregional relatedness. Based on these influencing variables, scenarios for the future development of the region are developed for the year 2030. Following the scenario generation, the collaborative process design is reflected to gain insights into future procedures of integrating multi-actor perspectives in urban development research.

The second research article (Chapter 3) presents the combined modeling of specific, objective spatial characteristics and the residents’ subjective assessments of their related influence on the urban quality of life. The GIS is used
to integrate both dimensions to calibrate structural equation models for a representative population sample from the two focus communities of Schlieren and Dietikon.

The third research article (Chapter 4) tests the particular influence of urban growth on the residents’ place relations on a city scale for a subsample of the community of Schlieren. This work applies the concept of place attachment as a response measure for the residents' perceived place quality, while also testing socio-demographic and objective housing factors as predictors. The demand for a spatially differentiated analysis of place attachment responses becomes apparent.

The fourth research article (Chapter 5) analyzes the spatial patterns of the residents’ place attachment on a neighborhood scale. The study answers the questions of how and why place attachment varies among neighborhoods in the city of Schlieren. Regression models for different yet statistically comparable neighborhoods are calibrated and the results of the analysis are displayed in maps. In turn, implications for urban planning domains are discussed, in terms of applying the digital map data of place attachment for monitoring the residents’ perspectives on urban quality.

Finally, the conclusion of this thesis (Chapter 6) summarizes the main findings and presents further implications for the design of future procedures in assessments of urban quality of life.
References


Introduction


2. Research article I - Identifying urban transformation dynamics: Functional use of scenario techniques to integrate knowledge from science and practice


Abstract

Many urban regions are exposed to rapid growth, leading to vast changes in land use with diverse ecological, socio-economic, and aesthetical impacts. Regional scenarios are suitable for identifying possible urban development patterns. However, one challenge of scenario construction is integrating the knowledge of both science and practice for a better understanding of the complex interactions between impact factors in the urban fabric.

The objective of this research is to enhance process design for a collaborative scenario analysis in the context of urban development. The scenarios are constructed for a case study of the Limmattal region, a suburban agglomeration close to Zurich, Switzerland, and we demonstrate a functional structure for science–practice collaboration within the process of scenario building. The types of communication between science and practice are systematically varied, which leads to four consistent scenarios for 2030.

Our analyses of regional system dynamics reveal the most important feedback loop among five impact factors within the region, which allows for a better understanding of the systemic interactions in regional transformation. This process design shows the potential to support knowledge integration in research processes involving science and practice, and assists informed planning strategies for urban transformation.

Keywords: Formative scenario analysis (FSA), Urban system transformation, Feedback loop, Science–practice collaboration, Knowledge integration, Regional dynamics
2.1. Introduction

The transformation of an urban region is a complex, real-world problem. Clear transformation goals for urban areas often remain ill-defined (Stauffacher and Scholz 2013) and research on such transformations must cope with interactions between human and environmental factors in a dynamic spatial system. Thus, new methodological approaches that support both science and practice in understanding the possible future development of the urban fabric are necessary.

Complex interactions are perceptible in suburban regions of agglomerations in Europe and worldwide (Gennaio et al. 2009). Despite significant local differences, suburban regions are characterized by land consuming settlement development with lower utilization densities. Spatial patterns in suburban regions have been debated intensively in the discourse on urban sprawl phenomena (Irwin and Bockstael 2007; Johnson 2001). Urban sprawl is associated with diverse environmental effects, such as the loss of green space, fragmented land-use divisions, and an increase in site distances, which, in turn, impacts transportation demands, resulting in higher energy consumption and traffic emissions (Wolf and Meyer 2010; Travisi et al. 2010). The expansion of urban space at its fringes poses further threats to the quality of life by increased social segregation, loss of local identity and the aesthetic degradation of landscape and architecture (Wissen Hayek et al. 2011; Schumacher et al. 2004).

These diverse social and environmental factors and the inherent uncertainties of spatial development exceed the abilities of traditional planning methods (Ratcliffe and Krawczyk 2011); therefore, decision-making in urban planning has to cope with diverging preferences and complex interactions, not only between stakeholder interests, but also between the aforementioned components of urban structure (Jepson 2004; Hogarth et al. 1980). A procedural challenge, Healey refers to as coping with the relational complexity of spatial transformation (Healey 2006). Her particular concern lies in adequate spatial conceptions and their subsequent prospective imaginations being articulated in strategic spatial planning.

Strategic planning frameworks attempt to complement a more coherent spatial logic in response to socio-spatial phenomena (Albrechts et al. 2003) such as resource protection, urban sprawl, meaningful land use regulations, and larger infrastructure investments. These phenomena may stretch beyond local or national administrative boundaries, interrelated within dynamic patterns of social and economic networks. Their spatial impacts and implications for place quality cannot be understood without taking into account the relationships between the
actual physical places, the interaction of actors, and the meaning given to the places (Healey 2007). Accordingly, this relational complexity must be reflected in processes of strategic spatial planning.

One way to achieve a better understanding of these complex interactions (e.g., unintended rebound effects of zoning policies and new suburban housing developments) is to facilitate meaningful representations of different scientific disciplines and specific knowledge by practitioners in urban planning and design in the research process on spatial planning (Brand et al. 2013). Transdisciplinarity makes this possible. It is a specific form of research setting in which actors from science and society collaborate in the common process of knowledge production (Stauffacher and Scholz 2013; Jahn et al. 2012; Häberli et al. 2001). As such, it follows the need to address complex, real-world problems from diverse knowledge domains, and facilitates capacity building and consensus formation (Scholz 2011). Taking into account the diversity of scientific and societal views on real-world problems, their integration (e.g., knowledge, interests, values) is the main challenge in such research approaches (Hadorn et al. 2008). Transdisciplinarity is distinguished from interdisciplinarity, which is defined as a mode of research that integrates concepts and methods of two or more disciplines but remains within the academic system (National Academy of Sciences 2005).

Gaining insights into the future paths of an urban region requires an integrated, comprehensive and systematic method (Ratcliffe and Krawczyk 2011; Marshall 1993). In this context, scenario development has evolved as a tool for effectively forming conceptions of an uncertain future (Godet 2000; van Notten et al. 2003; Chermack 2005; Kok et al. 2011). According to Fahey and Randall (Fahey and Randall 1998, p.6) “scenarios are descriptive narratives of plausible alternative projections of a specific part of a future.” Scenario techniques are distinct from other future-oriented projection methods (e.g., foresight, trend analysis, visioning) in their ability to integrate complexity and uncertainty. The use of scenario techniques in regional and urban contexts is relevant for modeling, planning, and learning about alternative spatial developments with inherent uncertainties (Petrov et al. 2011; Höjer et al. 2011; Walz et al. 2007; Fromhold-Eisebith et al. 2009; Kirchner-Hessler 2004). They also help to provide insights into the preferences and decision-making of urban and regional planning actors (Ratcliffe and Krawczyk 2011; Bügl et al. 2012).

Research on scenario techniques has made substantial contributions in the form of structured typologies and methodological frameworks (van Notten et al. 2003; Börjeson et al. 2006; Wiek et al. 2006; Scholz and Tietje 2002). However, further
methodological enhancement is required for systematic procedures that integrate different knowledge domains of practice and science (Kowalski et al. 2009) and for adequate formats for scenario communication (Kowalski et al. 2009; Mahmoud et al. 2009).

Only recently, the integration of stakeholders in scenario development was reviewed by Wangel (Wangel 2011), emphasizing the need to explicitly reflect the shaping role of key actors in scenario studies. Zegras and Rayle (2012) examined how scenario planning is able to enhance science-practice collaboration in a regional planning context for Portuguese cities, and their contribution focused on collaboration effects for participants in a pre- and post-test experimental design. Yet the methodological formats to facilitate such a collaborative scenario process have not been in focus. In fact, Reed et al. (2013) pointed out the importance of structured information flow as a success factor in multi-actor scenario studies. More precisely, structural guidance for eliciting and aggregating information from participants and the provision of information to participants is demanded (Reed et al. 2013). However, a systematic procedure guiding communication intensity and format is missing, and thus one focus of our study. Our first research question is as follows:

[1] How can we integrate knowledge for regional scenario building in a collaborative research process among disparate actors from science and practice?

Understanding regional transformation requires a profound system analysis before strategies can be defined, because urban regions are complex and dynamic systems par excellence. Within urban systems, we find a multiplicity of interrelated feedback loops (Forrester 1969), and their detection and interpretation allow for a better understanding of the adaptive potential and vulnerable impact structures in the case region (Le et al. 2012). Insights into system feedback loops to enable complex system understanding can be considered a “key component of sustainability learning” (Scholz 2011, p.439). Previous research provides evidence for the misperception of feedback principles as individuals tend to interpret contexts as causally linear (Sweeney and Sterman 2007); however, individuals can learn to perceive and understand feedback loops. Meaningful representations of circular feedback loop models (e.g., verbal, graphical, numerical) can promote such learning processes (Scholz 2011; Schaffernicht 2010). Nevertheless, we did not find a case application that integrates the identification of regional feedback loops during scenario analysis. In fact, Burt (2007) argued for further development of system analysis techniques within the scenario methodology to reveal systemic
sources of discontinuities and disruptive events in future system states. We aim at a better understanding of the interdependent feedback relations in the case region, together with stakeholders. Thus, our second research question asks:

[2] How can we reveal major internal dynamics in the form of intraregional feedback loops in a collaborative scenario analysis?

Revealing feedback loops is one thing, but making the knowledge and insights from a scenario analysis accessible to all involved is another challenge. Providing adequate scenario formats for communication and interpretation is particularly relevant when disparate stakeholder groups are involved (Celino and Concilio 2010). Storylines are an established format in scenario analysis, and comprehensible language and a clear structure are essential when illustrating relevant characteristics of scenarios effectively (Walz et al. 2007). Specific terminology from different scientific disciplines and practice domains, including urban planning, transportation, social work, landscape architecture, and real estate development, must be presented in a consistent and comparable format (e.g., aspects of topography, infrastructure, settlement identity, urban design). The interrelation of socio-spatial characteristics on different spatial scales demands a representation that integrates implications beyond the originating scale. However, we could not find a storyline format for scenario communication in the context of urban and regional planning. Therefore, our third question is the following:

[3] How can we describe scenarios with multi-scale information for territorial futures enabling interpretation and communication between scientists and practitioners?

In essence, this paper presents a collaborative process scheme for scenario analysis in the field of regional development. We contribute to the current discourse on coping with relational complexity in the context of regional transformation strategies. We obtained our results from a research project that aimed at developing quality indicators for future urban living environments in the Swiss Limmattal region (cf. Section 2 of this research article).

This paper is structured as follows: we (i) provide information on the case study area and (ii) the applied functional-dynamic scenario methods. We then (iii) describe the resulting impact factors, elements of the system feedback loops, and the format for scenario presentation. The results are (iv) discussed with regard to the value and innovative potential of the implemented approach and in light of
current research on spatial scenario techniques. We then (v) raise implications for future research and practice options before concluding.

2.2. Case study area

The collaborative scenario analysis is carried out for a case study of the Limmattal region, a suburban settlement belt in the agglomeration of Zurich, Switzerland. The Limmattal is selected as a typical suburban region that Schumacher and colleagues describe as “a miniature of Switzerland” (Schumacher et al. 2004, p.232). The term suburban refers to the urban territories situated at the fringes of, and in-between, the core cities with their compact appearance. Particularly, in the Western European context, these urban areas have been described ambiguously as Zwischenstadt (Sieverts 2004), an element of urbanscape (Eisinger and Schneider 2003), postsuburbia (Borsdorf 2004), and the sprawled periphery (European Environment Agency 2006). One common ground of these concepts is a lack of the characteristic traits of the traditional compact European city; while at the same time representing urbanity as a form of life, independent from certain territorial boundaries. Implications for planning in these urban areas are debated controversially. Without dissent, though, is the demand for improving the quality of life in these settlements.

Suburban spaces are both the result and driver of urban development processes with unintended effects. The negative effects of urban sprawl are directly perceptible in the reduction of environmental quality, cultural heritage, and quality of life (Wissen Hayek et al. 2011; Schumacher et al. 2004).

This holds particularly true for the Limmattal region, which is comprised of 15 communities, all situated along the Limmat River. The region extends over 24 km between the cities of Zurich and Baden, and has an area of 18561 hectares with about 165,210 inhabitants and 117,949 employees (as of 2010) (Statistical Office Canton Aargau 2010; Statistical Office Canton Zurich 2010). In the network of Swiss cities, the Limmattal region has an important position as the western gateway to Zurich (Eisinger and Schneider 2003; Oswald et al. 2003). Due to its topography, it is one of the major growth corridors for the expansion of the largest city in Switzerland.

As Fig. 1 illustrates, the landscape is both dominated and fragmented by an extensive, (inter-) nationally significant infrastructure in the form of linear transport axes. It is characterized by a patchwork of land uses, such as residential neighborhoods, industrial areas, shopping centers, and areas for nonproductive
industries, as well as agricultural areas of vineyards, fields, pastures, forests on tops of hills, and natural areas along the river (Schumacher et al. 2004). Current urban development is affected by high rates of new inhabitants (+ 12,200; meaning + 10% from 2000 to 2010) (Statistical Office Canton Aargau 2010; Statistical Office Canton Zurich 2010), comprised of 32.6% non-Swiss citizens compared to the average of 22.4% in all of Switzerland (Swiss Federal Statistical Office 2010). With lower (but rising) land prices and rental rates for housing and office space, compared to the central areas of Zurich, the region currently attracts migration from Zurich and other regions, and is characterized by a high number of commuters. The region provides important spatial, economic, and social buffers, as well as recreational and ecological capacities for the core city of Zurich.

![Figure 1 Location of the Limmattal region within the agglomeration of Zurich. (Source of base map: Swisstopo, 2011)](image)

The structure and development pattern of the Limmattal region are comparable to other European regions. We considered regions to be comparable according to structure (e.g., orographic or legal growth concentrations in suburban growth areas; patchwork structures situated along major transportation axes) and the current development patterns challenged by sprawl phenomena (e.g., growth in population, jobs and subsequent mobility demand, net migration gains, growth in built-up areas, rising land prices). According to the structural analyses carried out...
by Borsdorf (2004) and the European Environment Agency (European Environment Agency 2006), we found suburban settlement patterns around Florence in Italy, around the city of Luxembourg and in the southern development axis of Vienna (along Vösendorf), in Austria to have similar characteristics. This also holds true for the southern axis of Gothenburg, Sweden, along the Mölndalsån River (Enhörning 2010), and for the outskirts of Tallinn, in Estonia and of Bratislava, in Slovakia as further examples (Kasanko et al. 2006).

2.3. Methods and procedural concept

2.3.1. Formative scenario analysis

The formative scenario analysis (FSA) was introduced by Scholz and Tietje (2002) and builds on a systematic, impact factor-based procedure, while fully acknowledging intuitive contributions. Within the category of systematic-formalized techniques (Kosow and Gaßner 2007), the FSA does not build on probability calculations. This distinguishes comparable systematic approaches such as cross-impact analyses (Weimer-Jehle 2006) from the FSA, which can further be distinguished from scenario techniques such as trend extrapolation and creative-narrative techniques following the method typologies by Kosow (2007). Trend extrapolation techniques strongly depend on quantitative data sets and mainly support projections of single future states; however, they often neglect interactions. Methods from the category of creative–narrative techniques emphasize intuitive logic with less formalized but creative approaches.

The FSA was chosen because, first, it allows the analysis of direct variable impacts and internal scenario consistency in matrix based approaches. Therefore, the relational complexity of influencing factors in an urban region can be analyzed. Second, the FSA particularly supports the exploration of possible and plausible states with multiple alternative futures, in contrast to narrow trend predictions. And third, the FSA allows for the combined integration of qualitative and quantitative information.

The FSA procedure originally consists of nine steps in four phases (i–iv) as illustrated by Fig. 2. The goal & scope formation (Fig. 2, steps 1.1–1.2) is the initial stage (i) of the process, in which the functional goal and the spatial and temporal system boundaries are determined, defining the context that is addressed with the scenario study (Walz et al. 2007). During the system analysis (ii) the current system properties are represented by a set of impact factors \(d_i (i = 1, ..., F)\). These impact factors (also referred to as descriptors) are defined (Fig. 2, step 2.1) as decisive
system elements that influence current and future system behavior and are likely to impact other elements (Spörri et al. 2009).

With the formation of an impact matrix, the assessment of direct mutual impacts among the defined factors is carried out, resulting in ranks for activity and sensitivity (also named passivity) (Fig. 2, step 2.2). A thorough analysis of the resulting activity and passivity ranking is done (preferably) with graphic representations, such as a system grid (cf. Appendix) and system graph. Visual representations of direct impacts allow further understanding of the dynamic potential and structure of the examined system (Fig. 2, step 2.3). We integrated a loop analysis of critical system dynamics into the FSA to identify the logic of system feedback loops between two or more impact factors (Fig. 2, step 2.4).

Following the final selection of a sufficient set of impact factors, (iii) the actual scenario construction starts with the definition of future levels for each impact factor (Fig. 2, step 3.1). Each impact factor is described by at least two discrete levels. A level \( n_i \) can be either quantitative or qualitative. Assuming that impact factor \( d_i \) represents energy consumption per capita in the Limmattal region, we assigned three possible future levels: \( d_i^1 = 1 \) for a strong reduction in the individual

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**Figure 2** Procedural steps in formative scenario analysis [adapted from 35]. Variations in type and format of communication between science and practice from the perspective of the academic team (Trtuneyt and Stauffacher 2012).
energy usage of 31%; level \( d^2_i = 2 \) for a solid reduction of 19%; and \( d^3_i = 3 \) for rather low decrease of 3%. The formal description of a resulting scenario \( s \) is a specific, consistent combination of levels \( n \) for a full set of each impact factor \( d \) (Scholz and Tietje 2002). In equation (1), \( k \) is the total number of scenarios, while \( F \) denotes the number of impact variables.

\[
\mathbf{s}_k = \left( d^{n_1}_i, ..., d^{n_j}_j, ..., d^{n_F}_F \right)^T
\]

Scenario construction and selection in the FSA contains the calculation of internal consistency for all level combinations. Internal consistency refers to the selection of only logically possible scenarios. Our scenario selection followed a concept-driven, top-down procedure (Scholz and Tietje 2002), where we first created future narratives for the Limmattal region based on qualitative inputs from a group of practitioners and discussions among the scenario analysts. The produced scenario narratives were then described by the set of impact factors and their respective, previously chosen levels, followed by a formal assessment of their internal consistency (Fig. 2, step 3.2). Similar to the impact assessment, the consistency analysis draws upon a matrix approach, and for all of the impact factors, each specific combination of future levels is rated according to its logical consistency. In the final phase (iv), the scenario interpretation, results are described by qualitative storylines in a structured form and interpreted collaboratively by scientists and practitioners (Fig. 2, step 4.1). The interpretation and communication of the scenarios were performed using a functional perspective and were facilitated in a moderated group workshop (Fig. 2, step 4.2).

2.3.2. Systematic science–practice collaboration in scenario development

The scenario study was carried out jointly by a research group consisting of scientists from the disciplines of landscape and environmental planning, social sciences and architecture, and the practice actors representing urban designers, investors, and representatives of public authorities from the case region. The actors in science and practice that participated in the three workshops are shown in Table 1. The practice actors were invited according to the degree that they are affected by or are able to affect the research topic due to their professional background, as well as their possible regional knowledge.
Table 1. Overview of participating actors from science and practice during scenario workshops I, II and III.

<table>
<thead>
<tr>
<th>Workshop I (N = 15)</th>
<th>Workshop II (N = 24)</th>
<th>Workshop III (N = 28)</th>
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<tbody>
<tr>
<td><strong>Science-Practice interaction</strong></td>
<td><strong>Science-Practice interaction</strong></td>
<td><strong>Science-Practice interaction</strong></td>
</tr>
<tr>
<td>5 urban designers from established architecture offices; 9 scientists: Modeling group of 5 disciplines (architectural-, environmental-, transport-, and economic modeling, and environmental decision-making) interested in the scenarios as input for spatial modeling systems;</td>
<td>6 representatives of authorities (Federal administration, Canton of Zurich, City of Schlieren and Dietikon); 2 representatives of regional planning associations (Zürcher Planungsgruppe Limmattal (ZPL), Limmattalbahn); 2 representatives of small and medium enterprises conducting projects in the Limmattal in the sectors infrastructure planning and building technology;</td>
<td>4 urban designers from established architecture offices; 6 representatives of authorities (City of Zurich, Baden, Dietikon and Schlieren); 1 representative of regional planning associations (Limmattalbahn); 2 representatives of small and medium enterprises conducting projects in the Limmattal in the sectors infrastructure planning and real-estate development;</td>
</tr>
<tr>
<td>1 moderator / process observer</td>
<td>1 scientist focusing on the analysis of the Limmattal’s spatial structure and potentials;</td>
<td>1 scientist focusing on the analysis of the Limmattal’s spatial structure and potentials;</td>
</tr>
<tr>
<td>12 scientists: Modeling group of 5 disciplines;</td>
<td>12 scientists: Modeling group of 5 disciplines;</td>
<td>12 scientists: Modeling group of 5 disciplines;</td>
</tr>
<tr>
<td>1 moderator / process observer</td>
<td>1 moderator / process observer</td>
<td>1 moderator / process observer</td>
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Each procedural step of the FSA method has a specific and adequate type of communication (Fig. 2), which depends on the goal of the individual steps throughout the research process. Hence, a functional-dynamic approach is used, as introduced by Kruetli and colleagues (Kruetli et al. 2010) and Stauffacher and colleagues (Stauffacher et al. 2008). We distinguish three major types of communication (Fig. 2), namely information, consultation, and collaboration. These types vary in the directional flow of information (Trutnevyte and Stauffacher 2012), intensity of commitment, and formats for interaction. Information describes a unidirectional flow of information, such as when academics inform practitioners about the scientific procedures applied and findings obtained. An example is when practitioners are informed about the calculation of feedback loops that were conducted entirely by the research team.

By consultation, we also refer to a form of one-way communication, in which practitioners contribute their specific knowledge. This is the case when stakeholders report on the strengths and weaknesses of the case region to the academic team. Collaboration is a bi-directional type of communication of the process and common findings. It includes binding commitments, such as the jointly defined goal and guiding questions of the scenario study.
These three types of communication varied throughout the scenario procedure. During the phases of goal and scope formation, and in the early steps of the regional system analysis, the analysts relied on the integration of knowledge from regional practice actors (Fig. 2, Steps 1.1–2.1). In order to form relevant perceptions of future urban developments, a common guiding question was jointly accepted in the workshop; therefore, the type of communication used was collaborative. The common guiding question reads:

What are plausible regional qualities of the Limmattal region in 2030 and 2050 with regard to the following areas:

- urban and architectural design
- the aesthetics and perception of public space
- the adaptability, flexibility and possibility of spatial conversion
- ecological sustainability
- social sustainability
- economic productivity requirements of a society based on services and knowledge?

During the second workshop, the participating practitioners conducted an analysis of strengths, weaknesses, opportunities, and threats (SWOT-analysis; Hill and Westbrook 1997; Milgram et al. 1999). In addition to the workshop format, case encounters in the region were carried out among the participants to improve the understanding of the regional impact factors on-site. Based on the outcomes of the SWOT-analysis, we determined regional impact factors in five major domains for structuring the descriptors: politics, economy, society, technology, and environment (P-E-S-T-E). The definition of impact variables benefited from consulting the practitioners to contribute to crisp variable definitions. This first set was further evaluated and reduced by scientific experts with regard to its sufficiency and validity for representing the regional system (Fig. 2, steps 1.2 and 2.1). With the reduced set of 18 factors, an analysis of direct mutual impacts (4-point ordinal scale from 0 = no direct impact at all to 3 = strong causal impact) was carried out by five scenario analysts. The set of impact factors then was concentrated to 11 factors (d₁–d₁₁) in order to maintain a manageable degree of complexity (Appendix Table 1).

Communication during the later stages of the system analysis phase was mainly characterized by procedural information provided from scientists to practice partners (Fig. 2, steps 2.2–2.4). This procedural information contained basic information on applied methods and planned timeframes, such as that used for the
analysis of feedback loops and the expected format of the results. The phase of scenario construction started with a consultation of the practitioners on the suggested definitions of future levels (Fig. 2, step 3.1). During the scenario analysis and selection, a more intense consultation proved to be useful for collecting the stakeholders’ feedback on the scenarios’ plausibility and contextual relevance (Fig. 2, step 3.2–3.3). During the final phase of the scenario interpretation, the participants from academia and practice collaborated on the semantic profiles of the storyline details. The results and possible practice implications of the scenario study were then discussed in a large group workshop (Fig. 2, steps 4.1–4.2).

2.3.3. Revealing crucial system dynamics

In order to cope with the relational complexity of urban systems and their future dynamics, insights into feedback loops are considered important (Scholz 2011). We analyzed system feedback loops through the direct mutual effects between two or more impact factors. A feedback loop can be defined as a causal, unidirectional relationship between at least two impact factors in a system; therefore, it represents a circular causality (Le et al. 2012). Within the logic of the FSA, a feedback loop is given whenever an impact factor influences other factors affecting back on the first one.

For the loop analysis, we calculated the frequency of loops in each impact relation between factors that were part of a single loop. The analysis differentiated among loop classes for impact factor relations, and was carried out with standard system analysis software extended by a feedback analysis module (Tietje 2010). The maximum length of loops included in the analysis was $r = 7$, as longer loops were assumed to have a weaker impact (Tietje 2010). Loops were calculated based on the direct impact strengths of the descriptors used to identify the most important loop, which was defined as the loop whose impact relationships were involved in the highest number of other loops (Tietje 2012).

We define a feedback loop $L$ with a length $r$ when it combines $r$ different impacts $v_i$ ($i = 1,...,r$). With every single impact $v$, the number $q$ denotes the frequency of loops that contain the impact, and we calculate the mean number $\bar{q}(L)$ of all impacts in the loop $L$. We focus our analysis on the most important loop $L_{mi}$, which can be described as the loop that entails the highest $\bar{q}$ of all loops $P$ in the system (see Equation 2).

\[ \bar{q}(L_{mi}) = \max_{L \in P}(\bar{q}(L)) \]
2.3.4. Guiding scenario interpretation with multi-scale narratives

When a scenario analysis is used to identify territorial futures, the choice of spatial scale matters, and a storyline format for a scenario communication in the context of urban and regional planning demands a meaningful representation of socio-spatial characteristics and their implications beyond the originating regional scale. Therefore, we constructed scenarios on a regional scale. Graymore et al. (2008) argued for the regional scale as the most appropriate scale for learning about sustainability criteria in strategic planning and assessment. This type of scale allows for identifying preferences, values, and future expectations, which form crucial factors in urban transformations (Coelho et al. 2010; Grimm et al. 2008). However, a regional scale level is embedded in a hierarchy of multiple scales.

Relational impacts from and to other scale levels, such as the national or the supranational level, can be considered as exogenous factors. Such factors (e.g., the economic development in Switzerland and Europe) can significantly affect regional development; therefore, the interaction among scale levels was acknowledged twofold. First, to ensure consistency with current national and European scenarios, two recent scenario studies were taken into account: (i) the scenarios developed by the European Spatial Planning Observation Network (ESPON) at the European level (ESPON 2006); and (ii) the “Scenarios for sustainable settlement and infrastructure development in Switzerland 2005–2030” (Perlik et al. 2008). The overall logic of the superordinate scenarios was acknowledged within the descriptor set, whereas the variables had to be defined according to the specific conditions at the regional level. Second, small-scale developments on a municipality level were covered with the initial SWOT-analysis.

In order to illustrate the Limmattal region as it might be in 2030, we complemented the multidimensional, but rather abstract, scenario table (Appendix Table 1) with qualitative scenario storylines. Three major dimensions were chosen to compare scenario storylines across scales and to facilitate communication among different scientific disciplines and with practitioners.

The first dimension describes functional characteristics, which are essential for illustrating the situation of a region (Soja 2009). Thus, the scenario descriptions start by specifying the functional area and the role of the Limmattal region in Switzerland. Each alternative situation in the year 2030 is explained with regard to inter-/national relationships, functional associations, connectivity, dynamics of development, predominant societal values, culture of planning (e.g., participative and cooperative), and the community structure.
The second dimension depicts place qualities. The quality of a place is affected by the interplay of existing physical entities, their perception through diverse actors, and by a mix of governing regulations on different spatial scales (Healey 2006). Bölling and Christ decode place qualities according to networks, spaces, and places (2006) in the discourse on the Zwischenstadt concept. Oswald and colleagues (2003) present knots, relational flows, and boundaries as essential entities in their theoretical conceptualizations on the Netzstadt. Kurath (2011) argues that the lack in place qualities, for instance in the urbanscape of Switzerland, is a result of an insufficient transfer of these “ideal-world” planning concepts into applicable “real-world” interventions. A meaningful format to communicate characteristics of socio-spatial futures should, therefore, address different related layers of intervention into place quality. Such intervention layers integrate the urban environment on different spatial scales including region, town, and parcels. They should also include policy and actor aspects, pointing to possible sets of planning instruments. The categories Structure, Gestalt, and Form, outlined by Schaefer (2011), provide our basic structure for the scenario presentation according to the idea of interventional layers:

- We interpret structure as determined by topographical patterns, the allocation of land uses and land use densities (zoning), and the infrastructure systems. Interventions are guided by spatial and infrastructure planning on the regional scale.
- Gestalt comprises the culturally perceived qualities of villages and city districts and their potentials for transformation on the city or district scale. This transformation potential is given, for instance, by the reserves of building zones. Communal and district plans are possible instruments for intervention.
- Urban design, architecture, and the design of open spaces generate a physical form, which makes objects and ensembles spatially characteristic and recognizable. It has historically evolved and refers to the local scale with small-scale interventional plans.

A meaningful representation of future regional qualities requires not only considering the physical environment and its interaction with perceptions of actors and policy interventions at a variety of scales, but also to cover all dimensions of the urban quality of life (Pacione 2003). Thus, the third dimension includes the specific social, economic, and environmental potentials of the region, and addresses them in the scenario storylines. The described potentials entail the quality of living conditions (a mix of social milieus and their place attachment); the attractiveness of the business location (specified by local public infrastructure,
economic structure, functional mix, and synergies of value chains); and the quality of ecosystem services (ecological and recreational connectivity, biodiversity, options for recreation, and options for identification).

2.4. Results

In the following section, we first present the main outcomes of the application of formative scenario analysis in systematic science–practice collaboration. We then present the most important feedback loop in the regional system. Finally, we conclude the results section with structured regional scenario outlines.

2.4.1. Regional impact factor assessment

Fig. 3 depicts the resulting system grid of the impact analysis (Appendix Fig. 1) including mean values for the activity and passivity of the variables. It shows the culture of planning and planning instruments as active impact factors with disproportionately high activity scores and relatively lower passivity rankings. The culture of planning has the highest impact on the case system, which is given by the ratio of the activity and passivity scores. We identified a cluster of ambivalent regional impact factors with disproportionately high activity and passivity. These are economic and demographic development, relatedness to place, transport infrastructure, and density of uses, of which economic development showed the highest activity scores. Although they are highly sensitive, ambivalent impact factors strongly influence other system elements; therefore, ambivalent factors show high system embeddedness.
Figure 3. FSA system grid of direct variable impacts. Dotted lines indicate the mean value of activity and passivity ratings. Active variables score activity ratings above average of all variables, whereas the passivity rank is below average; passive variables are impacted by other variables and score passivity ratings above average, while the activity rank is below average. Variables above or below average in both activity and passivity sums are labeled ambivalent and buffering variables, respectively (Scholz and Tietje 2002).

Three impact factors have disproportionately high passivity and relatively low activity scores. Social structure, spatial appearance, and energy efficiency are passive, although energy efficiency is the most reactive system element. The realization of optimal energy demand and supply patterns is strongly influenced by the diverse characteristics of other system elements, such as the demographic development, density of uses, or transport infrastructure.

The remaining group of eight impact factors shows below average activity and passivity. System factors such as community structure, ecological connectivity, and segregation are buffering factors, each of which has a low to moderate influence on the system. They can be considered to be stabilizing the system.
2.4.2. Crucial system dynamics in the region

As illustrated in Fig. 4, the most important feedback loop spans the factors of demographic development, social structure, transport infrastructure, community structure, and spatial appearance, relating again to demographic development. It describes a core process of socio-spatial interaction that can either be positive, thus reinforcing the system dynamics in the Limmattal region, or negative, predicting a stabilizing characteristic for the region. Demographic development is assumed to be the emanating factor, which is strongly driven by further extra-regional impacts, such as immigration into the greater Zurich agglomeration, its economic development, and the housing market. Alteration in the regional demographic development of the Limmattal region determines the social structure of the population in the case region.

Figure 4. Most important system feedback loop. Displayed are direct impacts ≥ 2. Color of impact factors indicates factor type according to activity (left number) and passivity (right number) scores. Colors of loop relations indicate frequencies of loops involved in this impact conjunction. The loop whose impact conjunctions are involved in the highest number of other loops is considered the most important loop in terms of the system’s internal dynamics.
Behavioral patterns of mobility choices are impacted by changes in the social structure. This can lead to differing modal splits, which set the demands on transportation infrastructure, and changes in transportation infrastructure affect the community structure. Steering mobility flows and planning future transportation infrastructure exceeds the boundaries of single communities, such as regional commuter flows or the financing of major investments in transportation infrastructure. Such region-wide characteristics of transportation infrastructure demand the common engagement of communities, and they enlarge the need for concerted planning among communities. Combined with common operating institutions and possible cost efficiencies in region-wide operations, the need for concerted action can trigger changes in community structure, such as the amalgamation of communities.

Currently, an integrative process among communities can be observed in the Limmat region with the possible amalgamation of the communities of Killwangen and Spreitenbach in 2015. With significant changes in community structure, the spatial appearance of the region in terms of the functional and visual quality of the quarters is affected. A modified community structure will result in differing political and planning foci with subsequent spatial development interventions (e.g., zoning). Ultimately, the overall spatial appearance influences demographic development by attracting more (or less) migration from outside the region.

2.4.3. Scenario descriptions

The four resulting scenarios are presented here with their key characteristics. The scenario “Character City” (i) presents the Limmat region with a strong identity, achieved through a clear sequence of attractive centers and a mix of contrasts in land uses and architecture. Traditions are preserved and current transformation dynamics are deployed as opportunities. In the scenario “Smart City,” (ii) the Limmat region is positioned as a clean-tech pioneer. It is characterized by the highest possible energy efficiency through high densities of services and short distances, the implementation of cutting-edge technology in buildings, open spaces and transport infrastructure, and an optimal, attractive modal split infrastructure design. The market steers the development in the scenario, “Pure Dynamic,” (iii) resulting in a fuzzy mix of commercial areas, settlements, green spaces, and transport areas, without creating a character specific to the Limmat region, as there is no overall regional development concept. “Charming Valley” (iv) presents the region as a human-nature ecosystem with a strong interpenetration of a dense city with small-town values in a modern form, and a productive and
resource-rich landscape. In this scenario, the region is characterized by a robust and cross-linked system of green spaces, which guides settlement development.

The storylines depict four different foci of possible transformations in the region, emphasizing design, technological, economic, or ecological aspects. Within those possible transformation states, the role of planning interventions is assumed to differ significantly. At the level of the most active variable, culture of planning (d₁) the scenarios can be distinguished from the intense cooperation among planning actors and high levels of participation in the Character City scenario, to no cooperation among communities in the market-driven Pure Dynamic scenario. The intense cooperation among the communities in the Character City scenario is reflected by a full amalgamation of the current communities. The level of the impact factor, community structure is described as one administrative unit called Limmattal City.

The full amalgamation of all existing communities describes a radical yet possible shift in administrative structures, which would also be realized in the Smart City scenario. The development towards a highly innovative clean-tech region would require bundling the community structure (e.g., financing and spatial capacities) for the highest energy efficiency in dense suburban structures. In the scenarios Pure Dynamic and Charming Valley, the existing 16 communities would remain as they are currently.

The Charming Valley scenario describes a future state in which a well-balanced human–environment ecosystem leads the overall development of the valley. A new light rail train, the Limmattalbahn, then plays one crucial role in the system’s characteristics. Significant development projects in the regional transportation infrastructure are also assumed for Character City and for Smart City in particular. For the Pure Dynamic scenario, further investments into public transport would be low.

Transportation infrastructure and community structure, as identified elements of the most important feedback loop (Fig. 4), are factors within the loop on which planning can have a direct influence. However, the effects of such planning interventions remain subject to the influences of further factors, and remain to be discussed.
2.5. Discussion

In the following section, we first discuss the procedural findings to integrate knowledge for scenario building among actors from science and practice. Second, we interpret our results for the regional impact dynamics in the Limmatatal region. This includes reflecting on the most important feedback loop identified. Third, we consider the value of the presented structuring of scenario narratives.

2.5.1. Science–practice collaboration in scenario building: procedural orientations

There is a vibrant discourse on how territorial scenarios can represent spatial complexity in a meaningful way by integrating knowledge between actors from science and practice (Ratcliffe and Krawczyk 2011; Zegras and Rayle 2012; Reed et al. 2013). We extend the current discussion by presenting a functional-dynamic approach for the scenario development and analysis process. During this process, we alter (dynamic aspect) the type and format of communication according to the aim of the respective process step (functional aspect). We postulate that applying the presented approach eases the collaboration and advances meaningful representations of knowledge sources for scenario construction. Our approach leads to more transparency, and clarifies, which knowledge from whom should be taken up during which phase of the scenario process. A clarity in roles and responsibilities of science and practice actors, which was also found by Eames and Egmose (2011), who present a five-phase procedure of community foresight. They conclude that a key success factor of their procedure is the “clear distinction over the respective roles and responsibilities of the different participant groups, which recognized and valued the differing knowledge and expertise of those involved” (p. 778). In providing systematic guidance on the information flow and collaborative intensity, our presented scheme goes beyond other applications of formative scenario analysis observed thus far (Bügl et al. 2012; Gurung and Scholz 2008). The approach may be suitable to alter the commitment among the different disciplines and practice actors.

A systematic evaluation of the beneficial effects has yet to be carried out. Currently, our first evaluation builds upon personal process experiences and feedback given at the end of the scenario project, and points in a positive direction: stakeholders welcome the greater clarity about what is expected from them and how their input was taken into account. For future research, we suggest a systematic evaluation to be carried out in a comparative study between different types of process guidance for scenario development.
The resulting scenarios are seen as a socially robust outcome (Scholz 2011), able to attract societal consensus on future development. The choice of practitioners that participated in the study should, however, be considered critically. In line with Wangel (2011), we observed the relationship between the choice of participants and the outcomes of scenario analysis; both the process and its result depend on their backgrounds of knowledge, values, and goals. Thus, the potential consensus might not be fully realized. Yet the participants certainly could profit from the exercise by gaining an improved insight into the relational complexities of the case. The degree to which this kind of scenario study facilitates capacity building among key practice partners within the region has yet to be understood.

We interpret scenario planning as a learning space to explore plausible future states of regional development. Meissner and Wulf (2013) recently examined cognitive impacts of scenario planning on framing bias and decision quality. In contrast to Meissner and Wulf, who conclude that scenario planning may increase the decision quality, we ask for caution when observing scholars claiming scenario analysis as a tool for direct decision support. From our perspective, scenario techniques are suitable to facilitate the process of opening up for future orientations, for example, between practitioners and scientists. Thus, we emphasize that the formative (“forming”) capacity of the chosen scenario approach is heuristic only.

2.5.2. Interpretation and reflection on regional impact dynamics

In this research work, we first identified a set of 18 impact factors according to their activity and passivity within the Swiss Limmattal region. In addition, based on the outcomes of the regional system analysis, we presented the most important regional feedback loop.

Although the factors of planning instruments and the culture of planning are both active system elements, the culture of planning showed the highest impact strength of all factors in the analysis. The factor of economic development had the highest activity scores, whereas energy efficiency was the most reactive system element. In addition, we found ambivalent factors such as demographic development and transport infrastructure with high activity and passivity levels (above average). These highly embedded factors suggest that regional development in the Limmattal region is driven by economic and demographic development. This rather obvious finding is supported by previous research
describing economic and demographic development as the crucial driving forces of regional urban development (Batty 2008; Rounsevell et al. 2006).

It is essential to ask in which way regional development can be influenced by planning interventions. Although economic and demographic development are not steerable directly, Friedman (2005) emphasized the influence of the culture of planning. In line with Keller (1996) regarding differences in the culture of planning, we observed disparate planning cultures, expressed in preferences for zoning regulations, and the weighing of possible interventions to reach future states, within our workshop series. In contrast to Keller and colleagues, the culture of planning is understood in a wider context in this study. It refers to the form and level of collaboration and participation of planning actors, and further involves the mode by which meaningful planning instruments are applied. We postulate that with a more concerted culture of planning across municipal and disciplinary boundaries, actors will be more likely to affect the spatial appearance of the whole region.

Based on the outcomes of the regional system analysis, we identified the most important feedback loop. Aiming at a better understanding of feedback relations in the case region, our results demonstrate that we can initiate feedback thinking together with stakeholders. Feedback loops, reinforcing or balancing, are major drivers of development throughout cities (Button 2002). Within the method used, the polarity of feedback loops is not included, since polarity refers to the positive (reinforcing) or negative (stabilizing) character of the loops. Polarity may deliver important qualitative information about the loop effect on the originating factor and, hence, back on the system itself. However, Kim (1995) points to a major weakness when analyzing the polarity of feedback loops. It does not answer which loops are most dominant.

The most important loop represents the main loop for the system’s internal dynamic, and the loop’s importance can be described as the intensity of the relational embedding within the system. In fact, Tietje (2012) argues that the number of loops passing through an impact depicts the intensity of the feedback; however, detecting the most important loop should be clearly distinguished from the overall functioning of the system, as other important loops exist. These other important loops can be as crucial for the functioning of the system as the most important one (Tietje 2012). Still, it is essential to retrieve loops by importance to facilitate the stakeholder discourse.
The nature of feedback loops implies a significant time lapse until impacts occur, which creates a challenge in communicating the implications of loop findings to regional stakeholders and decision-makers. Our graphical representation of system dynamics proved to be useful, particularly to represent the most important loop. However, we observed very controversial perceptions of the presented loop by the participants. While some practice actors agreed on the usefulness of the feedback loop with respect to learning about current regional dynamics, others questioned its applicability to specific local contexts. We critically emphasize the sensitivity of the loop factors over time as they reflect the internal dynamics perceived today. Future changes in the region (e.g., a major disruptive event) might lead to significant changes in the relationship of activity and passivity scores, or the overall composition of the set of relevant variables.

In our study, the most important loop appears among the five variables: demographic development, social structure, transport infrastructure, community structure, and spatial appearance. Our findings describe a mechanism of socio-spatial interrelatedness, and we interpret this mechanism as an additional systemic driver of sprawled and fragmented land use patterns in suburban Switzerland.

Demographic development has already been identified as a major force in shaping regional transformation. With a population growth of 10% between 2000 and 2010 (Statistical Office Canton Aargau 2010; Statistical Office Canton Zurich 2010), and the number of jobs at +40% from 1985 to 2005, the social structure within the valley has changed significantly (ZPL 2012). Not surprisingly, transport infrastructure solely offers the potential for direct interventions by urban and infrastructure planning. The mode of transportation has, without doubt, been found to be associated with regional settlement structures (Travisi et al. 2010); although, the interpretation of impact causalities between transport infrastructure and fragmented land use patterns remains circular. Still, we can argue that interventions in the transport infrastructure will impact regional development either towards more concentrated and compact or towards disperse and fragmented structures.

Our loop findings now demonstrate that besides the obvious effects, we can expect additional systemic relationships in community structure and spatial appearance back at demographic development. Changes in community structures in Switzerland are common in the form of community amalgamations (Jeanneret 2010), which influence the spatial appearance of a region, as planning nuclei and spatial clustering (e.g., zoning) occur in a new administrative framework. The
question of place quality would then be debated in a different administrative and spatial context. Yet, the interferences among different scale levels on feedback loops are still subject to further research.

In essence, with the analysis of the most important feedback loop, we observe a representation of the relational complexity that goes beyond direct or indirect variable impacts on place quality in the Limmattal region. Our procedure highlights the necessity for integrating such representations into strategic planning processes for urban regions. This type of procedure is in line with Sieverts (2004), asking to better incorporate the plurality of factors and their interrelatedness for a rearticulation of regional development strategies.

The reflection of the most important feedback loop aims at a better understanding of systemic forces for transformation within an urban region. This illustrates the idea of an “urban transformation involving a host of factors operating over a long period of time” (Pacione 2005, p.50). Feedback loops point actually to such long-term developments. In his theoretical reflection on urban origins Pacione refers further to the essential roles of “social stratification and individual and group decision-making underlying the complex reality of the transformation” (Pacione 2005, p.50). We find the social stratification represented in the most important feedback loop with our variable social structure. Individual and group decision-making are in our view represented as inherent process characteristics in the interaction of all loop elements, referring to the central role of the diverse actors in urban transformation.

Within our transdisciplinary research setting we jointly develop orientations on urban futures among a group of actors from science and practice. Our findings substantiate thus the theoretical concept of useful knowledge in urban geography brought up by Pacione (2003), who describes academic research alone as no longer sufficient to provide orientation for transformations of the contemporary urban environments (Pacione 2003, p.29). In fact, both the integration of feedback thinking and the collaboration of science and practice in a transdisciplinary research process can be understood as an essential step towards meaningful representations of the urban realm.

2.5.3. Reflecting on adequate formats for communicating spatial scenarios

With research question 3 we raised the issue of presenting territorial scenario narratives in a consistent and systematic manner. The guiding dimensions of Structure, Gestalt, and Form integrate functional and quality characteristics with
information across scales. By this, we are able to describe the future images of a region, representing their relational implications beyond the regional scale. Structure depicts the level of spatial planning on the regional scale; Gestalt focuses mainly on the district and quarter level; and specifications of Form address architectural design on a project or parcel level. Our resulting scenario format eases the translation of qualitative narratives into spatially explicit data formats required as input for extensive spatial modeling systems. Thus, it offers not only an interface to practice, but also to other scientific disciplines that can join the scenario process for more in-depth analysis of regional interrelationships. The involved practitioners emphasized the usefulness of the format to compare the scenarios; however, we clearly acknowledge the need to systematically evaluate the impacts of communication with different scenario formats.

2.6. Conclusions

Scenario development in an urban region shows the potential to support coping with relational complexity and actor diversity when asking for guidance on possible future developments. We demonstrated a scenario procedure with a functional-dynamic cooperation among actors from science and practice. This approach allows for knowledge integration and the construction of a common representation of plausible future system states. By analyzing feedback loops, we deepened system understanding with an explicitly relational component and opened up discourses on adapting hidden loop dynamics in a region. We postulate that the analysis and mutual interpretation of important feedback loops with regional stakeholders can enhance feedback thinking during the scenario study. It, therefore, is a means to generate better strategies to cope with the relational complexity of spatially explicit systems in urban planning. However, the expected time lapses within feedback loop dynamics and their interference with different scale levels have yet to be analyzed. The dimensions of Structure, Gestalt, and Form offer a consistent and clearly structured format for presenting scenario narratives, and ease translation into quantitative descriptors for further urban system modeling. Whether or not the transformed societies described in the scenarios are desirable and probable has to be the subject of further analysis; therefore, it must be reflected critically when scenario analysis is presented as a tool for direct decision support. From our perspective, scenario techniques are suitable in facilitating the process of opening up for future orientations between practitioners and scientists. Thus, our presented scenario approach should be regarded as heuristic only.
Acknowledgments

This work is part of the "SUPat — Sustainable Urban Patterns" project, which is funded by the Swiss National Science Foundation’s National Research Program (NRP 65) “New Urban Quality” (http://www.nfp65.ch), Research Grant: 406540-130578. We are grateful to the numerous stakeholders for their active participation, reflections, and valuable input throughout the scenario study. We acknowledge the valuable input given by Olaf Tietje (Systaim) on the analysis of feedback loops and by Adrienne Grêt-Regamey (ETH Zurich, PLUS) and Roman Seidl (ETH Zurich, NSSI) on earlier versions of this work. We would also like to thank the three reviewers for their very constructive comments that significantly helped to improve this paper.
### Appendix A. Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life

<table>
<thead>
<tr>
<th><strong>Current State</strong></th>
<th><strong>Character City</strong></th>
<th><strong>Smart City</strong></th>
<th><strong>Pure Dynamic</strong></th>
<th><strong>Charming Valley</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture of planning (d1)</td>
<td>Medium level of public participation; poor collaboration with other communities</td>
<td>Higher level of public participation; cooperation within/good connections to other communities</td>
<td>Medium level of public participation; good collaboration within/connections to other c.</td>
<td>Medium level of public participation; no cooperation within the community</td>
</tr>
<tr>
<td>Community structure (d2)</td>
<td>16</td>
<td>Limmat City</td>
<td>Limmat City</td>
<td>16</td>
</tr>
<tr>
<td>Economic development (d3)</td>
<td>117'949 Employees1</td>
<td>138'000 Employees1 (Growth: +17%)</td>
<td>138'000 Employees1 (Growth: +17%)</td>
<td>138'000 Employees1 (Growth: +17%)</td>
</tr>
<tr>
<td>Population development (d4)</td>
<td>165'210 Inhabitants2</td>
<td>196'600 Inhabitants3 (Growth: +19%)</td>
<td>196'600 Inhabitants3 (Growth: +19%)</td>
<td>196'600 Inhabitants3 (Growth: +19%)</td>
</tr>
<tr>
<td>Life style groups (d5)</td>
<td>Life style diversity, market driven</td>
<td>Dynamic life style diversity, steered by planning</td>
<td>Dynamic life style diversity, steered by socio-economic market drivers</td>
<td>Dynamic life style diversity, steered by planning</td>
</tr>
<tr>
<td>Segregation (d6)</td>
<td>Mixed society within the valley, rather separated within the community, separated in building blocks and buildings</td>
<td>Mixed society within the valley, separated within the community, building blocks and buildings</td>
<td>Mixed society within the valley, separated within the community, building blocks and buildings</td>
<td>Mixed society within the valley, mixed within the community, mixed in building blocks, separated in buildings</td>
</tr>
<tr>
<td>Energy efficiency (d7)</td>
<td>Reference year</td>
<td>BFE Scenario III4 (-19%)</td>
<td>BFE Scenario IV4 (-31%)</td>
<td>BFE Scenario I4 (-3%)</td>
</tr>
<tr>
<td>Local identity (d9)</td>
<td>No own character</td>
<td>Developing a strong own character</td>
<td>Developing no own character</td>
<td>Developing a strong own character</td>
</tr>
<tr>
<td>Ecological connectivity (d10)</td>
<td>Poor connectivity across the Limmat and poor regional connectivity</td>
<td>Connectivity is enhanced but bad on a regional level</td>
<td>No active enhancement of connectivity</td>
<td>Optimal on regional level</td>
</tr>
<tr>
<td>Density of uses (d11)</td>
<td>Core centers Utilization Factor (UF) = 1.21 Living areas Utilization Factor (UF) = 0.55</td>
<td>Moderate densification in core centers; mild densification in living areas; higher multifunctionality</td>
<td>Moderate densification in core centers; high multifunctionality in living areas; high multifunctionality</td>
<td>Moderate densification in the core centers; higher multifunctionality</td>
</tr>
</tbody>
</table>

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6. Personal communication with Patrick Schirmer on zonings densities in the Canton Zurich, EU project SustainCity (http://www.sustaincity.org).
Figure A1 Impact matrix: Direct impacts of each variable on individual system variables (rounded means of all rating scores); ratings are based on a 4-point scale (0 = no causal impact at all; 1 = low causal impact; 2 = medium causal impact; 3 = strong causal impact).

Appendix B. Supplementary data

For the full scenario descriptions, which are provided as supplementary material to the online version of this research article; please see: doi: 10.1016/j.techfore.2013.08.030
Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life

References


Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life
3. Research article II - Mediating effects between objective and subjective indicators of Urban Quality of Life: Testing specific models for safety and access

Published as: von Wirth, T., Grêt-Regamey, A., Stauffacher, M. (2014). Mediating effects between objective and subjective indicators of urban quality of life: testing specific models for safety and access. Social Indicators Research, 1-22; doi:10.1007/s11205-014-0682-y

Abstract

Enhancing the urban quality of life (QoL) is an explicit policy goal of many countries, yet it is rarely studied using models that relate objective measures of the urban environment to the subjective evaluations of residents. It thus often remains unclear how planning interventions in the urban environment may influence residents’ satisfaction with their living conditions. In particular, during periods of significant urban growth, such as those recently observed in Switzerland, which result in diverse, unwanted threats to the local QoL (e.g., loss of green spaces, traffic congestions, and fear of crime).

This study uses data from a sample of 1,693 residents that participated in a postal survey about urban QoL. The responses were combined with objective attributes of residential conditions, using geographic information systems. Structural equation models were calibrated to examine the direct and indirect effects of important indicators of urban QoL, namely safety in public spaces and access to central urban facilities. The study sheds further light on the mediating effects between objective characteristics and subjective evaluations that influence the urban QoL.

The results showed predominantly low correlations between objective characteristics and subjective evaluations of urban QoL, which confirmed the findings of the few previous studies on this topic. Surprisingly, this study also found a strong link between objective access and perceived accessibility. This relation was explained by the spatial scope of the study region and suggested that the scale discordance theory should be tested in future research. The findings implied that variations in objective measures do not reliably represent differences as evaluated by residents.

Keywords: Urban quality of life, Structural equation model, Safety, Accessibility, GIS, Switzerland
3.1. Introduction

This research article examines the mediating effects between important indicators of urban quality of life (QoL). Currently, examining QoL predominantly concerns life in cities: more than 50% of the world’s population now reside in urban areas (WHO and UN Habitat 2010). Residents’ satisfaction with their urban living environment significantly contributes to QoL (Marans and Stimson 2011; Sirgy and Cornwell 2002; Davis and Fine-Davis 1991; Campbell et al. 1976), in combination with the satisfaction gained in other aspects of life, such as health, relationships, employment and material wealth (Cummins 1996; Sirgy 2012).

Research on urban QoL has encompassed several notions, such as the happy city, neighborhood satisfaction and residential well-being (Ballas 2013; Sirgy et al. 2008). Well-being is often expressed as the composite of affective components, such as pleasant emotions and satisfaction with preferences in major life domains (Diener 2006). Hence, a person’s well-being is based on subjective experience, whereas QoL usually refers to both the external “objective” circumstances and the person’s “subjective” perception and evaluation of these external characteristics, including their bidirectional relations. Consequently, Cummins concluded that “any comprehensive estimate of QoL must comprise both, subjective and objective measures” (2005, p. 700).

Few empirical studies have investigated the interplay of both influences (Liao 2009; McCrea et al. 2006), which predominantly confirmed previous findings of generally weak relationships between objective conditions and subjective QoL in other life domains (Evans and Huxley 2002). However, a recent study by Oswald and Wu (2010) suggests the opposite. This place-specific analysis found a significantly high correlation between measures of objective and subjective human well-being across the US. These contradictory empirical findings indicate the need for additional research, particularly on place-specific QoL.

This study presents an empirical analysis of urban QoL in a rapidly growing region in Switzerland. It combines measures of the objective urban environment with the subjective evaluations of residents in a disaggregated manner. That is, the study applies structural equation models that make parsimonious use of few important predictors of urban QoL; safety in public spaces and access. In doing so, the study seeks to enhance the understanding of the variable interplay in order to contribute to differentiated inferences for urban policy strategies.
3.1.1. Current state of research on objective and subjective indicators of urban QoL

There is growing agreement in the scientific literature that objective and subjective measures are necessary in studying the QoL in places. Likewise, policy implications for enhancing QoL (e.g., in a deprived urban neighborhood) should also consider both dimensions (Cummins 2000; Liao 2009). Their related constellation has already been acknowledged in early theories on QoL. In a seminal work on welfare and QoL in (Western) Germany, Zapf (1984) distinguished four combinations between the objective living conditions and their subjective perception by individuals. Zapf combined dichotomous categories for the objective conditions (i.e. good conditions vs. bad conditions) and the individuals’ perception (i.e. positive evaluation vs. negative evaluation) resulting in four states. For example, the ‘dissatisfaction dilemma’ describes a state of dissonance, wherein individuals perceive their living conditions as relatively bad, whereas objective measures indicate the opposite. In contrast, individuals reporting positive evaluations of their current state of life, although they adapted to rather poor objective environmental conditions may be satisfied, whereas objectively privileged persons may be dissatisfied (Noll 2002). In fact, Campbell et al. (1976) already pointed to the dilemma, that similar environmental conditions are evaluated differently by individuals. Consequently, informed urban policy making should reflect these distinct QoL states supported by empirical research findings.

The empirical research to date has provided scant, inconsistent findings from studies that tested objective and subjective indicators of urban QoL. On the one hand, there is evidence for low to no correlations between objective and subjective measures of QoL in general, and of urban QoL in particular (Evans and Huxley 2002; McCrea et al. 2006; Liao 2009). The studies emphasized that immediate inferences made from changes in objective conditions (e.g., of the urban living environment) on subjective QoL (e.g., improvements in residents QoL) are not appropriate.

Liao (2009) found only a few significant correlations between objective indicators and subjective perceptions in seven life domains of metropolitan and country areas in Taiwan. The findings of this study indicated that variations in objective QoL across counties do not reliably depict QoL differences, as perceived by the residents, although the results showed consistency in the domain of environmental quality. It is suggested that more detailed studies (e.g., disaggregated to few
specific measures) of the relationship could further explicate the interplay of objective and subjective measures (Liao 2009).

McCrea et al. (2006) presented an empirical analysis of urban QoL in an Australian study region. The study jointly used objective and subjective indicators in a structural equation model and confirmed the hypothesized relationships. Weak relationships (i.e., low magnitude of coefficients) were found between measures of objective access and subjectively perceived access and between objective density, cost of housing, and a broad measure of perceived overcrowding. The objective measures explained little variance in perceived access and overcrowding. The study identified limitations in omitting important predictors known to influence urban QoL, such as crime and safety. In addition, McCrea et al. used a broad measure for perceived overcrowding in a large-scale study region in Australia. However, the patterns of relations between objective and subjective factors may significantly differ in a more densely populated, smaller scale setting in Western Europe.

A recent study by Oswald and Wu (2010) yielded contrasting results. It found that the relation between subjective assessments and objective measures of QoL was indeed meaningful. The study used a subjective life satisfaction measure to show the same “pattern of QoL as previously estimated from solely non-subjective data” (p. 576). This place-specific study found a significant high correlation ($r = 0.6$) between objective and subjective human well-being across the US, based on place amenity effects. Oswald and Wu concluded that subjective measures of QoL offer “genuine information about the quality of human lives” (p. 579).

A study by Angur et al. (2004) also found congruence between objective and subjective predictors of residents’ QoL in their neighborhood. The objective measures (e.g., percentage of vacant homes in the neighborhood) were significantly related to residents’ satisfaction with their homes in general and with the perceived security against crime. The findings showed a statistically significant degree of correlation, however, the objective variables were less strongly associated with overall neighborhood quality than were the subjective variables.

Because of the partly conflicting findings of previous studies, the question of the relation between objective and subjective factors remains unresolved. They imply the need for additional research—particularly in place-specific QoL—that focuses on specific domains instead of broad, hence unspecific, categories. Thus, the present study examines their relations as predictors of urban QoL by using the...
particular factors of safety in public spaces and accessibility to services and facilities.

These dimensions were selected according to the optimal centrality theory (Archibugi 2001; Cicerchia 1999) and the theory of city size (Bettencourt et al. 2007; Batty 2013). The optimal centrality theory describes the relation between the beneficial effects of urban centrality (e.g., easy access to services, facilities, opportunities) and the unwanted, negative aspects of central urban locations (e.g., overcrowding, safety issues, social exclusion by higher land prices). The theory postulates that the trade-off between the benefits of “city effect” and the costs of “urban load” can be maximized, which would then describe a preferable state of urban size and result in a maximum of net benefits to urban QoL. Similarly, in their theory of city size, Bettencourt et al. (2007) identified both the benefits and unwanted consequences of urban scale, such as increasing crime rates with increasing city size. Thus, in the present study, accessibility is a measure of the benefits of urban growth, and (threats to) safety in public spaces is a variable representing unwanted cost effects.

Safety in public space (also referred to as security) was found to be an important predictor of urban QoL (Sirgy 2012). There is evidence that lack of safety is adversely correlated with the QoL of residents (Michalos and Zumbo 2000). However, the way safety in public space is measured often varies across studies. Many studies of public safety have not accounted for different sources of threats, such as crime, traffic accidents, unattended dogs, and poor roadway infrastructure (Loukaitou-Sideris 2006). Safety in public urban spaces is particularly related to the threats perceived by pedestrians and cyclists. Hence, Loukaitou-Sideris found two main sources of perceived threats in crime and traffic accidents (i.e., pedestrian/cyclist—automobile crashes). The only study that examined the relationships between objective crime data and subjective feelings of safety was carried out by Lee and Marans (1980) in the metropolitan area of Detroit. However, they used safety as a factor in order to understand scale discordance as one explanation for weak relationships between objective and subjective measures. Moreover, other scholars measured safety in public spaces either objectively, such as by the rates of reported crimes in a neighborhood (Loukaitou-Sideris et al. 2001; Giles-Corti and Donovan 2002) or by subjective perception (Kitchen and Williams 2010; Michalos and Zumbo 2000).

While the lack of safety in public spaces is considered associated with urban dissatisfaction and stress, the accessibility to important services and facilities in the urban realm (e.g., access to public transportation, shops, gastronomy, schools)
was found to be a key amenity, contributing significantly to residents’ satisfaction with their urban environment (Talen 2002; Sirgy and Cornwell 2002; Rogerson et al. 1989). Although it is a complex concept, many studies have measured accessibility using either the objective distance or the perceived proximity to such services and facilities. Recently, Zenker et al. (2013) confirmed that “access to central services in cities” was the strongest predictor of satisfaction in a sample of German agglomerations. However, their approach to an index of city satisfaction was built only on the perceived, self-reported ratings of residents and did not integrate them with objective measures. McCrea et al. (2006) found a significant but weak relationship between objective access and the accessibility ratings perceived by residents in the Australian study region.

Despite the previous research, statistical models that include objective measures and perceived attributes for safety in public spaces and access do not yet exist. Consequently, McCrea et al. emphasized the importance “to continue to develop research designs that explicitly seek to investigate the links between the objective measures and the subjective evaluations of the urban environment” (2011a, p. 85).

3.1.2. Rationales and hypotheses for this study

This study analyses the mediating effects of specific objective and subjective indicators of urban QoL. An effect of mediation occurs when a factor (i.e., in this study, the subjective evaluation) accounts for the relation between an explanatory variable (i.e., the objective urban conditions) and a criterion variable (i.e., urban QoL). Mediation analysis helps to clarify “how or why such effects occur” (Baron and Kenny 1986, p. 1176). Mediating factors can influence urban QoL on different geographical scales. For example, the geographical scale of reference might be the local neighborhood, the city, or the regional scale. However, satisfaction with the urban environment in these different spatial domains were found to be correlated (Sirgy and Cornwell 2002; Lu 1999; Campbell et al. 1976). Because of this interrelatedness, urban QoL might also be seen as a composite of neighborhood, city and regional satisfaction (McCrea et al. 2011b), which, consequently, is utilized in this study.

In modeling urban QoL by using both objective characteristics of the environment and subjective measures of individuals, two different entities of study have to be combined. That is, the objective conditions refer to the characteristics of places, while the subjective survey ratings refer to individuals. Measurements of the former are often based on spatial units of reference (e.g., a neighborhood or city zone), whereas the latter refers to a household in which the individual lives. Each
survey participant can be identified by a distinct place locator based on the households’ address. Geocoding by geographic information systems (GIS) makes this possible. When the household location of a survey participant is defined, other spatial information can be linked to that location, such as the distance to important urban facilities (e.g., station, shops, and school). The individual’s location can also be related to other geocoded information, such as the population census and building register. Hence, the use of GIS permits the integration of survey data with objective spatial information (Marans and Stimson 2011).

This study tests the relational paths between safety in public space and access to predict urban QoL. In this analysis, seven structural relations are hypothesized in order to gain better understanding of how access to services, as a measure of urban centrality, and safety in public space are mediated by subjective perception in their influence on urban QoL (see Fig. 2, which illustrates the structural and measurement models and displays the hypotheses given below in the form of arrows). The path model not only estimates the intensity of relationships between the objective and subjective measures but also tests the effects of mediation by the subjective measures of access and safety. Hence, the following hypotheses are proposed (Table 1).

**Table 1 Hypotheses for this study**

<table>
<thead>
<tr>
<th>Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1</strong> Higher objective access significantly predicts higher subjectively perceived access.</td>
</tr>
<tr>
<td><strong>H2</strong> Higher objective threats to safety significantly predict lower subjectively perceived safety.</td>
</tr>
<tr>
<td><strong>H3</strong> Higher subjectively perceived access significantly predicts higher subjective urban QoL.</td>
</tr>
<tr>
<td><strong>H4</strong> Higher subjectively perceived safety significantly predicts higher subjective urban QoL.</td>
</tr>
<tr>
<td><strong>H5</strong> Objective access is significantly correlated with objective threats to safety.</td>
</tr>
<tr>
<td><strong>H6</strong> The relationship between subjective urban QoL and objective access is mediated by subjective access (i.e., there is no significant relationship between subjective urban QoL and objective access).</td>
</tr>
<tr>
<td><strong>H7</strong> The relationship between subjective urban QoL and objective threats to safety is mediated by subjective safety (i.e., there is no significant relationship between subjective urban QoL and objective safety).</td>
</tr>
</tbody>
</table>
3.2. Methods

3.2.1. The study area

The analysis was carried out in the Limmattal area, a suburban settlement belt in the agglomeration of Zurich, Switzerland. Extending over 24 km along the Limmat River, it is one of the major growth corridors in the expansion of the largest city in Switzerland. The particular study region consists of two municipalities, Schlieren and Dietikon, as shown in Fig. 1. Combined, these municipalities comprise an area of 1,582 ha including 41,942 inhabitants and 31,365 employees as of 2012 (Statistical Office Canton Zurich 2013).

![Figure 1 Map of the Limmattal region in Switzerland. Spatial dispersion of survey respondents' household locations. Source: Swisstopo 2010](image)

The study area was selected as a typical suburban region that is described as “a miniature of Switzerland” (Schumacher et al. 2004, p. 232) characterized by a patchwork of land uses in a polycentric suburban form. The municipalities are growing rapidly in terms of population and workplaces. Between 2007 and 2012, the population increased by 5,692 or 15.7 %, compared to the average increase in Switzerland of 5.9 % during this period. Current forecasts expect the population to
increase by 7,000 inhabitants (17 %) until the year 2025 [ZPL 2012]. The regional economy is dominated by service industries (e.g., the media, logistics and health care sectors) and a few remaining manufacturing sites. The number of jobs is also projected to increase significantly from 31,365 (2011) to 37,000 (18 %) until 2025 [ZPL 2012].

With lower (but rising) land prices and rental rates for housing and office space, compared to the central areas of Zurich, the region currently is attracting migration. The share of non-Swiss citizens is 42.7 % (in 2012) compared to the average of 23.3 % in Switzerland [BfS 2013]. The study region also provides important spatial, economic, and social, as well as recreational and ecological capacities for the core city of Zurich. Regional growth currently results in pertinent land consumption and intense urbanization. Former industrial sites are now being transformed into new, large-scale housing areas. The rising demand for mobility, which has resulted in increased commuting and leisure traffic, has led to unwanted effects (e.g., noise emissions and traffic congestions). In response, urban planning in the region currently aims at compact city development with further densification in central zones. The current urbanization has been accompanied by debates about safety in public spaces, which have been publicized in the local media (e.g., on crime incidents). However, the causes underlying the interplay of objective safety and the subjective feeling of safety remain unclear.

In short, the rapid growth in the study region poses considerable challenges in the diverse aspects of the local and regional QoL.

3.2.2. Sampling procedure

Data were obtained through a survey on urban QoL conducted between May and July 2013. A representative sample of residents aged 18 years and older living in the study area was randomly selected from the citizen register by applying a stratified random sampling for the equal representation of women and men. The questionnaire was distributed to 5,500 residents of which 1,699 completed and returned them. The response rate was thus 31 %, and the response sample was representative of the population in the study region.

The socio-demographic, household and housing characteristics of the sample suitably fit the population census data as of 2011/2012 (see Table 2). However, respondents had a higher median age, showed higher levels of education and were more likely to be Swiss citizens. The sample is also spatially representative of local subunits, such as administrative city districts.
Table 2 Sample description and comparison with population characteristics

<table>
<thead>
<tr>
<th>Variable (unit)</th>
<th>Survey sample 2013</th>
<th>Census*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage female of those aged 18 and over</td>
<td>51.4</td>
<td>49.2</td>
</tr>
<tr>
<td>Median age of those aged 18 and over [Years]</td>
<td>49</td>
<td>43</td>
</tr>
<tr>
<td>Percentage born in Switzerland</td>
<td>57.5</td>
<td>54.3</td>
</tr>
<tr>
<td>Percentage with Swiss nationality</td>
<td>69.5</td>
<td>57.2</td>
</tr>
<tr>
<td>Percentage with a Master degree or post-graduate qualification</td>
<td>10.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Percentage with mandatory high school degree as qualification</td>
<td>19.5</td>
<td>14.7</td>
</tr>
<tr>
<td>Average household size [Persons]</td>
<td>2.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Percentage of car free households</td>
<td>20.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Median of net dwelling area [in m²]</td>
<td>93</td>
<td>78</td>
</tr>
<tr>
<td>Percentage of dwellings that are single detached houses</td>
<td>10.2</td>
<td>7.6</td>
</tr>
<tr>
<td>Percentage of dwellings that are multiple apartment houses</td>
<td>79.3</td>
<td>71.7</td>
</tr>
<tr>
<td>Percentage of households renting (vs. owning) of those aged 18 and over</td>
<td>72.4</td>
<td>74.1</td>
</tr>
</tbody>
</table>

* Census Data from the following sources: BFS 2013; Statistical Office Canton Zurich 2013

3.2.3. Selection of measures

In order to determine the urban QoL attributes that are currently relevant for the population in the study region, we first conducted a thorough literature review on urban QoL predictors. Second, two focus group workshops were carried out with local city planning experts (N = 5) and with residents (N = 7) from the study region. The workshops aimed at identifying the relevant factors that influence the urban QoL in the local and regional context. Applying the personas technique (Grudin and Pruitt 2002), the first workshop focused primarily on the objective characteristics of quality in the urban environment. The participating experts collected and discussed concrete attributes that contribute to a high level of urban QoL and determined which factors have limiting effects on the QoL. The resulting set of attributes contained the following dimensions: safety, density of utilization, accessibility and connectedness of functions, amenity values of public spaces, compactness, and clarity of urban design.

During the second workshop, key determinants of residential well-being were explored based on a stepwise procedure. Participating residents were asked first to describe their residential needs with respect to urban QoL; second, the concrete attributes that contribute to their satisfaction with the current urban environment were identified; third, participants noted future attributes that might contribute to their residential well-being. In addition, residents ranked the attributes according to their importance. The resulting set of attributes describing residential well-
being included the following: safety in public spaces, quietness/absence of noise, places for and quality of interaction (e.g., with neighbors), places and sense of belonging, proximity to services and functions for necessities, and accessibility to green spaces and recreation areas.

The attributes identified in both explorative workshops were operationalized in the paper-and-pencil questionnaire. Further dimensions that were found to be important predictor variables in the literature review on urban QoL were added (e.g., building aesthetics and affordability of housing).

3.2.4. Measured variables

The paper-and-pencil questionnaire collected the subjective assessments of survey respondents on diverse aspects of urban QoL. It covered urban QoL with satisfaction measures on four spatial scales and satisfaction with seven life domains (not reported here). Measurement scales also included a six-item place attachment scale, residential and household variables as well as socio-economic variables. All variables used for this study are shown in Table 4 in the “Appendix”.

3.2.4.1. Subjective variables

The latent variable urban quality of life was measured using three manifest variables. First, the item regional satisfaction was based on the question: “In general, how satisfied are you with the region you are living in?” Residents answered according to a ten-point scale from 1 = very dissatisfied to 10 = very satisfied. Second, the item satisfaction with city asked residents how satisfied they were with “the city you are living in.” Answers were also measured on a ten-point scale from 1 = very dissatisfied to 10 = very satisfied. Third, the item neighborhood satisfaction was based on responses to the question “In general, how satisfied are you with your neighborhood?” which were also measured on the ten-point scale from 1 = very dissatisfied to 10 = very satisfied. The ten-point scale was chosen to guarantee the coherence of the measurement scales with the Statistics on Income and Living Conditions (SILC) instrument. SILC is an established instrument used in European policy analysis. Because it assesses cross-sectional and longitudinal data on QoL conditions in all European Union member states, including Switzerland (since 2003), it could be a valuable reference for national and international comparisons in future analyses.

The manifest variables used to measure subjectively perceived safety and access were formulated in questions asking the participants how much they agreed or
disagreed with individual item statements. The responses to each item were scored on a five-point scale (from 1 = do not agree at all to 5 = I fully agree). Safety in public spaces was measured using three items referring to crime, road safety and the general sense of safety at night: “There are only few crime incidents here”; “I feel safe cycling here in the streets” and “Streets and public places are safe here at night”. Finally, subjective judgments about access to services and facilities (i.e., public transport, shopping, school/kindergarten, and gastronomy) was measured based on four items: “I live close to the train station”; “Shopping facilities are nearby here”; “I can reach a kindergarten or school quickly by walking”; and “A restaurant or a Café is accessible within a short distance from here”. In the study region, all school locations, primary and secondary, also host a kindergarten at the same location; therefore, both could be referred to in one item.

In measuring the perceptions of residents in cities, it is often difficult to define the spatial boundaries of the unit of reference (e.g., the neighborhood). However, previous research showed evidence of a significant dissimilarity between resident- and census-defined spatial unities. For example, individual perceptions of neighborhood boundaries can differ markedly (Coulton et al. 2001). Thus, the wording of items in the survey referred to the neighborhood in general, and no spatial boundaries were defined for the spatial unit of reference.

3.2.4.2. Objective variables

Objective access was operationalized by three manifest distance measures. The ArcGIS 10.1 spatial analyst cost distance function was used to calculate the distances of each household. Cost-weighted distance analysis was applied because, in contrast to the straight line (Euclidean) distance, it delivers representative distance values, particularly in regions where geographical factors demand routes longer than a straight line between two points (e.g., railroad tracks, rivers, and mountains), which is particularly the case in the study region. It is referred to as the “effective distance” in modifying the straight line distance for the effects of landscape and moving behavior (Adriaensen et al. 2003). In cost-weighted distance, the distance is a cost factor. This procedure uses raster cells (here: 1 m × 1 m) and takes into account the cell’s distance and the cost of moving through it. The cost for moving through a cell is defined by resistance values, which enables specifying route preferences (e.g., by assigning high resistance values for geographic obstacles). Movable cells were assigned with a resistance value of 1. Roads with more than two lanes were given a value of 3, and larger tunnels were assigned a value of 5, whereas the destination cell itself has the lowest costs, and accordingly is set to 0. The resistance value for non-traversable spatial obstacles,
such as train tracks and rivers, were set to an extreme resistance value of 10,000 to force the least-cost algorithm to select realistic bypasses (e.g., passing over the closest bridge). The outcome was the least cost or the shortest path from a chosen destination to the survey household. The unit of distance measurement was a cost value that can be converted into a distance measure by multiplying the cost by the cell size (Adriaensen et al. 2003). Distances were calculated between several functional destinations and each survey household within the study region (e.g., nearest train station and school/kindergarten).

The latent variable objective safety was measured using two manifest objective variables, accident density and crime density. While accident density captured all traffic accidents in public space, crime density accounted for the registered crime incidents (vandalism and theft) in public spaces. Both data sets were provided by the Cantonal Police for the Canton of Zurich for the latest available year (2012) and include all police records that were given a spatial coordinate for the incident location. Incident locations were mapped on the hectare raster grid (100 m × 100 m; the smallest spatial unit for which information is provided by the Swiss Federal office of Statistics), and density measures for accidents per hectare raster cell and crime incidents per hectare raster were calculated. Accordingly, the density values for each survey respondent were based on the respective accident and crime values of the hectare cell in which the household was located.

3.2.4.3. Linking subjective and objective attributes by spatial location

The information gained from the survey respondents was linked to information describing the current urban realm in the study region. This observable information on the urban environment had a clear geographical reference, which means that every object’s spatial location (e.g., of a school building within the city) could be described by distinct geometric coordinates. Similarly, the survey data received geometric information according to the spatial household location of each survey respondent. This process, which is known as geocoding, added geodetic coordinates to every subject of the QoL database (i.e., each survey respondent) and used the address information available from the citizen register (street, house number, and postal code). Geocoding was carried out based on the digital street network data for Switzerland provided by the Swiss Post Service, combined with digital building information administered by the Swiss Federal office of Statistics. Combining both datasets guaranteed a high accuracy of geometric reference data for street and building positions. Of the 1,699 responding resident households, geocoding could be carried out for 1,693 addresses. Six subjects are missing because of incomplete address information. Accordingly, these subjects were
excluded from the further analysis. This is because the objective data for the urban environment of each household needed to be calculated based on the household locations of the survey respondents. The final dataset for the modeling thus contains 1,693 subjects. The spatial distribution of the sample is displayed in Fig. 1. ArcGIS 10.1 was used for the spatial analysis of the objective characteristics of the respondents’ locations (e.g., calculation of distances from household location to important urban facilities; matching each household with information from the geocoded census and police information, such as population densities, density of crime and accidents).

3.2.5. Data analysis

3.2.5.1. Data quality and transformation

The data analysis of the manifest variables showed no or few missing values. The objective manifest variables had none. All subjective QoL measures had 1 % or less missing values; all subjective variables (for access and safety) had between 1.4 and 4.6 % missing values. The pattern of these incomplete data was identified as missing completely at random (Little’s MCAR test = non-significant). However, two manifest variables had a higher number of missing values [perceived access to school/kindergarten at 8.2 %; perceived safety (“cycling here in the streets”) at 7.6 %]. The missing pattern in both was identified as missing at random, which means that the probability of missing data in the particular variable depended on other observed variables, but not on the missing data itself. This was the case for the variable, access to school/kindergarten, which may be related to the type of household (e.g., if the household is without children). In addition, the variable perceived safety (“cycling here in the streets”) did not apply to all residents and was presumably left out by residents who did not use bicycles. This question asked for the cyclist’s perception of safety on the city roads.

Traditional approaches to handling incomplete data include case deletion or single imputation (e.g., when missing values are replaced by the mean of the observed values for that item). While the first would have biased the sample towards residents with children in school/kindergarten and those using bicycles, the latter could distort data distributions and variable relations. With mean substitution, variance would have been strongly attenuated which, then could have produced biased covariances with other dimensions. Consequently, the multiple imputation (MI) technique was applied. MI proofed to have significant advances over traditional approaches (Acock 2005; Schafer and Graham 2002). Each missing value was replaced by a pooled estimate of multiple value simulations. The repeated estimation of each value was based on a Markov Chain Monte Carlo algorithm. It
ensured that the uncertainty of missing values was captured by adding the error variance between the simulation steps. Hence, an imputed dataset with unbiased standard errors was gained.

All manifest subjective variables used in the analysis were only slightly skewed, with absolute statistics for skewness and kurtosis below ±1 (e.g., negative skewness ranging from −0.009 to −0.963 and positive from 0.011 to 0.777). Because of the large sample size, the visual inspection of univariate QQ—plots was chosen for further analysis and confirmed acceptable close-to-normal distributions for all manifest subjective variables. The objective measures for access were only slightly skewed, however; distance to school/kindergarten had a positive skewness of 1.78. Distance values were not transformed because the additional inspection of histograms still showed a close-to-normal distribution. In addition, not transforming distance measures permitted the direct interpretation of the access values. This also applied to the values for objective safety. Crime and traffic densities were positively skewed (3.41; 3.71). Histogram inspection showed reasonably normal distributions, and tests with square root and natural log transformations did not result in considerable improvements. Hence, data transformation was not applied.

3.2.5.2. Analytic procedure

To test the proposed hypotheses, structural equation modeling (SEM) was chosen to analyze the effect of objective and subjective variables on urban QoL. SEM is suitable here because it can incorporate both directly observed (i.e., manifest) and not directly observable (i.e., latent) variables while analyzing data for inferential purposes (e.g., for their mediating effects). Hence, SEM helps to explain how well a theoretical model that is a priori hypothesized serves as an approximation of the mechanisms underlying the observed associations. In contrast to traditional multivariate procedures, SEM is capable of assessing and accounting for measurement error deriving from the observed variables. Unbiased estimates are calculated for the relationships between latent constructs in the main structural model. Indeed, providing explicit estimates of the error parameters is particularly necessary in social and behavioral research when the measurement of variables is often recognized as difficult and error-prone (e.g., for the concept of urban QoL).

Within the framework of structural equation modeling, maximum likelihood estimation was used in the measurement and structural models, based on the correlation matrix in AMOS 20.0 (Arbuckle 2011). Figure 2 illustrates the conceptual model, which entails five measurement models based on 15 manifest variables and the structural model. The model uses 10 perceived manifest variables.
variables that were measured by the survey to explain three latent variables. It then further uses five objective manifest variables to measure two latent objective variables.

In the visual representation of the path model, the rectangles represent observed manifest variables and the ellipses represent latent variables. A one-way arrow displays an unidirectional relationship, whereas the two-way arrow stands for hypothesized covariance. To ensure clarity in Fig. 2, the symbols for measurement error components and residual terms are not displayed.

3.3. Results

The average score for the urban QoL was 7.21 (SD = 1.81; range 1–10). The descriptive results of all manifest variables are provided in Table 4 in the “Appendix”, including the correlational matrix. Based on the correlational data, three models were estimated. Model 1 tested a mediated path model in which the
relationships between the two objective latent variables and urban QOL were mediated by the perceived latent measures for access and safety. In model 2, the direct paths between the objective latent variables for access and safety and the latent factor urban QOL were added in order to test these paths for significance, which means that the subjective latent variables for access and safety would fully mediate these paths. The goodness of fit statistics were evaluated. Finally, in model 3 additional paths that significantly contributed to an improvement of the model fit were added, following the screening of modification indices and standardized residuals carried out in model 2.

3.3.1. Structural equation modeling

Structural equation models were estimated to predict urban QoL and examine the mediating effects between objective and subjective measures. In model 1, the five measurement models were found eligible; all manifest variables loaded well onto their respective latent variables. The standardized factor coefficients for the measurement models are shown in Fig. 2; the lowest standardized factor coefficient was 0.41.

The goodness of fit statistics indicated a fair fit to the data for model 1. The Chi square statistics were, not surprisingly, rather poor, which can be explained partly by the sensitivity of Chi square statistics to sample size (Byrne 2010). However, the RMSEA (0.053) and SRMR (0.057) showed an acceptable good fit in considering the thresholds for the absolute fit indices according to Steiger (2007). RMSEA values <0.07, and following Hu and Bentler (1999), a SRMR value <0.08 describe acceptable model fits. Table 3 displays the estimates and goodness of fit indices for all three models.
Table 3 Resulting estimates of the structural equation model with goodness of fit statistics (N = 1,693)

<table>
<thead>
<tr>
<th>Structural Model</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
<th>Model 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est.</td>
<td>Sig.</td>
<td>R²</td>
<td>Est.</td>
<td>Sig.</td>
<td>R²</td>
</tr>
<tr>
<td>Subjective access</td>
<td>.37</td>
<td></td>
<td>.38</td>
<td></td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>Objective access (H1)</td>
<td>-.61 ***</td>
<td></td>
<td>-.62 ***</td>
<td></td>
<td>-.61 ***</td>
<td></td>
</tr>
<tr>
<td>Objective threats to Safety (H2)</td>
<td>-.24 ***</td>
<td></td>
<td>-.23 ***</td>
<td></td>
<td>-.23 ***</td>
<td></td>
</tr>
<tr>
<td>Subjective urban QoL</td>
<td>.24</td>
<td></td>
<td>.24</td>
<td></td>
<td>.25</td>
<td></td>
</tr>
<tr>
<td>Subjective access (H3)</td>
<td>.22 ***</td>
<td></td>
<td>.29 ***</td>
<td></td>
<td>.28 ***</td>
<td></td>
</tr>
<tr>
<td>Subjective safety (H4)</td>
<td>.46 ***</td>
<td></td>
<td>.45 ***</td>
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<td>.45 ***</td>
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</tr>
<tr>
<td>Objective access (H5)</td>
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<td></td>
<td>-.43 ***</td>
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<td>-.43 ***</td>
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<tr>
<td>Subjective urban QoL</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Objective access (H6)</td>
<td>.13 *</td>
<td></td>
<td>.12 *</td>
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</tr>
<tr>
<td>Objective threats to safety (H7)</td>
<td>.06 n.s.</td>
<td></td>
<td>.06 n.s.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Goodness of fit indices</th>
<th>χ² (258) = 2745.6</th>
<th>χ² (252) = 2721.9</th>
<th>χ² (231) = 1109.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td></td>
</tr>
<tr>
<td>Normed χ² = 10.6</td>
<td>Normed χ² = 10.8</td>
<td>Normed χ² = 4.80</td>
<td></td>
</tr>
<tr>
<td>SRMR = .057</td>
<td>SRMR = .055</td>
<td>SRMR = .045</td>
<td></td>
</tr>
<tr>
<td>RMSEA = .053</td>
<td>RMSEA = .054</td>
<td>RMSEA = .034</td>
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<td>AIC = 2949.55</td>
<td>AIC = 2937.93</td>
<td>AIC = 1366.96</td>
<td></td>
</tr>
<tr>
<td>GFI = .906</td>
<td>GFI = .906</td>
<td>GFI = .958</td>
<td></td>
</tr>
<tr>
<td>CFI = .891</td>
<td>CFI = .892</td>
<td>CFI = .961</td>
<td></td>
</tr>
</tbody>
</table>

Note. Path to (→); path from (in italics); correlation (↔); *p < .05; **p < .01; ***p < .001

Test of hypotheses in SEM found a significant association between objectively measured access and subjectively perceived access. With a standardized regression coefficient of −0.61, objective access accounted for 37% of the variance explained in subjectively perceived access. Thus, hypothesis 1 is supported. The negative regression estimate means that subjectively perceived access increases according to shorter objective distances.

The test of hypothesis 2 found objective threats to safety was a significant predictor of subjective safety (standardized β = −0.24). The higher the crime density and the density of traffic accidents, the lower the perception of safety in public spaces, although only 6% of the variation in perceived safety was explained. Subjectively perceived access and subjective safety in public spaces were both found to be
significant predictors of urban QoL. Thus, both H3 and H4 are supported. The two latent variables combined explain 24% of the variation in urban QoL. Hypothesis 5 is also supported because the two objective variables, access and safety, are significantly correlated (r = 0.44). The more central one’s location in the city (i.e., the smaller the distances to central services), the higher the objective rate of crime and traffic accidents in public space.

The effects of mediation through subjectively perceived access and perceived safety were tested by adding the two direct paths between the objective latent variables for access and safety on one hand and QoL on the other hand, which is presented in model 2. Adding the paths slightly improved the model fit [χ² (6) = 23.7; p < 0.001], as indicated by the test result showing a significant χ² difference. The goodness of fit indices remain the same. With regard to hypothesis 6, objective access was weakly associated directly with QoL, which showed that this path was only partially mediated by subjective access (rejecting H6). The correlation between objective threats to safety and QoL (hypothesis 7) is non-significant, which supports the assumption that this path is fully mediated by subjective perception of safety.

Table 3 shows that compared to model 2, in model 3, additional paths could be added, which significantly improved the fit of the model. No new associations were added to the structural model. However, seven new paths were implemented in the measurement models. The fit indices now indicated an overall good fit. Correlated error terms were found between manifest variables in the measurement model of subjective urban access: perceived access to school/kindergarten and perceived access to public transport as well as perceived access to public transport with access to central shopping facilities.

In addition, the error term of the manifest variables for objective access showed a significantly shared variance with manifest perceived access variables: objective distance to school with perceived access to school and objective distance to station with perceived access to public transport. Adding these error correlations only slightly affected the model estimates, whereas the model fit to the data was improved significantly [χ² (21) = 1,612.9; p < 0.001].
3.4. Discussion

This study examined mediating effects between specific objective measures of the urban environment and residents’ perceived QoL by using structural equation models. The study found significant relationships of varying strengths between the objectively and subjectively measured variables.

3.4.1. Interpretation and contextualization of the findings

A significant association between objective access and subjective access was identified. Surprisingly, this association was found to be relatively strong, which means that the subjective evaluation of local access significantly corresponded with the objective conditions. Improvements in the residents’ access to services and facilities (e.g., by opening new local stores in the neighborhood and shortening travel times with new public transport infrastructure) would be reflected in the subjective evaluations and would positively affect the urban QoL of residents. This implies that measures of perceived accessibility would be a meaningful representation of the objective circumstances to a certain degree. This finding is in contrast to McCrea et al. (2006), who found only weak links between the latent measures of objective and subjective access. The spatial scope and typology of the study region may have played a significant role here. Whilst the Swiss region used in this study is relatively compact, McCrea and colleagues used data for the Australian region of South East Queensland, where distances from survey respondents’ households to central locations are much greater. In addition, the Swiss study focused on a suburban settlement area, whereas the large-scale study region in McCrea et al. comprised diverging settlement patterns from inner-city districts to remote rural locations. Both the spatial extent and the relative homogeneity of settlement patterns may affect the congruency of objective measures and their subjective evaluation.

This interpretation can be supported by the scale discordance concept of Lee and Marans (1980) which showed that the discrepancy between objective spatial units of measurement and the individual’s perception of these spatial units (e.g., a city district) significantly affected the correlation of these measures. Thus, in studies of smaller territories, the effect of scale discordance may be weaker. In fact, Angur noted that “congruence among objective and subjective indicators was stronger when the neighborhoods in question were small” (2004, p. 51). Consequently, it is postulated that the smaller the spatial scope of the study region, the greater the likelihood of congruency in the relationship of objective and subjective indicators of
urban access. Thus, for planning purposes, small-scale studies are probably more informative.

We found a significant but weak influence of measured objective safety in public space on the subjective evaluations of safety. This finding aligns with Lee and Marans (1980) who found modest correlations between the objective measures of crime and the survey respondents’ feelings of safety. This would imply that interventions into street safety and reduction of crime could have an improving effect on people’s personal feeling of safety. Incidents that pose a threat to objective safety, such as crime and traffic accidents, are significant stress factors because the objective safety impacts negatively on perceived safety, which in turn significantly affects urban QoL.

Perceived access and perceived safety were found to be significant predictors of urban QoL. Perceived safety was identified as the stronger predictor of the two when the standardized beta coefficients were considered. This finding suggests that safety in public spaces has a greater influence than does the proximity to central services. According to optimal centrality theory (Cicerchia 1999; Archibugi 2001) this indicates the importance of feeling safe in an urban environment over the perceived high centrality. The importance of safety is interpreted as one of residents’ motive in choosing suburban locations over core city centers (in addition to other factors, e.g., housing costs and availability of space), which is an ongoing trend in the Swiss agglomerations. In suburban settlement areas, people still have comparably good access to local suburban centers, while they expect stressful factors, such as threats to safety being fewer or absent. However, the current population growth in Swiss agglomerations also leads to rapid densification in these suburban settlements. According to optimal centrality theory, certain levels of suburban growth might be reached, wherein the negative effects of urban load result in a perceived loss in urban QoL.

The hypothesized effects of mediation were only partly confirmed in this study. The effect of objective access was only partially mediated by subjective access. This finding aligns with McCrea et al. (2006) and suggests that additional variables may be associated with objective access, which could positively affect urban QoL. In contrast, the influence of objective safety on urban QoL was fully mediated by the subjective evaluation of safety.
3.4.2. Limitations and options for follow-up QoL research

This study focuses on one suburban study region and does not allow for comparisons between different study regions (e.g., of different spatial scope). Future research could explicitly address the specific role of spatial characteristics by including settlements of different scales (e.g., a small village, a medium-sized town and a large agglomeration). Such studies might further clarify the role of spatial extent and its influence on scale discrepancy theory with regard to residents’ evaluations. This study built on data from one measurement point in time. Hence, dynamic aspects of urban QoL are not included. Marans and Stimson (2011) claimed the necessity of including urban change in models of urban QoL. Applying longitudinal study designs may integrate these aspects, although they often are resource intense.

This study used GIS techniques to link objective characteristics and subjective evaluations by their location in space. The use of GIS in this study was limited to the procedures of geocoding, cost-distance analysis and the spatial joining of household locations with further objective data on the urban environment. Future research on QoL could use spatial analysis in GIS, which may shed further light on the role of spatial scope in the relationships among objective and subjective predictors. For example, geographically weighted regression techniques could help analyze the local variation of estimated regression coefficients over space (Fotheringham et al. 2003). Crespo and Grêt-Regamey (2013) recently demonstrated the benefits of using local regression analysis in urban planning by analyzing the spatial variability of local parameter estimates. Evaluating the existence of clusters in the spatial arrangement of urban QoL using indices for spatial autocorrelation (e.g., Moran’s I, Geary’s C) could further help to understand the spatial variation in urban QoL itself. Nevertheless, in this study the test of spatial autocorrelation of the urban QoL measures did not find significant clustering (results not reported here).

The QoL indicators used in this study may be influenced by additional variables. For example, the perceived feeling of safety in a public space is apparently affected by other variables. There is evidence that personal exposure (i.e., victimization and explicit observation) to safety threats in public spaces affects personal feelings of safety, as do local media reports on the topic. QoL models by Jeffres and Dobos (1995) found that residents’ assessment of community quality was highly dependent on the information communicated through the local media, interpersonal communication, and personal observations. Future studies on safety
in public spaces should consider these influences, such as by including control variables for individual experiences with threats to safety.

Structural equation modeling was chosen as appropriate to studying the effects of mediation. Several scholars have claimed that SEM supports the interpretation of causal interrelations among variables. However, SEM builds on covariances among variables, and it is apparent that these correlational data shed only limited light on causality. Despite thorough theoretical embedding, caution should be used in making inferences of causal relations among the tested variables. Future research on urban QoL is needed, particularly in the form of controlled experimental studies. For example, choice experiments using conjoint analysis could present decomposed alternatives of urban neighborhood conditions in order to elicit the preferences of residents, as suggested by Hagerty et al. (2001). It should also be considered that the path models estimated in this study were assumed to have linear relationships between the latent variables. Considering non-linear interrelations may help in finding more coherent linkages between objective and subjective measures.

Finally, this study used a reductionist, bottom-up model to explain the influences on urban QoL. Characteristics of individuals, such as personality traits and lifestyle, were not included. Integrating such moderating factors in future research could explain further causes of weak relationships between objective urban conditions and their subjective evaluation, as suggested in top-down theories (Lance et al. 1995). A stratified analysis of individual characteristics or lifestyle habits would also allow the derivation of implications for urban policy makers who have to cope with trade-offs between investments in public spaces for different preference groups (e.g., an indoor pool vs. a kindergarten vs. public transport facilities).

Despite the identified limitations, the findings of the present study yielded new insights into the mediating effects between the predictors of urban QoL and thus have implications for supporting policy making.

3.4.3. Implications for urban management

An obvious, however important implication of this study is that urban policy makers should include the dimensions safety in public space and access to services and facilities in monitoring and evaluating the urban QoL. The two variables were confirmed as evident predictors of QoL. A second implication arises from the conclusion that spatial scope matters in relating objective and subjective indicators
of QoL. For urban planning purposes, this means that the spatial stratification of objective and subjective QoL indicators offers an added value and should be applied. This could be implemented with the help of communal and regional GIS applications, already in use by many communities. Displaying and analyzing variations in the indicators between spatial units (e.g., neighborhoods, city districts) could highlight relative differences and potentials for interventions in certain areas.

This study found weak links between objective safety and the subjective evaluations of safety but stronger significant relations between objective and perceived measures for access. In monitoring urban QoL these findings imply a necessary differentiation among domains. The subjective evaluations of access and safety in public spaces were found to be significantly related to the subjective satisfaction measure for urban QoL. This finding indicated that subjective measures are appropriate in identifying the importance of different indicators to explain satisfaction with urban living. For example, urban planners and policy makers interested in a representative public opinion about the perception of urban quality (e.g., their satisfaction in using urban spaces) should analyze residents’ evaluations of these QoL aspects, based on responses to survey scales. However, if the goal and implications are expected to provide guidance for interventions in the objective environment, then the use of subjective measures may not be appropriate because of their inconsistent pattern of correlations. Thus, in the case of evaluations of objective characteristics, weighted objective indicators might be preferable. Frameworks such as the four QoL states presented by Zapf (1984) may then help combining both, the results from objective measures and their subjective evaluations to reflect both dimensions when informing urban management. This may support urban policy makers, for instance, when choosing target areas and target groups for local social policies in cities.

Finally, another implication of this study is that its findings could support processes of participatory planning, which currently often lack appropriate representations of residential knowledge. Many processes of participatory urban planning still build on the engagement of only a few active residents (Burby 2003). Complementing their arguments with the representative measurement of perceived QoL attributes, combined with objective measures of the urban environment, would be a valid source of citizen inclusion.

In conclusion, this study contributed to the understanding of the interplay of important indicators of urban QoL. The study further specified research designs used in the scant previous research (e.g., McCrea et al. 2006) by testing safety in
public spaces and urban access. The findings of the present study partly replicated and confirmed previous findings, while its new findings shed light on the relevance of spatial scale in relating objective characteristics and subjectively perceived measures of urban life. There is growing agreement in the scientific literature that objective and subjective predictors are necessary in the study of the QoL of places. Similarly, policy making with the purpose of enhancing QoL should also consider both dimensions (Cummins 2000; Liao 2009). The scientific debate about integrated measurement models of QoL has only recently spurred renewed interest (Costanza et al. 2007) and thus remains a subject of further research.

Acknowledgements

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Table 4: Descriptive statistics and correlation coefficients of all manifest variables used in the structural equation models

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References


4. Research article III - Exploring the influence of urban change on place attachment

Manuscript submitted for publication as: von Wirth, T., Grêt-Regamey, A., Moser, C., Stauffacher, M. (under review) Exploring the influence of urban change on place attachment. *Journal of Environmental Psychology*

Abstract

Urban environments are transforming quickly in response to demographic and economic development. Such changes pose significant challenges on residents’ well-being and individuals’ affective bonds to places. Place attachment has been identified as an essential indicator for these person-place bonds. Surprisingly, place attachment has only rarely been studied in its response to the perception of change.

This study uses data of \( N = 746 \) residents from a postal survey to explore the influence of perceived changes in the urban environment on residents’ place attachments in the agglomeration of Zurich, Switzerland. The region is rapidly growing in population, jobs, and urban infrastructure. A measure of residents’ perception of urban change (PUC) was captured with two different measurement scales. The first scale was based on text items (PUC-t), and the second scale was based on the semantic assessment of images at different points in time (PUC-i).

The study found significant effects of urban change characteristics on place attachment, suggesting that residents’ place attachments are robust against rapid urbanization per se. When change in the urban environment is perceived as an attractive upgrading and as (still) familiar, it positively affects place attachment. Thus, urban design can influence residents’ relatedness to places. Detailing elements that characterize attractive and familiar city places resulting in positive affective responses should be the subject of further research. We suggest that the dynamic aspects of environmental change should be articulated more explicitly in place attachment theory.

Keywords: Place attachment, perceived urban change, city growth, people-environment relations
4.1. Introduction

In a rapidly urbanizing world with global mobility, the individual’s experience and affective bonds with places have recently spurred renewed interest, as reflected in place attachment research (Manzo & Devine-Wright 2014; Scannell & Gifford 2010a; Raymond et al. 2010).

The attachment to places is one concept among several in the domain of describing people’s relationships with places. When studying person–place relations, scholars also refer to the sense of place (Stedman, 2002; Jorgensen & Stedman, 2006), local identity (Bonaiuto et al., 2002; Carrus et al., 2005), sense of community (Chavis & Wandersman, 1990; Francis et al., 2012), and topophilia (Tuan, 1974). Within this plurality, these concepts are often expressed as multifaceted, relational phenomena incorporating three main dimensions: the place characteristics, the personal characteristics, and the psychological processes of perceiving and experiencing place (Scannell & Gifford, 2010a).

Place attachment affects the individual’s well-being and is influenced by a variety of predictors from these three dimensions (Manzo, 2014; Lewicka, 2011). Surprisingly, place attachment, as a spatially related concept, has rarely been studied in terms of testing the influence of variation in place characteristics over time. There are few and inconsistent findings on the perception of place change and its impact on people’s affective place bonds (Devine-Wright, 2014). Devine-Wright pointed to the “primary importance in understanding the impacts of such changes” (2014, p. 168), yet the current understanding of the ways environmental changes affect place attachment “remains in its infancy” (2014, p. 165). For many years, personal characteristics received the most attention in place attachment research (Hernandez et al., 2014; Lewicka, 2011). Considering significant changes in places and their effects on residents, place bonds are of particular interest during times of rapid urban growth.

Rapid urbanization has been identified as an accelerator of innovation and economic growth and an opportunity for efficient infrastructure usage. At the same time, it also poses severe challenges through unwanted ecological, socioeconomic, and health impacts (Bettencourt & West, 2010). While these impacts have been studied extensively to date and are readily quantified and monitored, the effects of urbanization on social processes and human interaction with the urban environment are less tangible (Slemp et al., 2012). Yet, human well-being is affected if residents’ place perceptions and senses of place are impaired by rapid urban development (Johnson & Zipperer, 2007).
Consequently, this study explores the influence of changes in the urban environment on residents’ place attachments observed in a region in Switzerland. The region is rapidly growing in population, jobs, and urban infrastructure. The urban densification and the intense inflow of new residential groups are part of a currently contested city development. This development is challenging the local identity and community coherence. It might also be a significant stressor for person–environment bonds. As these bonds can affect the behavioral intentions of residents, for example, toward accepting or opposing urban planning interventions, this study has implications for monitoring and communication in urban management.

4.1.1. Theoretical considerations on place attachment

Research on place attachment is not grounded in a common theoretical understanding. Neither the developmental processes of human-place bonds, nor the concept and influence of place are coherently defined among scholars. In fact, Manzo and Devine-Wright only recently pointed to the insufficient development of the theory, whereas many scholars pursued empirical studies in the past based on a diversity of definitions of place and place attachment (Manzo & Devine-Wright, 2014).

The concept has been defined by different scientific disciplines, such as environmental psychology, human geography, and sociology, though a common understanding is missing (Scannell & Gifford, 2010a). Giuliani referred to place attachment as “the section of human experience represented by affect which people experience, in various ways and varying awareness, with reference to places in which they are born, live and act; also in the relation to the other persons who live and operate in the same places” (2003, p. 137). One tentative description stems from Low and Altman’s seminal work that referred to place attachment as “an integrating concept that emphasizes affective relations to environmental settings” (1992, p.7); or, in short: place attachment is the degree of meaning given to specific environments. It develops over time and results in emotional bonds that people have with places (Low & Altman, 1992).

The existing definitions are appropriate to describe an emotional bond with specific places; however, they do not offer a clear distinction between place attachment and closely related concepts. One such concept is residential satisfaction, which has been widely used in the domain of landscape and urban planning, described as an attitudinal and affective perspective on positive or negative place experiences.
(Amérigo, 2002). This is why Hidalgo and Hernandez (2001) added the aspect of an individual seeking to maintain closeness to meaningful places to the original definition given by Low and Altman. Place attachment is treated as a uni-dimensional concept, whereas other studies see place attachment as part of an overarching, superordinate concept labeled with sense of place (Hernandez et al., 2014). Sense of place then builds on the dimensions of place identity (or identification), place dependence, and place attachment (e.g., Jorgensen & Stedman, 2006). Our study acknowledges the distinct, multiple dimensions of person–place relations. However, this study focus is solely on the concept of place attachment. Rather than building on a specific theory, this research is grounded in two conceptual frameworks.

First, the tripartite model presented by Scannell and Gifford (2010a) defines the three constituting dimensions for place attachment: the place characteristics, the personal characteristics, and the psychological processes of perceiving and experiencing place. However, it is not a theoretical process model of how place attachment develops; the scheme helps distinguish the influencing factors and involved processes. The process dimension includes affective, cognitive, and behavioral components, which play major roles in understanding the impact of environmental change on place attachment.

Secondly, the framework of place change proposed by Devine-Wright (2009) suggests five stages of psychological response to transformation of places. According to the author, individuals respond to place changes by becoming aware, interpreting, evaluating, coping, and acting. The study also suggests three dimensions to evaluate place change unfolding over time: its “extent, rapidity, and (the level of persons’ perceived) control” (p. 429). Consequently, our research incorporates the dimensions of extent and rapidity by developing an item-based scale on perceived characteristics of urban growth. In addition, our study findings are discussed in light of the response model to place change and, hence, further enhance this framework.

4.1.2. Empirical findings on place attachment phenomena in changing environments

Place attachment is a key concept for capturing affective person–place bonds. Empirical research found evidence for a variety of predicting factors of place attachment. However, indicators on the influence of either urban place characteristics or their change over time do not exist in the literature.
An extensive overview on the state of research is provided in Lewicka’s seminal review study (Lewicka, 2011), which includes the antecedents and consequences of place attachment. Among the personal characteristics, the length of residency (Bonaiuto et al., 1999; B. Brown et al., 2003) was positively correlated with people’s place attachments, whereas findings were inconsistent on the roles of other socio-demographic factors, such as age, gender, and educational level (Bonaiuto et al., 1999; Lewicka, 2005). This suggests that the influences of these factors on place attachment are most likely mediated or moderated by other factors (Lewicka, 2011).

Among social predictors studied to date, the strength of community ties has consistently shown a positive relation with people’s attachments (Bonaiuto et al., 1999; Lewicka, 2005). Brown and colleagues (2003) and Lewicka (2010) provided insights into the influence of housing and neighborhood variables and reported home ownership as a consistent positive predictor. Studies testing specific housing characteristics, such as living in cooperative housing, are non-existent. Yet, cooperative housing is a specific type of housing tenure established in many countries, including Sweden, the UK, Canada, and the US (Clapham, 2012). Cooperative housing offers a unique context for resident involvement assumed to have a positive effect on the social cohesion within the housing community and beyond. Surprisingly, living in cooperative housing and other housing variables, such as type of dwelling, have only rarely been studied.

Findings on the outcomes of higher or lower place attachment are still scant. Some evidence suggests that place attachment is positively related to pro-environmental behavior (Scannell & Gifford, 2010b; Vaske & Kobrin, 2001), while community attachment was identified as a significant predictor for individual well-being (Theodori, 2001) and place-related engagement (Perkins et al., 1996) in community organizations. Studies also found a positive relationship between the intensity of place bonds and the resistance to introduced place changes (Devine-Wright, 2009).

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1 Despite significant differences among cooperative housing types, it is ultimately a collective form of tenure to deal with management and maintenance of the housing infrastructure. Involvement varies between direct work (such as helping to clear up the area) and decision-making roles, such as deciding on development strategies. Many housing cooperatives in Switzerland offer common infrastructure, allow neighborhood ties to evolve (e.g., by providing common meeting rooms and initiating public activities in the neighborhood). In Switzerland, housing cooperatives own 145,000 housing units, which equals about 5.1% of the overall housing stock in the country (Wohnbaugenossenschaften Schweiz 2013).
4.1.2.1. Lack of research on how place changes influence individual attachment

For many years, interest was stronger in the social dimensions of place attachment than in its physical dimensions (Brehm, 2007). Droseltis and Vignoles (2010) pointed at the existing overemphasis on the individual differences in place attachment research, saying that it was at the expense of studying the influence of place characteristics and their variation over time. Little research has been done to capture dynamic aspects of place attachment. While some empirical studies have compared place attachment at different points in time, few other studies have focused on the implications of place changes on the affective place bonds of individuals (Devine-Wright, 2014).

Among the rare examples of longitudinal research on place attachment is a study by Korpela and colleagues (2009), who compared variation in place attachment over a 10-month period for a random sample in Finland. The study focused on the stability of individual place attachment over time in different environments and the choice of favorite places. The authors reported higher consistency in place attachment to favorite natural places than to places in urban contexts. However, the study focused solely on intra-personal variation in place attachment and did not include variation in place characteristics.

Chow and Healey (2008) evaluated place attachment and place identity over a transition phase of 5 months for undergraduate students moving from their homes to university dwellings. Based on interviews, the study considered how individuals made sense of the changes in their socio-spatial environments. Their findings suggested that the changes that occurred with the transition could manifest as erosion in the sense of belonging and attachment. Both studies comprised longitudinal research under 12 months. Such a time frame is very short when considering changes in place characteristics of urban environments, which often occur over a period of many years, even in rapidly developing regions. Hence, conducting longitudinal research on changes in urban environments would be costly and challenging. Accordingly, other research designs to capture the perception of changes in urban environments are needed.

4.1.2.2. Positive and negative impacts of place changes on place attachment

Only a few previous studies have covered the positive and negative impacts of place changes on place attachment. The positive effects of changing environments on people’s place attachments are largely neglected in the literature. However, Devine-Wright (2009) suggested that place attachment “may actually positively correlate with project support, when projects are interpreted as place enhancing”
The study reconsidered the “not in my backyard” (NIMBY) concept and identified local opposition as a form of place-protective action, occurring when changes to places interfere with existing affective place relations. Similarly, in his study on renewable energy technologies in Northern Ireland (2011), residents gave positive emotional responses 3 months after the installation of a tidal energy converter, which represented a significant change in the local place characteristics. The study found significant correlations between place attachment and residents’ acceptance of the installation.

However, the two studies each positioned place attachment as an explanatory factor influencing place-protective action (such as supportive action toward acceptable spatial developments; e.g. the installation of an energy infrastructure). In contrast, this article explores the relationship between place changes and place attachment “further back”, treating the characteristics of place change as influencing factors on residents’ place attachments, according to the dimension of place characteristics given in the theoretical framework by Scannell and Gifford (2010a).

Previous work mainly covered the negative impacts of change to places. In this context, Brown and Perkins (1992) referred to the “disruption” of place attachment. The article explored stressing effects on place attachments caused by disruptions, such as forced relocations due to flooding or landslides, for cases in the US and Peru. The authors developed a three-stage model of disruption, also adding understanding to the temporal phases of building place attachment. Recently, Manzo (2014) documented the negative effects of deprived contexts on place attachment. The author identified poverty, stigma, and displacements in social housing sites as significant stressors complicating residents’ place attachments.

In an interview-based study on desegregation in South Africa, Dixon and Durrheim (2004) argued that social changes, such as desegregation, could transform places and become influential as disruptive processes on place attachment, thereby eroding the sense of belonging to specific places. Their study confirmed evidence that environmental change, be it in the social or physical environment, can have negative impacts on the “landscape of place meaning” (p. 470).

Similarly, two empirical studies on the perception of landscape change in Switzerland found “that it is not landscape change per se that is assessed as good or bad, it is the (related) change in the meaning of landscape elements that leads to positive or negative assessments” (Hunziker et al., 2008, p. 140). Hence, when remembering our working definition of place attachment, Hunziker and colleagues’
findings suggested that place attachment is an important mediator between environmental changes and human assessments of landscape development. However, the study solely focused on mountain regions. No study exists that addresses the question of how rapid changes in the built urban environment affect residents’ place attachments. This could be of particular relevance during times of rapid urbanization and severe environmental challenges in urban areas of Switzerland and beyond. The ways individuals perceive changes in their urban environments are key to such studies.

4.1.3. The concept of urban change and its perception

Change is constant in the urban realm. Urban change refers not only to variation in the physical environment over time, but also appears in the economic, social, and political dimensions. Yet, science has neglected to study the perception and effects of intense changes in cities. Consequently, Bettencourt and West recently argued that “it is time for a science of how city growth affects society and environment” (Bettencourt & West, 2010, p. 912). City growth is one key aspect of urban change. In an early seminal review on urban change typologies, Sell and Zube (1986) identified urban growth as 1 of 3 major dimensions of change in addition to neighborhood transformation (urban renewal, gentrification) and mobility and relocation patterns.

Only recently, Slemp and colleagues (2012) concluded “the need to document and acknowledge urban growth impacts to residents’ sense of place and community identity.” (p. 147). Their study confirmed that “social systems are not inherently resistant to the impacts of land-use change, urban design and population shifts, and that these impacts are perceptible to residents” (Slemp et al., 2012, p. 141). Accordingly, the perceptions of residents in response to urban growth must be better understood, particularly in contexts where intense and rapid urban growth poses significant challenges for the local quality of life and community coherence.

The change model presented by Sell and Zube (1986) encompasses the aspects of physical change characteristics, as well as the human responses to the perception of these changes. The intensity and rapidity of urban growth belong to the first aspect of influencing factors, together with factors such as the type of change in contrast to the existing urban landscape and the individual’s proximity. Factors describing the individual’s perception of urban growth include the personal sense of control and options to influence changes, as well as concerns about personal costs and benefits induced by urban change. Finally, response categories to urban change were suggested as resistance, acceptance, ignorance, adaptation,
promotion of benefits, and personal relocation (Zube et al., 1989). The model of place change presented by Devine-Wright suggested the dimensions of extent, rapidity, and control influencing people’s behavioral responses to significant place changes (Devine-Wright, 2009).

Relating the perceived effects of urban growth to residents’ place attachments refers to a better understanding of the dynamic aspects of place attachment. Guiliani (2003) already pointed out that place attachment means a process of becoming attached and the outcome of being effectively attached to a place. Yet, as Devine-Wright (2014) argued, research to date has mainly focused on theoretical and methodological aspects instead of focusing on an understanding of the processes of attachment or detachment and the influencing factors leading to them over time.

4.1.4. The current study

Given the scant number of studies and the practical relevance of understanding the PUC for city management, the objective of this study was to explore the influence of perceived urban growth on residents’ place attachments. This study used one measurement point in time, asking participants for reflexive evaluations of the perceived changes. The hypotheses for this study were based on the previously outlined theoretical rationales and existing empirical findings. The supposed influence from socio-demographic variables follows the work of Lewicka (2011) and Rollero and de Piccoli (2010), whereas the hypotheses for the effects of house ownership and cooperative housing follow the rationales presented by Brown and colleagues (2003) and Clapham (2012). Finally, the hypotheses on the influence of the rapidity and quality (i.e., positive/negative valuation) of perceived urban change on place attachment are derived according to Sell and Zube (1986) and recent arguments by Devine-Wright (2014). Accordingly, the following hypotheses were proposed for testing:

- **H₁**: The greater the length of residency at the current address the higher the place attachment.
- **H₂**: House owners have a higher place attachment than renting tenants.
- **H₃**: The educational level significantly affects the individual’s place attachment.
- **H₄**: Residents living in cooperative housing are likely to report higher place attachments than residents in other housing types.
- **H₅**: Rapid urban change negatively affects place attachment.
- **H₆**: Perception of the urban change as an improvement predicts higher place attachment.
- **H₇**: Perception of the changed urban environment as familiar is positively related to place attachment.
4.2. Material and Methods

4.2.1. Participants

The study participants were N = 746 residents aged 18 and older living in the Swiss city of Schlieren. The sample was randomly selected from the citizen register applying a stratified probability sampling toward equal representation of women and men. Three thousand residents received a paper-and-pencil questionnaire between May and July 2013; 899 completed questionnaires were returned. A three-contact mailing procedure (initial mailing, postcard reminder, and follow-up full mailing) was used, resulting in a response rate of 30%. The questionnaire was provided in the German language. The information letter contained a note for non-German speakers in seven foreign languages, inviting them to participate in the survey with the support of family members and friends. The languages were chosen according to local population statistics.

From the 899 returned questionnaires, only 746 respondents completed the two measurement scales assessing the quality of urban change. Thus, the final sample consisted of 746 participants. The responding sample was representative of the population in the study region. The socio-demographic, household, and housing characteristics of the sample suitably fit the population census data as of 2011/2012 (see Table A1 in the Appendix). However, respondents (49.7% women) had a moderately higher mean age of 48.0 years (SD = 17.6) and were likely to be more highly educated. Of the respondents, 11.4 % held master’s or higher academic degrees, while the majority of respondents completed vocational training (40.2%). The survey respondents represented Swiss citizens disproportionate to the population, with 58.7% of subjects born in Switzerland. Overall, the average length or residency at the current address was 12.0 years (SD = 12.9). The mean household size was 2.55 (SD = 1.30), with 20.8% living in single households and 39.8% in households with children. The sample was also spatially representative for local subunits, such as statistical city areas in Schlieren.

4.2.2. Case study area

Schlieren is a suburban settlement of about 18,000 inhabitants in the Zurich metropolitan area, the largest agglomeration in Switzerland (Statistical Office Canton Zurich, 2014). Schlieren is growing rapidly in population and building stock. The population increased by 25% from 2007–2012, while the average increase for Switzerland was 5.9% in this period (BfS, 2013). Current forecasts expect the population to grow by 3,000 inhabitants (+17%) until the year 2025 (ZPL, 2012). The
building stock for residential use has also expanded. For example, between 2007–2012, the overall residential building stock increased by 23.1% (Statistical Office Canton Zurich, 2014).

The city was chosen as a case study because it is a typical, rapidly growing suburban region in Western Europe. The current growth has resulted in pertinent land consumption and intense urbanization. It poses considerable challenges on diverse aspects of the local quality of life; for example, growing noise emissions, traffic congestion, and safety issues in public spaces. One particular concern of policy makers and local planning experts is the loss of a sense of community in the city due to high migration rates. Urban policy makers are seeking to gain more knowledge about the potential influence of the causal effects on residents’ sense of belonging to the city. However, the underlying causes of residents’ place bonds in such rapidly growing communities remain unclear.

4.2.3. Materials and measures

The questionnaire was divided into four main sections. One section measured residents’ place attachments based on an adapted version of the neighborhood attachment scale (NAS; Bonaiuto et al., 1999). Another section included two different scales, which measured the residents’ PUCs. The questionnaire also had a section with measurement scales on perceived neighborhood characteristics and scales on satisfaction with the urban environment (neither are reported here). Finally, the questionnaire contained socio-demographic (i.e., age, gender, income, educational level, household size) and housing variables (e.g., categorical variables for living in cooperative housing, dwelling type, housing tenure, and a continuous variable for length of residency).

4.2.3.1. Place attachment scale

The dependent variable of place attachment was measured with a German version of the NAS validated by Bonaiuto and colleagues (Bonaiuto et al., 1999; Bonaiuto et al., 2003) from samples in Italian cities. The original NAS contains eight items. It was translated into German and reduced to six items. Participants rated the six items on a 5-point Likert scale (1 = I totally disagree to 5 = I totally agree). Items read, for example, “It would be very hard for me to leave Schlieren” or “The city of Schlieren is the ideal residential location for me.” The exact item wording is given in Table A2 in the Appendix.
Principal component analysis (PCA) was conducted, generating a 1-factor solution with an Eigenvalue of 3.6. The factor explained 59.5% of the total variance. The extracted factor label proposed by Bonaiuto and colleagues (“Neighborhood Attachment Scale”, 2003) was adapted toward place attachment city. The internal scale consistency was good, with Cronbach’s alpha coefficient = 0.86. Standardized item loadings, communalities, and descriptive statistics for the factor score are shown in Table A3 in the Appendix. Factor scores for place attachment were created based on the item means, retaining the scale metric as measured. This meant that higher factor scores indicated greater attachment to place. Summed factor scores were calculated because they preserved variation in the original data, a generally acceptable approach for explorative research situations (Tabachnick & Fidell, 2001).

4.2.3.2. Perceived urban change based on text items (PUC-t scale)

This study used two different measurement scales to capture the residents’ PUCs. Both scales were newly developed because a detailed literature review revealed no validated measurement scales available for this purpose. The first scale on perception of urban change (PUC-t) was an 11-item Likert-type scale containing text items, which were rated on a 5-point scale (1 = I totally disagree to 5 = I totally agree). Items read, for example, “I preferred Schlieren as it was in the past” or “People in Schlieren are still the same” or “Schlierens’ appearance improved over the last years”. Item choice was informed by literature research and followed the rationale presented by Sell and Zube (1986). Not only did these researchers refer to the dimension of rapidity, their study also distinguished change aspects in the physical urban environment and in the social context, which were both reflected in the item formulation. The exact item wording of the translated version is given in Table 1.

A PCA was conducted to analyze the underlying factorial structure. The analysis yielded three factors with Kaiser criterion larger than 1, explaining 65.26% of the total variance for the entire set of items. Factor 1 explained 23.7% of the total variance and was interpreted as attractive upgrading, representing aspects such as the improvement of a built environment’s appearance and higher attractiveness due to new inhabitants in the city. The second factor accounted for 21.4% and was labeled stressing growth, referring to a reactionary skepticism toward urban change and a critical perception of growth limits. The third factor was rapidity of urban change, and explained 20.2% of the total variance. It indicated a general perception of change intensity concerning the social and built urban environments.
Table 1 Summary of rotated factor loadings and communalities based on PCA for the 11-item scale on perception of urban change (PUC-t); item wording was translated from the original German version (N=709)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rotated factor loadings</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor “Upgrading”</td>
<td>Factor “Stressing”</td>
</tr>
<tr>
<td>Schlieren is developing in the right way.</td>
<td>0.823</td>
<td>-0.314</td>
</tr>
<tr>
<td>The city’s appearance improved over the last years here in Schlieren.</td>
<td>0.807</td>
<td>0.716</td>
</tr>
<tr>
<td>Schlieren became more attractive with the new residents.</td>
<td>0.762</td>
<td>0.636</td>
</tr>
<tr>
<td>From time to time, I think that there are now enough people residing in Schlieren.</td>
<td>0.735</td>
<td>0.700</td>
</tr>
<tr>
<td>From time to time, I think that there are enough new buildings constructed in Schlieren.</td>
<td>0.707</td>
<td>0.660</td>
</tr>
<tr>
<td>I liked Schlieren more in the past.</td>
<td>-0.499</td>
<td>0.680</td>
</tr>
<tr>
<td>Sometimes the development in Schlieren was so rapid that I could not find my way anymore.</td>
<td>0.677</td>
<td>0.498</td>
</tr>
<tr>
<td>Schlieren still appears as in the past. (reverse coded)</td>
<td>0.774</td>
<td>0.661</td>
</tr>
<tr>
<td>Schlieren has more residents today than only few years ago.</td>
<td>0.771</td>
<td>0.622</td>
</tr>
<tr>
<td>There were constructed many new buildings over the last few years here in Schlieren.</td>
<td>0.735</td>
<td>0.662</td>
</tr>
<tr>
<td>People here in Schlieren are still the same. (reverse coded)</td>
<td>-0.459</td>
<td>0.528</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td>2.605</td>
<td>2.351</td>
</tr>
<tr>
<td>% of total variance</td>
<td>23.69</td>
<td>21.37</td>
</tr>
</tbody>
</table>

Note. Factor loadings over 0.60 appear in bold; loadings below 0.30 are suppressed; PCA using Varimax rotation with Kaiser normalization

The internal consistency was acceptably good; attractive upgrading, Cronbach’s α = 0.82; stressing growth, Cronbach’s α = 0.78; and rapidity of change, Cronbach’s α = 0.69. Composite scores for the three factors were created based on the item means. This meant that higher scores indicated a more attractive PUC in factor 1 and a more stressing effect in factor 2. Hence, factors 1 and 2 were interpreted as qualities of urban change, whereas factor 3 indicated the perceived rapidity of the urban change. Table A4 in the Appendix summarizes the factor scores.
4.2.3.3. Perceived urban change based on image series (PUC-i scale)

The second scale measured perceived urban change based on the assessment of images (PUC-i). Subjects answered an 11-item semantic differential scale (Osgood et al., 1957), which referred to an image series attached to the questionnaire as an extra page in A4 color print. Each of the five image series showed four images from the exact same location in the city of Schlieren taken every 2 years between 2005 and 2011. Five different image series were randomly distributed among the sample participants (see Fig. A6 in Appendix). The image series were provided by the photographic inventory maintained by the Institute for Contemporary Art Research at the University of Applied Arts, Zurich. The institute is running a long-term photographic observation of urban transformation over a period of 15 years until 2020. Every 2 years, photographs are taken at 13 locations in public spaces within the city in a quasi-controlled manner, where camera position and angle remain similar. The images do not show persons and are captured during the same time of year or during the day to minimize seasonal and daylight differences.

Subjects were guided to answer the semantic differential on a 7-point bipolar scale for the images of 2005 and 2011 from −3 (i.e., fully agree with left pole wording) to +3 (i.e., fully agree with right pole wording). The poles were labeled with the respective adjectives to build the semantic differentials (for instance, *restorative* – *stressing* and *welcoming* – *preclusive*). The development of the semantic differential items followed the concept-adequate differential approach (Eck, 1982). The approach argued for concept- and context-specific development of scale items because the connotation associated with the presented pairs of opposing words can vary considerably with the concept being judged (Osgood et al., 1957). The choice of wording was based on existing semantic differentials in research on the perception of landscapes, urban form, and geographical entities (Green, 1999; Benz & Rambow, 2011; Eck, 1982). The item wording was then pre-tested and adapted to ensure adequacy for the specific concept of perceived urban change and the suburban study context in Switzerland.

Data from the semantic differential scale were also subjected to a PCA. The results indicated three dimensions that together explained 67.06% of the total variance. Three components were found using Varimax rotation with Kaiser normalization following the initial analysis. Eigenvalues were larger than the Kaiser criterion of 1. In addition, the visual inspection of the scree plot suggested a 3-factor solution. Table 2 shows the components and respective factor loadings after rotation, eigenvalues, and variance explained by each component. Items with loadings below 0.70 were discarded from the final solution, with one exemption for the item (*modern* – *old-fashioned*). The component loadings suggested the following
interpretation. Factor 1 was interpreted as *familiar*, factor 2 represented *inviting*, and factor 3 was labeled *urbanized*.

**Table 2**: Summary of rotated factor loadings and communalities based on PCA for the 11-item semantic differential scale on the visual perception of urban change for 5 image series in 2011 (PUC-i); item wording was translated from the original German version (N = 712)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rotated factor loadings</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1 “Familiar”</td>
<td>Factor 2 “Inviting”</td>
<td>Factor 3 “Urbanized”</td>
<td>h²</td>
<td></td>
</tr>
<tr>
<td>Swiss – International</td>
<td>0.775</td>
<td>0.604</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiar – Strange</td>
<td>0.735</td>
<td>0.331</td>
<td>0.677</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal – Anonymous</td>
<td>0.729</td>
<td>0.386</td>
<td>0.682</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loose – Compact</td>
<td>0.693</td>
<td>0.333</td>
<td>0.599</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restorative – Stressing</td>
<td>0.682</td>
<td>0.482</td>
<td>0.712</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diverse – Monotonous</td>
<td>0.838</td>
<td>0.761</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique – Common</td>
<td>0.810</td>
<td>0.724</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welcoming – Preclusive</td>
<td>0.375</td>
<td>0.741</td>
<td>0.721</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modern – Old-fashioned</td>
<td>0.528</td>
<td>0.506</td>
<td>0.552</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban – Rural</td>
<td>0.788</td>
<td>0.674</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordered – Chaotic</td>
<td>0.370</td>
<td>0.727</td>
<td>0.673</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eigenvalue*</td>
<td>3.076</td>
<td>2.801</td>
<td>1.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of total variance</td>
<td>27.97</td>
<td>25.46</td>
<td>13.63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Factor loadings over 0.70 appear in bold; loadings below 0.30 are suppressed; PCA using Varimax rotation with Kaiser normalization; * Eigenvalues of rotated sums of squared loadings

The internal consistency was acceptable for the *familiar* (Cronbach’s α = 0.79) and *inviting* (Cronbach’s α = 0.84) factors. However, the alpha value for *urbanized* had relatively low reliability (Cronbach’s α = 0.54). Nevertheless, the factor was kept in the analysis because of the explorative purpose of the scale. Component scores for the three factors were created based on the item means. The items from the semantic differential scale were recoded, so that higher factor scores indicated a higher, positive perception of *familiarity* with place, a higher degree of *inviting* place characteristics, and a more *urbanized* urban environment. Factor scores are given in Table A5 in the Appendix.
### 4.2.4. Analytic procedure

The data analysis of the variables included in the analysis showed few missing values. The variables had 1% and lower (e.g., for length of residency) to 4.7% (for the variable cooperative housing) missing values. Solely, the categorical variable for income had 6.8% missing values. The incomplete data pattern was identified as missing at random. Thus, missing data were not imputed and, consequently, the identified missing cases were deleted list wise for multivariate analyses. This explains the lower sample size in the hierarchical regression analyses.

Independent \( t \)-tests and one-factorial analyses of variances (ANOVAs) were applied to explore group differences in the dependent variable place attachment. Stepwise, hierarchical regressions were conducted to analyze the predictive effects of perceived urban change on place attachment for both measurement procedures, while controlling for person and housing characteristics. Model 1 tested for the personal characteristics, model 2 included housing variables, and models 3 and 4 tested the influence of perceived urban change, as measured by the PUC-t and PUC-i scales.

### 4.3. Results

#### 4.3.1. Results of group differences in place attachment (test of hypotheses 1–4)

The average value obtained on the place attachment scale was 3.47 \( (SD=0.92; \text{range } 1–5) \). First, the influences of socio-demographic and household variables on place attachment were tested. The results are shown in Table 1.

Women \( (M = 3.50, SD = 0.96) \) and men \( (M = 3.42, SD = 0.88) \) did not differ significantly on place attachment, \( t(728) = 1.22, p = \text{n.s.} \), while age and length of residency did affect place attachment. Higher place attachment scores were found with higher age \( (r = 0.25, p < 0.01) \) and with longer time of residency \( (r = 0.22, p < 0.001) \). Thus, Hypothesis 1, stating a positive relationship between length of residency and place attachment, was supported.
Table 3: Mean scores and standard deviations (in parentheses) of the place attachment scale by socio-demographic and household variables; differences in sample sizes are due to missing values.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Place attachment</th>
<th>Post hoc (Bonferroni)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) female</td>
<td>362</td>
<td>3.50 (0.96)</td>
<td></td>
</tr>
<tr>
<td>b) male</td>
<td>368</td>
<td>3.42 (0.88)</td>
<td>1.23 n.s.</td>
</tr>
<tr>
<td>t (728)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) 18 – 39 years</td>
<td>270</td>
<td>3.23 (0.90)</td>
<td></td>
</tr>
<tr>
<td>b) 40 – 65 years</td>
<td>300</td>
<td>3.50 (0.89)</td>
<td></td>
</tr>
<tr>
<td>c) over 65 years</td>
<td>142</td>
<td>3.81 (0.89)</td>
<td></td>
</tr>
<tr>
<td>F (2, 709)</td>
<td></td>
<td>20.53***</td>
<td></td>
</tr>
<tr>
<td><strong>Educational level (selected)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Compulsary school</td>
<td>122</td>
<td>3.70 (0.85)</td>
<td></td>
</tr>
<tr>
<td>b) Secondary (e.g., voc. training)</td>
<td>464</td>
<td>3.51 (0.91)</td>
<td></td>
</tr>
<tr>
<td>c) Tertiary (BSc degree or higher)</td>
<td>124</td>
<td>3.05 (0.93)</td>
<td></td>
</tr>
<tr>
<td>F (2, 707)</td>
<td></td>
<td>17.50***</td>
<td></td>
</tr>
<tr>
<td><strong>Household (HH) income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) &lt; 4000 CHF</td>
<td>93</td>
<td>3.60 (1.02)</td>
<td></td>
</tr>
<tr>
<td>b) From 4000 to 9999 CHF</td>
<td>405</td>
<td>3.51 (0.88)</td>
<td></td>
</tr>
<tr>
<td>c) From 10000 to 16000 CHF</td>
<td>155</td>
<td>3.33 (0.98)</td>
<td></td>
</tr>
<tr>
<td>d) &gt; 16000 CHF</td>
<td>40</td>
<td>3.40 (0.91)</td>
<td></td>
</tr>
<tr>
<td>F (3, 689)</td>
<td></td>
<td>1.68 n.s.</td>
<td></td>
</tr>
<tr>
<td><strong>Household type (selected)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Single household</td>
<td>151</td>
<td>3.41 (0.99)</td>
<td></td>
</tr>
<tr>
<td>b) Household with kids</td>
<td>287</td>
<td>3.51 (0.84)</td>
<td></td>
</tr>
<tr>
<td>c) Couple without kids</td>
<td>234</td>
<td>3.50 (0.91)</td>
<td></td>
</tr>
<tr>
<td>d) Shared flat</td>
<td>39</td>
<td>3.20 (1.14)</td>
<td></td>
</tr>
<tr>
<td>F (3, 707)</td>
<td></td>
<td>1.65 n.s.</td>
<td></td>
</tr>
<tr>
<td><strong>Cooperative housing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) yes</td>
<td>122</td>
<td>3.71 (0.86)</td>
<td></td>
</tr>
<tr>
<td>b) no</td>
<td>587</td>
<td>3.41 (0.92)</td>
<td></td>
</tr>
<tr>
<td>t (707)</td>
<td></td>
<td>3.35**</td>
<td></td>
</tr>
<tr>
<td><strong>Occupation type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Tenancy</td>
<td>524</td>
<td>3.41 (0.96)</td>
<td></td>
</tr>
<tr>
<td>b) Ownership</td>
<td>183</td>
<td>3.65 (0.74)</td>
<td></td>
</tr>
<tr>
<td>t (705)</td>
<td></td>
<td>-3.07**</td>
<td></td>
</tr>
<tr>
<td><strong>Type of dwelling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Detached single-family dwelling</td>
<td>74</td>
<td>3.68 (0.87)</td>
<td></td>
</tr>
<tr>
<td>b) Semi-detached family dwelling</td>
<td>49</td>
<td>3.53 (0.68)</td>
<td></td>
</tr>
<tr>
<td>c) Attached multi-unit dwelling</td>
<td>594</td>
<td>3.43 (0.94)</td>
<td></td>
</tr>
<tr>
<td>F (2, 714)</td>
<td></td>
<td>2.45 n.s.</td>
<td></td>
</tr>
<tr>
<td><strong>Length of residency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Less than 2 years</td>
<td>157</td>
<td>3.15 (0.92)</td>
<td></td>
</tr>
<tr>
<td>b) Between 2 – 10 years</td>
<td>313</td>
<td>3.43 (0.91)</td>
<td></td>
</tr>
<tr>
<td>c) More than 10 years</td>
<td>268</td>
<td>3.70 (0.87)</td>
<td></td>
</tr>
<tr>
<td>F (2, 735)</td>
<td></td>
<td>17.63***</td>
<td></td>
</tr>
<tr>
<td>r Pearson</td>
<td>738</td>
<td>0.22***</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Place attachment was assessed based on a 5-point Likert-type scale (from 1 = I totally disagree to 5 = I totally agree); t-tests and Pearson correlations were tested 2-tailed. n.s. = non-significant; * p < 0.05; ** p < 0.01; *** p < 0.001.
The respondents’ educational levels also affected place attachment. The main effect occurred for persons holding bachelor’s degrees or higher. The individuals with the highest education showed the lowest scores for place attachment. Therefore, Hypothesis 3, proposing a significant effect between educational level and place attachment, was supported. Household income did not have a significant influence on place attachment values. When considering housing and household variables, Hypothesis 2, stating higher place attachments among house owners over renting tenants, was supported, as place attachment was higher for house owners \( (M = 3.65, SD = 0.74) \) than for renting tenants \( (M = 3.41, SD = .96) \), \( t(705) = -3.07, p < 0.01 \).

Hypothesis 4 proposed that residents living in cooperative housing would report higher place attachments than would residents from other housing types. Residents living in houses owned by cooperative housing companies reported a significantly higher average place attachment \( (M = 3.71, SD = 0.86) \) than all other residents \( (M = 3.41, SD = 0.92) \), \( t(707) = 3.35, p < 0.01 \) (thus \( H_4 \) is supported). Finally, households with children showed the highest average place attachment among all the household types, whereas shared flats showed the lowest place attachment (however, the differences were not statistically significant).

### 4.3.2. Results from multivariate analyses (test of hypotheses 5–7)

To test how the PUC predicted variation in place attachment, hierarchical multiple regression analyses were carried out. The set of variables on personal characteristics (age, gender, education, and household type) was entered first, followed by housing variables. In a third step, the PUC-t factors were tested as predictors. Finally, the factors identified by the PUC-i scale were added to the model. The results of the hierarchical regression are provided in Table 4.

Age \( (β = 0.25, t = 6.15, p < 0.001) \) and living in a household with children \( (β = 0.12, t = 2.87, p < .01) \) were significant positive predictors of place attachment, whereas being more highly educated was a negative predictor \( (β = -0.15, t = -3.84, p < 0.001) \). Person characteristics explained 9.4\% of the variance in place attachment \( (R^2 = 0.094, F (4, 630) = 16.22, p < 0.001) \). Among the housing variables tested in step 2, living in cooperative housing \( (β = 0.13, t = 3.53, p < 0.01) \) and the length of residency \( (β = 0.13, t = 2.62, p < 0.01) \) were positive predictors for place attachment. Ownership and the type of dwelling did not have significant influences on residents’ place attachments. Model 2 added 3\% of predictive power to the model \( (R^2 \text{ change} = 0.029, F \text{ change} = 5.14, p < 0.001) \).
Table 4: Results of the hierarchical multiple regression for the effects on residents’ place attachment (N = 631)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ΔR²</th>
<th>B</th>
<th>ΔR²</th>
<th>B</th>
<th>ΔR²</th>
<th>B</th>
<th>ΔR²</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1 Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.094***</td>
<td>0.249***</td>
<td>0.153**</td>
<td>0.196***</td>
<td>0.183***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.040</td>
<td>0.049</td>
<td>0.070*</td>
<td>0.055</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher education*</td>
<td>-0.149***</td>
<td>-0.141***</td>
<td>-0.138***</td>
<td>-0.122**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household typeb</td>
<td>0.115**</td>
<td>0.090*</td>
<td>0.071</td>
<td>0.057</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2 Housing variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation typec</td>
<td></td>
<td>0.062</td>
<td>0.019</td>
<td>0.131**</td>
<td>0.139***</td>
<td>0.135***</td>
<td></td>
<td>0.163***</td>
</tr>
<tr>
<td>Cooperative housingd</td>
<td></td>
<td>0.131**</td>
<td>0.139***</td>
<td>0.135***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling typee</td>
<td></td>
<td>0.049</td>
<td>0.040</td>
<td>0.047</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of residency</td>
<td></td>
<td>0.125**</td>
<td>0.185***</td>
<td>0.163***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3 Perc. urban change, PUC-t</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.122***</td>
<td></td>
<td>0.122***</td>
<td></td>
</tr>
<tr>
<td>Factor 1 “Attractive upgrading”</td>
<td></td>
<td>0.383***</td>
<td>0.336***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2 “Stressing growth”</td>
<td></td>
<td>0.044</td>
<td>0.058</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3 “Rapidity of change”</td>
<td></td>
<td>0.086*</td>
<td>0.106*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step : Perc. urban change, PUC-i</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.020**</td>
<td></td>
</tr>
<tr>
<td>Factor 1 “Familiar”</td>
<td></td>
<td></td>
<td></td>
<td>0.159***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2 “Inviting”</td>
<td></td>
<td></td>
<td></td>
<td>-0.027</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3 “Urbanized”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.031</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.094***</td>
<td>0.123***</td>
<td>0.245***</td>
<td>0.266**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>16.219***</td>
<td>10.892***</td>
<td>18.292***</td>
<td>15.926***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF</td>
<td>16.219***</td>
<td>5.136***</td>
<td>33.476***</td>
<td>5.717**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** * p < 0.05; ** p < 0.01; *** p < 0.001; B = standardized coefficients

* Dummy variable for holding bachelor’s degree or higher

b Dummy variable for household with children
c Dummy variable for being owner (vs. occupation type: “renting tenant”)
d Dummy variable for living in cooperative housing
e Dummy variable for single detached family dwelling

In a third step, the three identified PUC-t factors were entered into the model. When a resident perceived change in their urban environment as an attractive upgrading ($β = 0.38, t = 8.82, p < 0.001$), this had a strong positive effect on their place attachment. Therefore, Hypothesis 6, which proposed that the PUC as an improvement would predict higher place attachment, was supported. The place attachment was also influenced by the rapidity of urban change. The standardized beta coefficient was positive ($β = 0.086, t = 2.29, p < 0.05$). Thus, Hypothesis 5, which
stated that rapid urban changes would negatively affect place attachment, was rejected. Having an adverse perception toward the transformation of the urban environment (i.e., describing the urban change as stressing and describing the former urban setting as better) did not significantly affect place attachment. The three factors identified from the PUC-t scale contributed an additional 12% to the explanation of the variance in place attachment ($R^2$ change = 0.122, $F$ change = 33.476, $p < 0.001$).

Finally, the three identified PUC-i factors were tested. The perception of the transformed urban environment as familiar positively affected place attachment ($\beta = 0.159$, $t = 3.70$, $p < 0.001$). Hence, Hypothesis 7, which proposed a positive relationship between familiarity of the changed urban environment and place attachment, was supported. There was no significant effect found for the perception of the urban environment as more urbanized.

The factors identified through the image series accounted for an additional 2% of the variance in place attachment ($R^2$ change = 0.266, $F$ change = 5.78, $p < 0.01$). The best fitting model predicting place attachment from the given set of variables was model 4, the linear combination of personal characteristics, housing variables, and the factors of perceived urban change ($R^2 = 0.266$, $F (14, 630) = 15.93$, $p < 0.001$), which accounted for 27% of the variation in residents’ place attachment measures.

### 4.4. Discussion

The aim of this study was to explore the influence of residents’ PUCs on their place attachments. As supposed, the PUC had a significant influence on place attachment. The findings suggest that place attachment is robust toward urbanization as such. Instead of being influenced by the urban change per se, residents were sensitive to the qualities of urban development. Even rapid and intense growth of the urban environment can have a positive influence on residents’ place attachments under the condition that residents perceive the changes as upgrading. Likewise, when the transformation of city places results in (still) familiar urban environments, place attachment is also positively related. The study found new influencing factors on residents’ place attachments to the city, such as living in cooperative housing, and confirmed significant socio-demographic predictors identified in previous studies.
4.4.1. Significance of new findings

First, this study tested the influences of personal characteristics and housing variables on place attachment. Findings from previous studies were confirmed. An individual with a higher level of education was more likely to report significantly lower place attachment. One explanation for the negative relationship is that there is more intense geographic mobility among subjects with higher levels of education (Lewicka, 2005). Furthermore, measures of age and length of residency were both positively related to place attachment. Age had a higher predictive power than the length of residency. Both factors were correlated and, as supported by prior studies, neither determinant influenced place attachment independently (Rollero & De Piccoli, 2010).

Second, when considering the influence of housing variables, living in cooperative housing was a significant positive predictor for place attachment in all models, when controlled for socio-demographic and further housing variables. This means that the housing context in cooperative associations (e.g., by more intense residential involvement in housing and property management) is likely to result in greater affective place bonds. However, self-selection could play a moderating role here, due to specific lifestyle groups choosing cooperative housing. Yet, the absolute number of cooperative housing units in Switzerland and their diversity of dwelling types with a broad price range make it more likely that the influence on place attachment may be in great part explained by the specific housing characteristics. For instance, within the canton of Zurich, there are 60,150 housing units owned and managed by housing cooperatives (Wohnbaugenossenschaften Schweiz 2013). This is about 18% of the housing stock in the agglomeration of Zurich, and 20.8% of the population was living in cooperative housing as of 2012 (Statistik Stadt Zürich 2012).

The significant influence suggests that this unique resident involvement, being assumed to positively affect the social cohesion within the housing type (Clapham, 2012), also has a positive effect on residents’ place attachments. This may also be supported by the fact that many housing cooperatives in Switzerland offer common infrastructure and activities enabling neighborhood ties (e.g., by providing common meeting rooms and initiating public activities in the neighborhood). To our knowledge, this is the first study showing this effect in Switzerland, a finding with implications for housing policies in Switzerland and beyond. It may offer suggestions for how to support local place belonging, engagement, and involvement intentions, for example, by granting the preferred right of preemption to cooperative housing associations in the region. It may also initiate idea building.
for how characteristics of cooperative housing associations could be transferred and implemented within the non-cooperative housing sector (e.g., shared guest rooms, common event spaces, or urban farming areas in multi-family dwellings).

Third, the study found a strong positive effect of perception of urban change as attractive upgrading on residents’ place attachments based on the PUC-t scale. This means that changes in the urban environment that are valued as beneficial to residents can strengthen persons’ place bonds. This finding aligns with research on the perception and valuation of landscape changes in Switzerland. In her qualitative study, Felber-Rufer (2006) showed that people’s evaluations of landscape transformation were mostly based on the perceived benefits, whereas the rate of transformation (i.e., slow or fast) had no influence on the evaluation (even though people generally noticed the differences between slow and rapid change rates).

In contrast, our study showed that the rapidity of urban change was a positive predictor of place attachment. One explanation for this positive influence is the negative image and deprived condition in the selected city of Schlieren up until 10 years ago. Assuming that residents experienced these living conditions, a rapid and intense transformation of diverse city areas might be perceived as a desirable development. In particular, when the changes are evaluated as city upgrading, it confirms evidence that urban interventions, such as neighborhood revitalization programs, affect the relations people develop with places (G. Brown et al., 2004).

Fourth, there was a positive influence for the factor of familiarity. This means that a perception of the urban environment as familiar following a transformation may result in an increase in place attachment. This finding offers implications for further research on identifying particular aspects of the built environment that locally represent familiarity. Integrating these aspects into the urban design may be particularly helpful in stabilizing the place relations of residents in rapidly changing environments.

Finally, the perceived urbanization as such did not have a significant influence on residents’ place attachments. This allows for the interpretation that urban growth per se is not the source of stressing or supporting effects on person–place bonds. Rather, the perceived place qualities following the transformation, including a valuation of individual benefits, affect place attachment. However, trade-offs can occur when dealing with divergent interpretations of what is an attractive and familiar urban upgrading, based on residents’ value systems. Therefore, the study findings strengthen the justification for using instruments that steer local
interventions toward attractive and familiar urban design based on representing citizens’ environmental perceptions and evaluations. In the case of Switzerland, these instruments entail mandatory architectural competitions or the legally binding definitions within local land-use plans prescribing certain urban design qualities on the parcel level (e.g., ‘privater Gestaltungsplan’), among others. However, most of these planning instruments only partly involve mandatory forms of citizen participation. Including residents’ opinions early in planning processes may help them cope with these trade-offs, particularly when the residents’ perceptions are captured with representative surveys, as done in this study.

4.4.2. Limitations and options for further research on dynamic aspects of place attachment

This study explored new ways of measuring the perception of place changes over time. Studying dynamic changes in the urban environment and residents’ perceptions of these changes suggest the use of a longitudinal research design. However, longitudinal research is resource intense and rarely funded over longer periods. Yet, acknowledging longer periods (e.g., > 5 years) when studying changes in the urban environment is essential. Such time frames make panel studies very challenging and point to the need to discover alternative ways to study dynamic factors influencing place attachment. The residential fluctuation over time could also significantly affect dropout rates in longitudinal designs. Still, ideally, future research should hold a panel of survey respondents over longer periods. Behavioral consequences of place attachment, such as moving behavior or place-related engagement, could then be included in an integrated model. An additional option for future study methods is the application of Bayesian statistics. By building on subjective views of probability that build on prior (e.g., qualitative) assumptions, the complex models of place attachment interaction with dynamic aspects of place change may be modeled without relying on large sample sizes (Dienes, 2011).

This study presented two reliable measurement scales for the PUC characteristics. While the text-based PUC-t scale explained more variance in place attachment and was less resource intense, the PUC-i scale based on five image series explained little additional variance in place attachment. The choice and amount of images may have influenced the explanatory power of the visual stimuli.

Further studies validating a larger number of these image series including, for example, a sample from outside the community of Schlieren, could lead to relevant insights on particular visual elements. These could contribute to evaluations, such as an evaluation of an attractive or familiar appearance of the urban realm.
Accordingly, the further development of the two measurement scales may take place in different domains. The text-based PUC-t scale proved a reliable scale and explained the considerably larger amount of variance in place attachment. Therefore, it is a valid instrument for research applications. Yet, it should be tested further. The image based PUC-i scale, on the other hand, is more resource intense due to the generation of the image series over time and could be of further use in monitoring and evaluating concrete elements of the urban environment that lead to attractive and urban design settings. Its visual stimuli, combined with affective responses from a semantic differential scale, could be used for further urban design studies and practical applications in cities.

Studies on antecedents and consequences of people attaching to places are still inconsistent and predominantly build on correlational designs; thereby, they shed little light on causalities, as did this study. Place-related behavior may occur in different forms. Persons’ participatory engagement could result in supportive or oppositional action toward planned changes in the urban environment (Lewicka 2011). This engagement may also support environment-protecting changes, or it may favor opposition to unwanted changes and protection of the status quo.

The influence of length of residency and other determinants on place attachment raised questions about depicting causality in studies on people–place relations. For instance, does the length of residency affect residents’ place attachments; or does a strong affective bond to the place of residence influence the length of residing at the place (or moving behavior from the place)? Certainly, there is a bidirectional influence, mediated by processes still undiscovered. Along this vein, Lewicka (2011) and Gustafson (2014) recently emphasized the distinction between identifying predicting factors of place attachment and identifying processes by which individuals become attached to places. As this study aimed at understanding the influence of environmental change on residents’ place attachments, the analysis of predictive factors was the focus. However, future research could include aspects of behavioral intentions and local engagement to further test associations with degrees of place attachment.

Place attachment varies over space and time, as do changes in the urban environment. The intensity of changes in the urban environment may vary significantly by factors such as neighborhood. These spatial differences have not been captured in the present approach. It could be a valuable option for further studies to identify spatial differences in change intensity in the urban environment and to analyze spatial patterns of place attachment itself. Surprisingly, little work has been done to explore the concept of place attachment as spatially
differentiated (Lewicka, 2011). This research could be done by making use of geographic information systems (GIS) and geostatistics. The application of GIS, together with place-related concepts established in environmental psychology and sociology, may bring added value to the understanding of the influencing factors in place attachment. As such, the presentation of results from place attachment research could be more applicable to the planning and urban design disciplines.

4.5. Conclusions

In conclusion, this study demonstrated the influence of residents’ perceptions of place changes driven by rapid urban growth and their effects on individual place attachment. The findings suggest that significant transformations of the urban realm, even when occurring within shorter time frames, can strengthen residents’ relationships to places when the changes are perceived as attractive upgrading and as (still) familiar environments. This implies that interventions in the urban environment can have positive influences on the intangible person-place relations. It also indicates that the inclusion of residents’ perceptions in early stages of urban planning may be valuable for identifying and mediating value trade-offs that might occur during later stages of urban changes. This may lead to only moderate disruptions or even a positive influence on residents’ place bonds during projects such as urban infill and densification programs.

This research not only uncovered the influence of urban growth on residents’ place attachments, but also identified significant predictors that positively relate to residents’ place bonds — predictors that are addressable by urban policies. For example, promoting the further engagement of cooperative housing associations in housing development is expected to have a positive influence on residents’ place attachments and subsequent local engagement. Therefore, it might be worth studying which aspects of cooperative housing contribute to higher place attachment and local engagement and in what ways these influences may be evoked in neighborhoods with other housing types. Identifying the affective responses of residents toward urban changes offers valuable knowledge for urban monitoring in diverse contexts and may help guide urban design. Accordingly, the dynamic aspects of urban transformation on individuals’ affective place bonds should be subjected to further research in other urban contexts beyond this Swiss case study.
Acknowledgements

The research presented in this article was carried out as a part of the project “Sustainable Urban Patterns”, funded by the Swiss National Science Foundation’s National Research Program (NRP, 65) “New Urban Quality” (http://www.nfp65.ch), Research Grant: 406540-130578. We are thankful to Meret Wandeler (Institute for Contemporary Art Research; ZHdK, Zurich) for granting us the right to use the image series taken within the long-term photographic observation in the city of Schlieren (http://www.beobachtung-schlieren.ch). In addition, we acknowledge the valuable collaboration with the city of Schlieren, represented by the Head of Urban Development Barbara Meyer. Finally, we thank Nora Muggli and Ralph Hansmann (both ETH Zurich, NSSI) for valuable inputs on earlier versions of this work.
**Appendix**

**Table A1**: Comparison of sample and population characteristics for the study region; mean, standard deviations, and percentages for selected person and household variables; sample size varies across items due to missing values

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample (N = 746)</th>
<th>Population (N = 17170)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Age (of residents 18 years or older)</td>
<td>714</td>
<td>48.0 (17.6)</td>
</tr>
<tr>
<td>Length of residency (years)</td>
<td>740</td>
<td>12.0 (12.9)</td>
</tr>
<tr>
<td>Reported net dwelling area [m²]</td>
<td>684</td>
<td>100.5 (38.6)</td>
</tr>
<tr>
<td>Size of household [persons]</td>
<td>729</td>
<td>2.55 (1.3)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>female</td>
<td>364</td>
<td>49.7%</td>
</tr>
<tr>
<td>male</td>
<td>369</td>
<td>50.3%</td>
</tr>
<tr>
<td>Country of origin</td>
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<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>438</td>
<td>58.7%</td>
</tr>
<tr>
<td>other</td>
<td>308</td>
<td>41.3%</td>
</tr>
<tr>
<td>Nationality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swiss</td>
<td>518</td>
<td>72.5%</td>
</tr>
<tr>
<td>other</td>
<td>196</td>
<td>27.5%</td>
</tr>
<tr>
<td>Level of Education [selected]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical/vocational training</td>
<td>293</td>
<td>40.2%</td>
</tr>
<tr>
<td>Master’s degree or higher</td>
<td>83</td>
<td>11.4%</td>
</tr>
<tr>
<td>Housing ownership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenancy</td>
<td>562</td>
<td>72.1%</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car-free household</td>
<td>137</td>
<td>18.7%</td>
</tr>
</tbody>
</table>

**Note.** References for population data:

* Kanton Zürich, Statistisches Amt, Gemeindedatenbank, 2013
* Bundesamt für Statistik, Strukturerhebung, 2011
* Mikrozensus Verkehr 2010, Bundesamt für Statistik, 2012
Table A2: Factor loadings and communalities based on PCA for the 6-item place attachment scale to city; displayed are the translated items of the German NAS scale by Bonaiuto and colleagues (1999) (N = 729)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor loading</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>The city of Schlieren is the ideal residential location for me.</td>
<td>0.838</td>
<td>0.702</td>
</tr>
<tr>
<td>It would be very hard for me to leave Schlieren.</td>
<td>0.817</td>
<td>0.668</td>
</tr>
<tr>
<td>I would willingly live in another location (reverse coded).</td>
<td>0.797</td>
<td>0.635</td>
</tr>
<tr>
<td>I have nothing in common with Schlieren (reverse coded).</td>
<td>0.800</td>
<td>0.640</td>
</tr>
<tr>
<td>I identify with the people of Schlieren.</td>
<td>0.688</td>
<td>0.473</td>
</tr>
<tr>
<td>I do not feel integrated in Schlieren (reverse coded).</td>
<td>0.672</td>
<td>0.452</td>
</tr>
</tbody>
</table>

Eigenvalue 3.569
% of total variance 58.48

Note. Items measured on a 5-point scale ranging from 1 = fully disagree to 5 = fully agree.

Table A3: Descriptive statistics for the place attachment to city scale (N = 729)

<table>
<thead>
<tr>
<th>Factor attachment to city</th>
<th>No. of</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Cronbach's α</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>items</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place attachment to city</td>
<td>6</td>
<td>3.47 (0.92)</td>
<td>-0.30</td>
<td>-0.48</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Note. Items measured on a 5-point scale ranging from 1 = fully disagree to 5 = fully agree.

Table A4: Descriptive statistics for the three PUC-t factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. of items</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Cronbach's α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: “Attractive upgrading”</td>
<td>3</td>
<td>3.33 (0.92)</td>
<td>-0.451</td>
<td>0.021</td>
<td>0.822</td>
</tr>
<tr>
<td>Factor 2: “Stressing growth”</td>
<td>4</td>
<td>3.16 (0.97)</td>
<td>-0.174</td>
<td>-0.470</td>
<td>0.780</td>
</tr>
<tr>
<td>Factor 3: “Rapidity of change”</td>
<td>3</td>
<td>4.53 (0.61)</td>
<td>-1.54</td>
<td>2.18</td>
<td>0.691</td>
</tr>
</tbody>
</table>

Note. Items were measured on a 5-point scale with 1 = I totally disagree to 5 = I totally agree.
Table A5: Descriptive statistics for the three PUC-i factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. of items</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: “Familiar”</td>
<td>3</td>
<td>3.86 (1.25)</td>
<td>-0.016</td>
<td>-0.125</td>
<td>0.785</td>
</tr>
<tr>
<td>Factor 2: “Inviting”</td>
<td>3</td>
<td>4.21 (1.31)</td>
<td>-0.080</td>
<td>-0.208</td>
<td>0.840</td>
</tr>
<tr>
<td>Factor 3: “Urbanized”</td>
<td>3</td>
<td>5.33 (0.92)</td>
<td>-0.681</td>
<td>1.53</td>
<td>0.544</td>
</tr>
</tbody>
</table>

Note. Items were recoded on a 7-point bipolar semantic differential scale from 7 = fully agree with left wording to 1 = fully agree with right pole wording.
Figure A6: Example of one image series used as visual stimulus for the rating on the PUC-i scale (see Table 2); subjects were instructed to rate the image series once for 2005 (image on top left side) and for 2011 (lower right side) image on two separate semantic differential scales with same items; image series is 1 of 5 provided in the supplementary material.
References


Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life
5. Research article IV - Exploring local patterns of place attachment in a suburban study region in Switzerland

Published as: von Wirth, T., Grêt-Regamey, A., Stauffacher, M. (2014). Exploring local patterns of place attachment in a suburban study region in Switzerland; Published in the Peer-reviewed proceedings of the 51st International Making Cities Livable (IMCL) conference, Portland, OR, 2014

Abstract

Sense of place has been identified as a contributing factor to residents’ well-being and as a relevant indicator for community sustainability. One way to conceptualize and quantify the sense of place is by measuring the concept of place attachment. Surprisingly, place attachment, as clearly being a spatially related concept, has been studied only rarely by spatial analysis.

This conference article explores how and why residents’ place attachment varies across neighborhoods in a Swiss case study; where urban areas are challenged by negative effects of rapid growth, such as threats to the urban environmental quality and residents’ perceived quality of life. The study draws data from a representative survey conducted among $n=899$ residents. Using geographic information systems (GIS) the survey responses were analyzed according to the residents’ household locations.

The analysis found significant differences in place attachment between neighborhoods. These patterns were explained by, among other variables, the perceived environmental conditions, such as the proximity to sources of noise (e.g. as a major railroad line) and to recreational green spaces. For three selected neighborhoods, the perceived environmental characteristics varied in their predictor influence on residents’ place attachment. Neighborhood bonds and building aesthetics were significant predictors in all three neighborhoods and in the city model. The use of spatial analysis and GIS may open the door to integrated assessments of social and environmental variables, both influencing the quality and livability of places.

Keywords: Sense of place, place attachment, geographic information systems, livability
5.1. Introduction

Sense of place has been identified as a contributing factor to residents’ well-being (Eyles and Williams 2008) and as relevant indicator of community sustainability (Stedman 1999). It builds on the interaction of psychological, social, and environmental processes connected to physical places (Stedman 2003; Tuan 1977).

The American Institute of Architects (AIA) identified the sense of place as a key component of livable communities. Urban design guidelines help create the sense of place based on “comfort, function, and attractive appearance” (AIA 2005), though they mainly consider the physical contribution of urban design to the sense of place. At the same time, other important variables influence the sense of place, for example, people’s experiences and expectations, social interactions in places, and geographic location (Bosselmann 2008). The idea of creating a sense of place solely based on urban design principles does not often build on a thorough evaluation. In fact, Stedman noted that “quantitative research on sense of place is still in infancy” (1999, p. 765; see also Jorgensen and Stedman 2006). Thus, understanding and capturing the sense of place remain a challenge for researchers and policymakers.

One method to conceptualize and quantify the sense of place is by evaluating the affective responses of persons to places. A key concept in capturing these person–place bonds is place attachment. The concept has been defined by different scientific disciplines such as human geography, environmental psychology, and sociology, though a distinctly common understanding is missing (Scannell and Gifford 2010). A tentative description stems from Low and Altman’s seminal work, which referred to place attachment as “an integrating concept that emphasizes affective relations to environmental settings” (1992, p. 7), in short, giving places a meaning. Place attachment is influenced by a large variety of factors, including person characteristics, social context, length of place experience over time, and characteristics of the urban environment (for a detailed overview on predictor variables, see for example, Lewicka 2011; Hidalgo and Hernandez 2001).

This study focuses on the influencing characteristics of the urban environment as perceived and evaluated by residents. Research findings suggest that place attachment has a positive effect on environmentally responsible behavior and place-protective attitudes (Patrick Devine-Wright 2009; Uzzell et al. 2002). Evidence also points to place attachment as a suitable predictor of resource conflicts, for example, concerning attitudes toward planned fee programs and overcrowding on public lands (Brown and Raymond 2007; Kyle et al. 2003). The
attachment to places may be located on different spatial scales (for instance, the house, the neighborhood, or the city) (Scannell and Gifford 2010).

Surprisingly, place attachment, as a spatially related concept, has been rarely studied in terms of integrating spatial analysis and its variations across space. For many years, interest in the social dimensions of place attachment had been stronger, compared to its physical dimensions (Brehm 2007). Research focused mainly on the perceptions, as well as the behavioral and affective responses of individuals. Little work has been done to explore the concept of place attachment as spatially differentiated (Lewicka 2011).

Spatial analysis entails a set of methods using topological, geometric, or geographic information about entities in disciplines such as geography, urban planning, and environmental sciences. Central to spatial analysis is the use of geographic information systems (GIS) and geostatistics. The application of GIS, together with place-related concepts established in environmental psychology and sociology, may bring added value to the understanding of the influencing factors in place attachment. As such, the presentation of results from place attachment research could be better applicable to the planning and urban design disciplines.

To date, few studies have used spatial analysis based on GIS in place attachment research. For example, Brown and Raymond (2007) examined the relationship between a map-based measure of place attachment and landscape values based on survey data. Brown argued that the mapping of information on place attachment provided “richer, place-based information for land use planning” (Brown and Raymond 2007, p. 89). Brown and Raymond emphasized the need to develop “analytic tools that can address the geographic dimensions of place more directly” (2007, p. 90). A study by Williams (1995) applied mapping of place meanings for ecosystem management and concluded that with the expanded use of GIS in ecosystem management, “intangible emotional and symbolic meanings can be mapped, displayed, and contrasted with each other” (p. 26). Stedman (2003) integrated survey data and spatial information about the place environment to understand the contribution of the physical environment to the sense of place. The study found that the physical landscape attributes significantly matter to constructed meanings of places and concluded that such constructs are not exclusively social (Stedman 2003). Stedman also argued for a stronger integration of spatially explicit analysis of the geographic setting into research on place attachment.
The only work that combined research on place attachment with spatial analysis in the context of urban transformation was carried out by Perkins and colleagues (2009) to evaluate new housing policies in Salt Lake City, Utah. The authors found that an urban intervention by developing new middle-class housing in a declined area improved the overall physical conditions in the neighborhood. However, spatial analysis of the maps suggested that the hypothesized spillover effects of the new housing appeared geographically limited and included unintended, negative psychological consequences. Nevertheless, the study concluded that the use of GIS was a valuable tool to analyze community-related, social variables for presentation to community and nonscientific professional audiences. The authors suggested increasing the use of a combined application of GIS and psychological and behavioral variables in planning research.

In essence, the few existing studies indicate a demand for studying place attachment by using spatial analysis methods. Thus, this conference article explores quantitative measures for place attachment in a Swiss case study in terms of their variations among city neighborhoods. Switzerland currently offers an appropriate study context for research on place attachment in urban areas. The prosperous economic situation attracts an increase in population, which is reflected in rapid urban growth patterns that significantly transform the characteristics and meanings of places (Hunziker et al. 2008; Felber Rufer 2006). Due to the topographic situation, the potential space for settlement growth is limited and requires compact city development within the existing settlement boundaries, a contested development strategy often opposed by local communities.

Thus, mapping and analyzing place attachment according to its variations across space may provide insights for integrating social indicators into planning disciplines when striving for livable and healthy communities.

This study answers the research questions:

(i) How does place attachment vary among neighborhoods?

(ii) Why does place attachment vary among neighborhoods?

By giving answer to these questions, we are able to discuss which of the influencing factors may directly be affected by urban planning and urban design.
5.2. Methods and Materials

5.2.1. Case study region

The Swiss city of Schlieren was chosen as the case study area. The city is a rapidly growing suburban settlement of about 18,000 inhabitants (as of the 2013 Cantonal statistics) in the Zurich metropolitan area, the largest agglomeration in Switzerland. The population of Schlieren increased by 25% between 2007 and 2012, compared to the national average increase of 5.9% for the same period (BfS, 2013). Current forecasts expect a further growth in population by 3,000 inhabitants (+17%) until the year 2025 (ZPL 2012). The city was chosen since it is part of a typical suburban region that is described as “a miniature of Switzerland” (Schumacher et al. 2004, p. 232).

The case study area is both dominated and fragmented by an extensive, (inter-)nationally significant infrastructure in the form of linear transport axes; as displayed in Figure 1. With 740 train trips per day, the railway lines crossing the area comprise the most frequently used section of train infrastructure in Switzerland (J. Heldstab and Kljun 2007). The study area is characterized by a patchwork of land uses, such as residential neighborhoods, industrial areas, shopping centers, and areas for nonproductive industries, as well as agricultural and natural areas along the river.

The rapid urban growth currently results in pertinent land consumption and intense urbanization. The urbanization has been accompanied by debates about the city’s identity and a substantial loss in the sense of community due to high migration rates and a poor city image. Urban policymakers requested to gain more knowledge about potential influences on residents’ attachment to the city and the differences in perception of place attachment among city neighborhoods. However, the causes underlying the place attachment in rapidly growing communities remain unclear.
Figure 1. Map of the suburban case region; the city of Schlieren with neighborhood boundaries and dispersion of survey households (n = 894). Color indicates the factor score on the place attachment scale.

5.2.2. Sampling procedure and characteristics

The sample from residents aged 18 years and older was randomly selected from the citizen register, applying a stratified probability sampling for equal representation of women and men. The respondents participated in a postal survey conducted between May and July 2013. A three-contact mailing procedure (initial mailing, postcard reminder, and follow-up full mailing) was used and resulted in a response rate of 30%. The full sample consisted of 1,699 returned questionnaires from two cities, whereas this study used solely the data for the city of Schlieren (n = 899 completed questionnaires). Since the full addresses of the survey respondents’ households were provided in 894 cases, this number constituted the final sample size for the analysis.

The responding sample was representative of the population in the study region. The socio-demographic, household, and housing characteristics of the sample fit the population census data as of 2011/2012. However, the respondents (50.6%
women) had a moderately older mean age of 49.3 years ($SD = 18.0$) and were likely to have higher education; 10.6% held master’s or higher academic degrees, while the majority completed vocational training (39.5%). The survey respondents were also more likely to be Swiss citizens (compared to the local population), with 55.2% born in Switzerland. Overall, the length of residency at the current address was on average 12.1 years ($SD = 13.1$). The residents’ average household size was 2.53 ($SD = 1.27$), with 22.0% living in single households and 39.3% in households with children. The sample was spatially representative of the distribution across the local neighborhoods in the city area. Four city neighborhoods were excluded from the analysis because they mainly comprised either industrial or forest areas; the respective number of survey respondents was too small ($n < 15$). Hence, the final total number of city neighborhoods included in the final sample was 13.

5.2.3. Measures used in the analysis

The questionnaire collected the subjective assessments of survey respondents on diverse aspects of urban quality of life (QoL), place attachment, and urban transformation. In addition, it covered residents’ perception on various neighborhood characteristics (for example, perceived density, accessibility of green spaces, neighborhood bonds, noise, and safety) as well as housing and socioeconomic variables.

Place attachment was measured with a six-item, place attachment scale, based on the neighborhood attachment scale (NAS) validated by Bonaiuto and colleagues (2003) in studies on Italian cities. The NAS, which originally contained eight items, was reduced to six items and was translated into German. Participants rated place attachment on a 5-point Likert scale (1 = “I totally disagree” to 5 = “I totally agree”). Examples of the items are: “It would be very hard for me to leave Schlieren” or “The city of Schlieren is the ideal residential location for me.” A principal component analysis (PCA) found a one-factor solution. The internal consistency of the place attachment to the neighborhood factor was found to be good, with Cronbach’s alpha coefficient = .85.

The perceived neighborhood characteristics were measured based on 30 items. Participants rated the items on a 5-point Likert scale (1 = “I totally disagree” to 5 = “I totally agree”). The PCA resulted in nine factor dimensions, out of which eight factors were used for this study.

The selection of the perceived neighborhood characteristics was informed by a thorough literature review and two focus group workshops held with local city
Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life

planning experts (N = 5) and residents (N = 7) from the study region. Participants were asked to collect, discuss, and rank characteristics of their urban environment contributing to QoL and residential well-being in the local and regional contexts. The resulting set of attributes consisted of the following dimensions: safety in public spaces, quietness/absence of noise, density of utilization, accessibility and connectedness of functions, amenity values of public spaces, compactness and clarity of urban design, places for and quality of interaction (e.g., with neighbors), places and sense of belonging, proximity to services and functions for necessities, and accessibility to green spaces and recreation areas. The attributes identified in both explorative workshops were operationalized in the paper-and-pencil questionnaire. Further dimensions were added to the questionnaire, based on the literature review (e.g., building aesthetics and affordability of housing).

The factor for perceived built density consisted of two items (e.g., “Buildings are built too densely here in my neighborhood”); Cronbach’s alpha coefficient = .74. The perceived accessibility of green spaces and recreational areas built on four items (e.g., “I can reach green spaces for recreation within walking distance”); Cronbach’s alpha coefficient = .77. The factor for perceived noise was measured with three items (e.g., “This is a quiet neighborhood without traffic noise”); Cronbach’s alpha coefficient = .61. Four items were included in the measurement of perceived safety in public spaces (e.g., “Streets and public places are safe here during the night”); Cronbach’s alpha coefficient = .72. The intensity of neighborhood bonds comprised three items (e.g., “People in this neighborhood are closely connected”); Cronbach’s alpha coefficient = .82. Building aesthetics was measured with three items (e.g., “Buildings in this neighborhood appear attractive to me”); Cronbach’s alpha coefficient = .74. Affordability of housing was based on three items (e.g., “Affordable housing for families is sufficiently available here”); Cronbach’s alpha coefficient = .79. Finally, perceived social diversity was measured based on two items (e.g., “This is a socially mixed neighborhood with a great diversity of people”); Cronbach’s alpha coefficient = .62.

All variables included in the analysis had from 1.6% (length of residency) to 4.4% (perceived building density) missing values. This incomplete data pattern was identified as missing at random. Missing data was not imputed; hence, missing cases were deleted listwise for multivariate analyses. All variables used in the analysis were only slightly skewed, with absolute statistics for skewness and kurtosis below +/-1 (e.g., negative skewness ranging from -.502 to -.139). Only length of residency was skewed by 1.58, though the visual inspection of univariate QQ plots confirmed acceptable, close-to-normal distributions.
5.2.4. Analytic procedure

In order to identify spatial patterns of place attachment, the survey data was linked to geometric information according to the spatial household location of each survey respondent, using ArcGIS 20. This geocoding process used the address information available from the citizen register (street, house number, and postal code), based on the digital street network data for Switzerland provided by the Swiss Post Service, combined with digital building information administered by the Swiss Federal Office of Statistics.

The methodological procedure started with a PCA that resulted in factor scores for place attachment and the perceived neighborhood characteristics (e.g., accessibility of green spaces, density, noise, and neighborhood bonds among residents). Factor scores for place attachment were then used in one-factorial analysis of variance (ANOVA) to explore the differences among neighborhoods. The deviations from the mean values for place attachment and the perceived neighborhood characteristics were mapped for further spatial analysis.

Exploring place attachment was extended by estimating linear regression models for three selected neighborhoods and the city of Schlieren in order to analyze the differences in predictor influence. The neighborhoods of Dorf, Spitalquartier, and Schlieren-West were chosen. Dorf is the old center of the city with a stable building stock of multi-dwelling units and single detached houses with lower building densities, whereas Spitalquartier is dominated by large-scale, multi-dwelling units, partly located along major roads and around a large hospital building.

Finally, Schlieren-West is a new residential neighborhood located along the main train tracks, where larger industrial and commercial areas had been transformed into new residential areas over the last five years. Linear regression models were calibrated for the full city sample and for the selected neighborhoods in order to compare the city model with the selected neighborhoods in terms of the influence of perceived place characteristics on the residents’ place attachment. When comparing coefficients for the same predictors across neighborhoods, interaction terms between a dummy variable for the respective neighborhoods and the predictor variable have to be included in the model. The interaction term tests the null hypothesis of no difference in coefficients between the chosen neighborhood as the reference group and all other neighborhoods with a probability score (data not reported here). Descriptive statistics for comparison of the selected neighborhood samples are presented in Table 3 in the Appendix.
5.3. Results

5.3.1. Variations in place attachment among neighborhoods

The average place attachment value for the sample was found at $M = 3.53$ ($SD = 0.92$, range = 1–5). To derive place attachment values on the neighborhood scale, the mean value across all individuals living in the respective neighborhoods was calculated. To explore the spatial distribution of place attachment ratings across space, the deviations of the neighborhood mean from the average place attachment value among all neighborhoods were mapped, as shown in Figure 2. The mapped standard deviations showed lower place attachment values in the central neighborhoods located along the train tracks. Particularly, the Bahnhofquartier neighborhood had a lower place attachment score on average ($< -1.5$ $SD$) compared to the mean value across all neighborhoods, whereas neighborhoods such as Dorf and Zelgli Ost, which are more distant from the main train line but in close proximity to recreational spaces, showed above average place attachment.

Figure 2. Map of standard deviations in the neighborhoods from the mean value for place attachment across all city neighborhoods.
The ANOVA in place attachment scores among the city neighborhoods confirmed significant differences, with $F(12, 836) = 6.30; p < 0.001$. For example, one main difference occurred between the neighborhoods of Dorf ($M = 3.84, SD = 0.92$) and Bahnhofquartier ($M = 2.82, SD = 0.90$); the post-hoc Bonferroni test result was significant ($p < 0.01$). Figure 3 displays the mean variations among the 13 neighborhoods included in the analysis.

**Figure 3.** Comparison of mean values for place attachment by neighborhood (range = 1–5).

The mean values for place attachment in the selected neighborhoods Spitalquartier ($M = 3.40, SD = 0.93$) and Schlieren-West ($M = 3.42, SD = 0.78$) did not differ significantly; the post-hoc Bonferroni test result was insignificant. Though, the differences in mean values between Dorf and Schlieren-West and between Dorf and Spitalquartier were significant; the post-hoc Bonferroni test yielded $p < 0.05$. Estimating standard errors as displayed in figure 3 allows for the comparison of variance among neighborhoods of different sample sizes, as it normalizes the standard deviation on the neighborhood sample size. The neighborhoods Dorf, Spitalquartier and Schlieren-West showed smaller standard errors. Accordingly, the heterogeneity of place attachment within these neighborhoods appeared smaller, due to smaller variances. The neighborhoods Bahnhofquartier, Huebler, Am Rietpark, and Rueti showed larger standard errors. Hence, there was a greater heterogeneity of place attachment scores within these neighborhoods. Consequently, the three neighborhoods Dorf, Spitalquartier and Schlieren-West, which showed higher homogeneity in place attachment were chosen for further multivariate analyses (section 5.3.3)
5.3.2. Spatial exploration of the perceived neighborhood conditions

Figure 4 and Table 2 in the Appendix display the spatial variations of the perceived neighborhood conditions. They also show the average length of residency by neighborhood, used as an independent variable in the following multivariate analysis. Considering the three selected neighborhoods, the maps showed relatively lower scores for length of residency ($M = 3.15$ years, $SD = 2.53$), affordability of housing, and intensity of neighborhood bonds for the new residential area of Schlieren-West. Additionally, the perceived noise score for this neighborhood was above the average value for the city (+0.5 to +1.5 $SD$). The building aesthetics score was perceived to be positively above average in Schlieren-West.

The neighborhood of Spitalquartier showed an above average score for length of residency (+0.5 to +1.5 $SD$) and positively perceived neighborhood bonds. The building aesthetics score was lowest in Spitalquartier, compared to the values of all other neighborhoods (on average < -1.5 $SD$). Perception of noise in this area was comparably low, which was also found for the Dorf neighborhood (on average < -1.5 $SD$). Residents in Dorf perceived neighborhood bonds and affordability of housing to be positively above average. Likewise, the length of residency was above average ($M = 14.96$, $SD = 14.50$).

5.3.3. Results of multivariate analysis

Linear regression models were applied to explore whether the predictive power of the perceived neighborhood conditions varied spatially. The analysis found both cases; significant predictors of residents’ place attachment were stable among the selected neighborhoods, whereas other factors differed significantly. Table 1 displays the results of the estimated regression models with eight explanatory variables on the dependent variable of place attachment.
Table 1. Comparison of regression models for selected neighborhoods and the city model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dorf (n=186)</th>
<th>Spitalquartier (n=133)</th>
<th>Schlieren-West (n=75)</th>
<th>All neighborhoods (n=796)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(intercept)</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Length_Res</td>
<td>.127 *</td>
<td>.209 **</td>
<td>-.158</td>
<td>.184 ***</td>
</tr>
<tr>
<td>Noise</td>
<td>-.098</td>
<td>-.074</td>
<td>-.262 **</td>
<td>-.123 ***</td>
</tr>
<tr>
<td>Neighb_Bonds</td>
<td>.259 **</td>
<td>.393 ***</td>
<td>.254 *</td>
<td>.287 ***</td>
</tr>
<tr>
<td>Safety</td>
<td>.056</td>
<td>.001</td>
<td>.106</td>
<td>-.020</td>
</tr>
<tr>
<td>Built Density</td>
<td>.137 *</td>
<td>.142</td>
<td>-.401 **</td>
<td>.068 *</td>
</tr>
<tr>
<td>Green_Spaces</td>
<td>.107</td>
<td>.105</td>
<td>.056</td>
<td>.099 **</td>
</tr>
<tr>
<td>Buildg_Aesth</td>
<td>.273 ***</td>
<td>.217 **</td>
<td>.277 *</td>
<td>.258 ***</td>
</tr>
<tr>
<td>Housg_Afford</td>
<td>-.061</td>
<td>-.077</td>
<td>-.204 *</td>
<td>-.050 .</td>
</tr>
</tbody>
</table>

adj. R²               | .411         | .433                   | .333                  | .375                      |

F (8, 177)            | 17.14 ***    |                        |                       |                           |
F (8, 124)            | 13.26 ***    |                        |                       |                           |
F (8, 66)             | 5.626 ***    |                        |                       |                           |
F (8, 787)            | 60.66 ***    |                        |                       |                           |

Note: β = standardized coefficients; * p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

The neighborhood bonds factor (the intensity of relations and trust among neighbors) was found to be a significantly positive predictor of place attachment in all three neighborhoods and in the global model. Likewise, building aesthetics was a significant factor that positively influenced place attachment in the selected neighborhoods and the city model.

For the neighborhoods of Dorf and Spitalquartier, the length of residency was a significant predictor of place attachment, but it was not the case for the relatively new residential neighborhood of Schlieren-West. In Schlieren-West, the perceived building density was found to have a negative influence on residents’ place attachment. The influence of noise was also perceived as a negative factor in this neighborhood. The explanatory power of the regression model was lower in Schlieren-West, compared to the other selected neighborhoods and the city model. For Schlieren-West, 33% of the variance in place attachment was explained by the chosen set of variables.
The city model across all neighborhoods found building aesthetics and neighborhood bonds as significant predictors with the strongest influence on place attachment, whereas the perceived noise was a significantly negative predictor of residents’ place attachment. The city model explained 37.5% of the variance in place attachment.

5.4. Discussion

This conference paper explored the spatial differences in place attachment for a Swiss suburban study region. The study found significant differences in place attachment values among neighborhoods. For the three selected neighborhoods, the explanatory factors varied in importance, whereas the two factors of neighborhood bonds and building aesthetics were significant predictors in these neighborhoods and in the city model.

5.4.1. Significance of identified spatial differences in place attachment

The visual inspection of the mapped place attachment values across the study region indicated potential clustering of higher place attachment in the southern part of the Dorf neighborhood and in the neighborhood of Schlierenberg. An initial analysis of the geographic features in these areas indicated their close proximity to green spaces, particularly the large recreational forest areas; it also showed lower densities of the built structures and farther distances from the main railway lines, for example.

Neighborhoods that are centrally located adjacent to the major railroad lines and to larger through roads showed lower place attachment on average than neighborhoods with longer distances from these infrastructures. Roads and railroads are both sources of noise emission. In the neighborhoods of Bahnhofquartier, Rueti, and Am Rietpark, the perceived noise exposure was significantly higher than in other city neighborhoods (see Figure 4 in the Appendix). In this context, Chasco and Gallo (2013) recently found noise as a place-based perception variable with a halo effect for a case study in Madrid. In this case, the authors referred to such an effect as residents in wealthier neighborhoods who did not perceive their environment as highly polluted based on their higher sense of place. Their study surprisingly found positive effects of the objective measures of pollutants on housing prices but a significantly negative effect of the subjective measures; the authors concluded that “housing prices are better explained by
subjective evaluation factors than by objective measurements” (Chasco and Gallo 2013, p. 145).

These results would mean that urban amenity values as perceived by residents are reflected in person-place bonds, which then would not be solely a social phenomenon (Stedman 2003). The positive influence of urban green space use aligns with recent findings by Irvine and colleagues (2013), who identified positive emotional place bonds as a derived effect from urban green space use for a case study in the UK. Bonaiuto and colleagues (1999) also found that a lack of green areas had an adverse effect on place attachment for residents of neighborhoods in Rome, Italy. Their study also found length of residency, buildings’ aesthetic pleasantness, and social relationships in the neighborhood as positive predictors. All three variables were confirmed by our findings. Particularly, neighborhood bonds and building aesthetics were found as influencing variables across all neighborhoods. The positive impact of building aesthetics on residents’ place attachment strengthens the evidence that urban design indeed affects the relation that people develop with places. Nonetheless, it remains a two-way interactive process. Surprisingly, safety in public space was found non significant in its influence on residents’ place attachment, whereas studies on residents’ urban QoL found safety as an important, significant predictor (von Wirth et al. 2014; Marans and Stimson 2011). This indicates differences between the concepts of place attachment and urban QoL.

The length of residency was found to be insignificant for the new residential area of Schlieren-West, although the place attachment value for this site did not differ from those of neighborhoods with longer lengths of residency (e.g., Spitalquartier). This result means that attachment to the neighborhood would not rely on specific, longer time frames, as described by Giuliani (2003), for example. Our findings suggest that when other influencing factors are given, place attachment could also be established over short time periods. However, when the average length of residency is longer, it may become an additional influencing factor. Additionally, residents within the community who are moving into new housing areas may have influenced the models. It is assumed that these residents already start with a certain degree of attachment to the city and relate to the new neighborhood environment in a short time due to their self-selected improvements in neighborhood amenities.

These dynamic aspects of place relations imply that place attachment should be captured continuously over time. Moving behavior and changes in neighborhood settings could then be addressed in relation to variations in residents’ place
bonds—an important research focus that Devine-Wright and Gustafson (2014) recently emphasized, particularly in its relevance for policymaking.

5.4.2. Limitations and research options for livable neighborhoods

This study compared place attachment patterns among city neighborhoods. The choice of administrative spatial boundaries as the basis for comparison should be critically cited as a source of statistical bias. The average values of place attachment for a city neighborhood were calculated based on point-based measures of households located within each neighborhood boundary. Hence, the choice of spatial boundaries influences the resulting neighborhood values, an error source known as the modifiable areal unit problem (MAUP). A variety of techniques has been developed to address MAUP (Anselin and Getis 2010). For example, kriging procedures based on variograms estimate models of the spatial correlation in the observed phenomena. The variogram model is then used to define distance weights in the kriging function. Kriging can be applied for example, when the analytical interest is in areas while the measurement is containing data at points. A kriging function then estimates variable values for areas where data are missing, resulting in a value surface (Wackernagel 2003).

Fotheringham and Wong (1991) outlined the sensitivity of parameter estimates in multivariate analysis to variations in scale and zoning systems. Therefore, the analysis undertaken in this study should be considered as an explorative, spatial differentiation of place attachment rather than as a spatially explicit procedure. One solution would be to apply geographically weighted regression (GWR) technique. The GWR technique allows testing different spatial units of reference for the local regression models based on distance and variable values across space. By using GWR, local planning tradeoffs can be illustrated. For instance, local regression analysis could support urban management to evaluate planned interventions in advance (such as the increase in local taxation across space). Crespo and Grêt-Regamey (2013) recently demonstrated this procedure using a hedonic house price model for the Canton of Zurich in Switzerland.

However, GWR relies on large sample sizes preferably with a constant coverage over space, which is a resource-intense measurement process, particularly for person-related variables. Data for the study at hand showed aggregated patterns of data points, because in larger dwellings several households were sampled. Overlaying point data with the same geographical coordinates would have biased the estimation of local regression models in GWR. In contrast, this study used independent regression models and choropleth maps based on administrative
boundaries to explore the spatial variations in place attachment and local differences in predictor importance. Though error prone, choropleth maps of socio-spatial phenomena are an established method to visualize data for policy support and urban management. Moreover, this study drew data from a representative sample of residents. In the research on the influencing factors behind a socio-spatial concept such as place attachment, this sampling approach can be a valuable source to inform urban planning strategies. It should complement city GIS that are often solely based on objective information about the urban environment.

5.5. Conclusion

In conclusion, this conference article explored the variations in place attachment and its predictors among city neighborhoods. The study found significant variation in place attachment among neighborhoods. For the three selected neighborhoods, the perceived environmental characteristics varied in their influence on residents’ place attachment. Neighborhood bonds and building aesthetics were significant predictors in all three neighborhoods and in the city model. The use of spatial analysis and GIS may open the door to integrated assessments of social and environmental variables, both influencing the quality and livability of places. Mapped information on place attachment may function as a valuable indicator for supporting the evaluation and monitoring of livable and healthy neighborhoods.

Acknowledgment

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Appendix

Figure 4a. Deviation from mean values for explanatory variables by neighborhood.
Figure 4b. Deviation from mean values for explanatory variables by neighborhood.
### Table 2. Overview on variables used in the analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range / unit</th>
<th>Dorf (n=186)</th>
<th>Spitalquartier (n=133)</th>
<th>Schlieren-West (n=75)</th>
<th>All neighborhoods (n=796)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place attachment</td>
<td>scale 1 - 5</td>
<td>3.85 (.93)</td>
<td>3.40 (.93)</td>
<td>3.42 (.78)</td>
<td>3.53 (.92)</td>
</tr>
<tr>
<td>Noise</td>
<td>scale 1 - 5</td>
<td>2.34 (.95)</td>
<td>2.53 (1.03)</td>
<td>3.15 (.94)</td>
<td>2.66 (1.03)</td>
</tr>
<tr>
<td>Neighb_Bonds</td>
<td>scale 1 - 5</td>
<td>3.45 (.81)</td>
<td>3.09 (.89)</td>
<td>3.20 (.77)</td>
<td>3.26 (.86)</td>
</tr>
<tr>
<td>Safety</td>
<td>scale 1 - 5</td>
<td>3.41 (.83)</td>
<td>3.33 (.80)</td>
<td>3.52 (.72)</td>
<td>3.38 (.82)</td>
</tr>
<tr>
<td>Built Density</td>
<td>scale 1 - 5</td>
<td>3.478 (1.07)</td>
<td>3.278 (1.95)</td>
<td>2.927 (.92)</td>
<td>3.226 (1.04)</td>
</tr>
<tr>
<td>Green_Spaces</td>
<td>scale 1 - 5</td>
<td>3.811 (.87)</td>
<td>3.609 (.83)</td>
<td>3.408 (.77)</td>
<td>3.626 (.86)</td>
</tr>
<tr>
<td>Buildg_Aesth</td>
<td>scale 1 - 5</td>
<td>3.42 (.99)</td>
<td>3.01 (.90)</td>
<td>3.51 (.88)</td>
<td>3.30 (.95)</td>
</tr>
<tr>
<td>Housg_Afford</td>
<td>scale 1 - 5</td>
<td>3.35 (.94)</td>
<td>2.99 (.97)</td>
<td>2.77 (.91)</td>
<td>3.00 (.99)</td>
</tr>
</tbody>
</table>

### Table 3. Overview on social and household characteristics of samples used in the analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range / unit</th>
<th>Dorf (n=186)</th>
<th>Spitalquartier (n=133)</th>
<th>Schlieren-West (n=75)</th>
<th>All neighborhoods (n=796)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (of residents 18+)</td>
<td>years</td>
<td>51.7 [18.74]</td>
<td>53.5 [18.04]</td>
<td>42.1 [13.61]</td>
<td>49.3 [18.0]</td>
</tr>
<tr>
<td>Gender [% female]</td>
<td>percentage</td>
<td>58.5</td>
<td>53.2</td>
<td>38.4</td>
<td>50.6</td>
</tr>
<tr>
<td>Academic education</td>
<td>percentage</td>
<td>8.5</td>
<td>10.6</td>
<td>16.8</td>
<td>16.2</td>
</tr>
<tr>
<td>Single Households</td>
<td>percentage</td>
<td>24.0</td>
<td>25.0</td>
<td>15.9</td>
<td>22.0</td>
</tr>
</tbody>
</table>
References


Devine-Wright, P. (2014). Dynamics of Place Attachment in a Climate Changed World. In L. C. Manzo, & P. Devine-Wright (Eds.), Place Attachment:
Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life

Advances in Theory, Methods and Applications (pp. 165-177). New York: Routledge.


6. Concluding remarks

This thesis had two objectives. First, it sought to increase the understanding about the influence of context-specific factors on the urban quality of life. Second, it sought to identify the procedural implications of how the residents’ perspectives and spatial characteristics can be integrated to inform urban development processes. Accordingly, two research questions guided the procedure applied in the Swiss case study region. The answers to these questions enlarge the existing evidence on how individuals experience and evaluate their urban environments, showing how the urban quality of life may actually be affected by urban planning interventions. Linking the place experiences of residents with objective spatial characteristics provides essential information for the integrated assessment of urban living environments, which may also enhance cooperation among local city actors. Thus, the thesis contributes to finding deliberative coping strategies for contested urban growth effects in Switzerland and elsewhere.

By accounting for the multiplicity of actor perspectives, spatial scales, levels of specificity, and characteristics of perceived urban change over time, the thesis followed the theoretical framework presented by Pacione (2003). A coupled understanding of the concept of urban quality of life was proposed, which was empirically applied by two measurement concepts: residential satisfaction and place attachment. The collaborations with stakeholders, planning professionals and residents from the Limmattal region followed the principles of transdisciplinary research, which aims to establish collaborative research settings between science and practice that seek to achieve societal impacts evolving from the common research process.

This concluding chapter begins in Section 6.1 by summarizing the key findings in order to answer the guiding research questions. The following Section 6.2 presents a synthesis of implications for urban development. Then, the methodological procedure applied in this thesis is critically discussed in Section 6.3, leading into an outline of future research options covered in Section 6.4. The thesis concludes with final comments in Section 6.5.
6.1. Summary of key findings

6.1.1. Specific factors influencing urban quality of life

With regard to the first research question, this thesis started with an analysis of the impact factors on place qualities in the context of the Swiss Limmattal region. The study identified clusters of relevant factors impacting current and future regional place qualities. The cluster of ambivalent impact factors included economic and demographic development, relatedness to place, transport infrastructure and density of uses, out of which economic development showed the highest activity scores. Ambivalent impact factors were strongly embedded within the regional system—that is, they actively influenced other system elements and were, likewise, sensitive to other influencing factors.

Among the core set of eighteen influencing factors, economic and demographic development were identified as the two main drivers of regional place qualities—a finding that supports previous research on the driving forces of scaling effects in cities (Batty 2008). This rather self-evident finding has implications for urban quality of life in the local contexts of the region. Economic prosperity and population growth define the objective framing conditions for urban growth patterns. Adapting to the subsequent effects of urban growth, be they beneficial or unwanted, constitutes the context in which urban quality of life evolves on local scales. Thus, local quality aspects can be seen as a result of appropriate coping strategies corresponding to variations in the two superior impact factors economic and demographic development.

The evolvement of regional place quality is furthermore driven by additional dynamic effects, which may enforce or slow down regional transformations. Such regional feedback loops are closed-impact effect chains. Our study demonstrated the procedure for identifying important feedback loops based on expert judgments. The five related impact factors representing the most important feedback loop described a mechanism of socio-spatial interrelatedness, with demographic development as the emanating factor. The identified loop structure was interpreted as an additional systemic driver of sprawled and fragmented land use patterns in suburban Switzerland. The analysis of the most important feedback loop illustrated the relational complexity of impact factors in the region and went beyond identifying solely direct variable impacts on place qualities.

In fact, coping with the relational complexity of spatial transformation and its inherent uncertainties was identified as one of the key challenges of urban
planning (Ernstson 2010, Healey 2006). A more comprehensive integration of the residents’ perspective on the urban environment was proposed as a meaningful way to reduce such uncertainties. That is, adding residents’ context-specific responses allows for an “additional layer of information in evidence-based planning” (Kyttä et al. 2013, p. 30). In this context, Stringer and colleagues (2006) emphasized the importance of including the perspectives from a range of knowledge sources (e.g. non-scientific experts and laypersons) into the management of socio-ecological systems in general. The authors argue that these information help obtaining a complete overview on the thematic issue at hand and will result in a more robust factual base reducing uncertainty. Local, context-specific inputs are considered central to adaptive management processes and were found being able to improve urban planning decisions substantially (Corburn 2003). In this thesis, the relevant, context-specific factors influencing the urban quality of life were identified by two focus group workshops held with (a) local city planning experts and (b) residents from the study region.

The resulting set of key factors on residents’ urban quality of life identified by the planning experts (a) included: safety, density of utilization, accessibility and connectedness of functions, amenity values of public spaces, compactness, and clarity of urban design. The set of currently relevant factors identified by residents (b) included: safety in public spaces, quietness/absence of noise, places for and quality of interaction (e.g., with neighbors), places and a sense of belonging, proximity to services and functions for necessities, and accessibility to green spaces and recreation areas. While there was congruency between planning experts and residents with regard to factors such as safety and accessibility, differences occurred in terms of reflecting a sense of belonging with places and social interaction in space. The planning experts generally chose factors on which planning and urban design interventions could have an effect, while residents focused on the functional characteristics of social place experiences.

To understand the specific beneficial and adverse effects resulting from urban growth, Study Two tested the (threats to) safety in public spaces and accessibility with regard to their influences on residential satisfaction. Both objective attributes and the residents’ subjective evaluations of the two factors were modeled. Accessibility was chosen as a measure for the benefits of urban growth, and (threats to) safety in public spaces was a variable representing unwanted cost effects, following the optimal centrality theory (e.g., Archibugi 2001) and the theory of city size (Bettencourt et al. 2007).
The first finding of this research was that both variables significantly affected the urban quality of life—and, therefore, should be included in evaluating and monitoring urban living environments. A second finding was, that perceived safety was identified as the stronger predictor of the two, which was interpreted by being one of the residents’ motives in choosing suburban locations over core city centers (in addition to other factors, such as housing costs and the availability of housing space). In suburban settlement areas, people have comparably good access to local suburban centers, but expect that stressful, unwanted influences (such as threats to safety) will be fewer or completely absent. However, the current population growth in suburban areas of the Swiss agglomerations has led to rapid densification in these suburban settlements. According to optimal centrality theory, urbanization in these areas might reach high enough levels that the negative effects of the urban load result in perceived losses to the urban quality of life.

The third study tested the particular influence of urban growth on residents’ place relations for a subsample of the city of Schlieren. This work applied the concept of place attachment as a response measure for residents’ perceived urban quality, while also testing socio-demographic and objective housing factors as predictors. With regard to the influence of housing variables, a key finding was that living in cooperative housing was a significant positive predictor of place attachment in all calibrated models. We concluded that the specific housing context of cooperative associations (e.g., more intense residential involvement in housing and property management) is likely to result in greater affective place relations. This influence suggests that the unique approach of resident involvement, which is assumed to positively affect the social cohesion within cooperative housing (Clapham 2012), also has a positive spillover effect on residents’ place attachments to the city.

This is a finding that has implications for Swiss housing policies. It offers arguments regarding how to support local place belonging and social cohesion by promoting cooperative associations in the current debate on subsidized urban housing. In this context, citizens of the Canton of Zurich vote on an initiative\(^2\) suggesting adaptations to the cantonal building regulations in September 2014, which may strengthen the promotion of cooperative housing. Further research should therefore investigate, which particular aspects of living in cooperative housing underlie this effect. This leads to the question: How can such aspects be incorporated into other housing types, particularly as cooperative housing

\(^2\) On September 28, 2014, the citizens of the Canton of Zurich vote about the political initiative on “affordable housing”. Upon acceptance of this initiative, communities would be granted with the preferred right of preemption towards building affordable housing in particular settlement zones.
associations manage to operate in more compact building infrastructures? For instance, in the city of Zurich, the average housing space per person is significantly lower in buildings owned by cooperative housing associations than in other housing types (Heye et al. 2013). Accordingly, further studies on the success factors of cooperative housing may also indicate housing characteristics supporting the acceptance of denser settlement structures. A second relevant finding of the third study was the residents’ distinct perception of urban growth, which is reflected in Section 6.2, according to the implications for urban management.

Finally, Study Four found significant spatial variations between neighborhoods with regard to residents’ place attachments. The perceived environmental characteristics of the three selected neighborhoods varied in their influences on residents’ place attachment, which suggests that urban amenity values as perceived by residents are reflected in person–place bonds. For instance, the length of residency, which is considered a reliable positive predictor for person–place bonds (Lewicka 2011), was found to be insignificant for the new residential area of Schlieren-West, although the place attachment value for this site did not differ from those of neighborhoods with longer lengths of residency. Accordingly, we concluded that attachment to the neighborhood does not rely on specific, longer time frames, as formerly suggested by, for example, Giuliani (2003). Our findings suggested that, given other influencing factors, place attachment could be established over short time periods. However, with increasing length of residency it becomes an additional influencing factor.

Two findings from the neighborhood analyses appeared relevant. First, residents’ perceptions of building aesthetics were found to be an influencing variable across all neighborhoods. This positive impact of the visual appearance of buildings (in German: das Ortsbild) on residents’ place attachment strengthens the evidence that urban design does indeed affect the relationship that people develop with places. Nonetheless, the emergence of people’s place attachment remains a coupled, interactive process. In addition, knowledge is yet to be gained with regard to which particular forms and concrete visual appearances (e.g., of building facades) tend to be perceived as attractive and familiar by residents in the specific suburban context. Secondly, the perceived intensity and quality of neighborhood contacts was found to be a positive predictor variable of significant influence in all neighborhoods, which confirmed the scant previous findings (Lewicka 2011).

It became apparent that urban quality of life is indeed influenced by characteristics of the physical and social environments. However, this influence appears to be an indirect effect, mediated by individuals’ perceptions, evaluations and experiences
with places. Assessing and sustaining the urban quality of life should then, necessarily, build on both dimensions: the objective characteristics of the urban environment (i.e., the objective urban potentials), and the perceptions, affective responses and behavioral experiences that constitute satisfaction with places and place meaning. Place meaning and residential place experience are observable and reliably quantifiable through, for instance, measurement scales for residential satisfaction and place attachment. Yet, they are not inherent values or services that are provided by urban landscapes or place characteristics themselves (Hunziker 2010). Accordingly, the thesis findings make evident that the immediate potential to influence urban quality of life through interventions in the urban environmental characteristics is limited. This is particularly true when considering that this urban living environment evolves within a market context, with land traded as a scarce commodity. Land ownership and access to building parcels, as well as investment capacities and legal-administrative contexts set by planning regulations, are obviously additional key factors in driving the spatial characteristics of cities.

In conclusion, urban quality of life is not producible nor is it sufficiently projectable by one discipline or one prescribed set of influencing factors. That is, interventions into urban space for instance by urban planning (such as the increase of green space in a neighborhood) do not necessarily lead to increases in the urban quality of life. However, urban potentials can be offered to enable the urban quality of life to flourish. Thus, urban planning is a necessary, however, not sufficient attempt to influence the urban quality of life. If the residents’ perception of places should be integrated into the development of place qualities, suitable approaches for this integration have to be provided.

6.1.2. Procedural findings for integrated research on urban quality of life

When considering the methodological challenges addressed in the second guiding question, two major conclusions are drawn.

First, the integration of residents’ perspectives and urban place characteristics needs to be conducted through spatial location. The distinct domains of residents’ place perceptions and the objective environmental conditions have different core entities of study. While the first focuses on individuals and social groups (e.g., their affective, cognitive, and behavioral responses), the latter studies spatial units and concrete elements in urban space. If individual and group perspectives are applied to inform spatial planning domains in a meaningful way, spatial references (e.g., residents’ household locations) for the occurrence of individual responses have to
be assigned. Linking “subjective” responses to distinct spatial references allows for a combined spatial analysis—for instance, by using Geographic Information Systems (GIS). The process referred to as geocoding allows for the analysis of spatial variation in concepts from the social sciences, such as residents’ place attachment.

This is a research procedure that Marans and Stimson (2011a) identified as a key challenge in future studies on urban quality of life. Thus, the sophisticated application of GIS techniques “is opening new frontiers for modeling in urban quality of life research”, especially when the research aims at integrating subjective and objective data (Marans & Stimson 2011, p. 441). More generally speaking, the findings of this thesis contribute to the opening up of spatial thinking in the social sciences (Goodchild and Janelle 2010). According to Goodchild and Janelle, accounting for spatial variation in social scientific approaches disintegrates the “boundaries to knowledge transfer and enhances the abilities in problem solving for purposes of scientific development” (p. 3).

Second, when considering the quantitative modeling of objective attributes of the urban environment and of residents’ perceived evaluations, this thesis found the relationship between objective attributes and measures of subjective perception to be weak and inconsistent. This means that the variations in objective measures did not reliably represent differences as evaluated by residents. Accordingly, immediate inferences regarding the effect of changes in the “objective” urban environment on the urban quality of life are not valid. Not only do they miss validity, but such inferences are also built on a narrow perspective of environmental determinism.

There exist spatially explicit modeling approaches that are able to sufficiently combine objective spatial variables, human preferences, and behavioral responses. For example, agent-based modeling (Felsenstein et al. 2010) and recent developments of Bayesian networks to model land-use decisions (Celio et al. 2014) each deliver sophisticated, place-specific analyses. However, their development is resource intensive, and their complexities pose significant challenges with regard to communicating model findings to stakeholders and local planning experts, as experienced during the transdisciplinary project on “New Urban Qualities” (Wissen Hayek 2013).

In consequence, we conclude that a separate but complementary modeling of either objective or subjective components is a meaningful alternative. Both analyses should, however, be embedded within a common modeling framework in
a spatially explicit manner (Wissen Hayek et al. 2013). That is, information from both domains should be displayed and analyzed according to their spatial co-occurrence. The results of such complementary models could then be integrated into guiding frameworks, such as the four states of quality of life presented by Zapf (1984), to inform urban management. This approach may support urban policy makers in, for instance, choosing target areas and target groups for local policies in cities. Such local area portfolios addressing both domains constitute a comprehensive information basis for local actor negotiations and participatory consultations.

6.2. Synthesis of implications for urban environments and their development

Considering the effects of rapid urban growth on residents’ place attachment, it was not the urbanization per se that affected attachment, but, rather, whether the urban changes were perceived as an attractive upgrade and whether the resulting urban environment was (still) familiar. This aligns with findings by Felber Rufer (2006), who concluded that the evaluation of landscape changes was influenced by the perceived individual benefits of the occurred change and by the symbolic functions of landscapes. In other words, the perceived utility of a change’s effects is essential for residents’ quality judgments of their affective place bonds. This aligns with the findings made by Hunziker et al. (2008) regarding the evaluation of landscape change in Switzerland. The authors conclude that “it is the change in the meaning of the landscape elements that leads to positive or negative assessments” (p. 140). In turn, this means that a positive influence on residents’ place attachment requires to identify local places and elements in public spaces with symbolic meanings that preserve familiarity or symbolize aspects of attractive upgrading. This could be accomplished, for instance, through representative surveys or site observations with different residential groups. More generally speaking, acknowledging the local narratives of place meanings contributes to the successful management of urban transformation. Then, even rapid urban growth can have a positive impact on urban quality of life, as shown by the analyses in the city of Schlieren.

When modeling objective attributes of the urban environment together with subjective evaluations by residents, the findings suggested spatial scale to have a moderating role. Accordingly, we postulated that, with smaller spatial scopes of study regions, the likelihood of congruence between the objective and perceived measures is greater. In consequence, in small-scale studies, objective measures
may be more valid representations of the perceived conditions. Thus, for planning purposes, small-scale studies (e.g., for neighborhood or a block ensemble) are probably more informative, and the inclusion of residents’ perspectives is more meaningful. This aligns with the assumption made by Hunziker et al. (2008) regarding the increasing importance of including people’s responses with smaller spatial scopes. However, the causal effects behind these interpretations remain subject to further research.

Such a relationship between the spatial scale level and the appropriate degree of citizen inclusion into urban planning raises additional questions regarding scale-specific urban policies and regulations. This is particularly true when considering compact city strategies towards inner densification in Swiss agglomerations. Built density is regulated by objective indicators on cantonal and city levels as part of the zoning plans. However, fears and conflicts regarding the actual threat of over-densification occur based on persons’ perception of local costs and benefits. In fact, the Swiss federal planning council stated that the observed trade-offs between densification and urban quality of life are mainly a matter of subjective perception (Rat f. Raumordnung 2012) based on experience and cultural norms.

This is particularly true when comparing the objective building densities in Switzerland in European or even a global context. The council recommended accounting for the “densification occurring through people’s mind” (p. 6) in order to create acceptance for denser living environments. One could postulate that the debate regarding densification should necessarily include these subjective perceptions, preferably in small-scale contexts. Consequently, instead of building solely on indices that refer to population density or to the extent of building volume in a given area, the arena for debates on urban densification should be complemented with data on local subjective perceptions and place experiences in order to anticipate supportive or oppositional attitudes. These analyses may, thus, also be the right approach for identifying the particular characteristics of a denser, yet (still) attractive and familiar local environment.

The call for opening up the Swiss density debate by integrating residents’ perspectives on a local scale is not completely new (Ilg and Zimmerli 2012). However, we propose such an integration informed by data analyses of local place meanings and positive or negative place experiences, preferably based on representative survey samples. This is a format that Kyttä and colleagues (2013) recently referred to as a new form of “contextually sensitive densification” (p. 30). Representative samples of city or neighborhood populations have the advantage of including information from those population groups, which normally do not engage
in public debates or participatory planning initiatives. This inclusion may lead to a higher legitimization of the results used for argumentation in urban policy making. Facing increases in local recourses against urban development projects in Swiss cities³, such procedures may, indeed, help identify and resolve local conflicts in the early stages of planning procedures. Recent developments in data availability and GIS applications have made such procedures applicable for smaller communities. For example, in a Swiss case study, the research project modularCity recently demonstrated how GIS-based online surveys regarding public perceptions and local knowledge may be used to inform participatory planning processes (modularCity 2014). Building on evaluations of the place experiences of individuals in combination with objective indicators of public spaces showed the potential to gain public legitimacy in the planning process. This may leverage concrete options for urban upgrading and help mitigating risks at early stages of planning projects. Such applications may be even more meaningful when applied as regular monitoring tools over time. As a further example, the city of Schlieren recently started using place attachment by spatial location as an indicator within its evaluation and monitoring scheme for urban development.

6.3. Critical reflection of the methodological procedure

This thesis addressed the impacts of specific factors on urban quality of life in a rapidly growing region. Studying dynamic changes in the urban environment, along with residents’ perceptions of these changes, suggests the use of longitudinal research designs. However, longitudinal research is resource intensive, particularly over longer time frames (e.g., more than five years). However, the time scales during which significant transformations become apparent in the urban realm can easily extend over many years, even in fast-growing city areas. With respect to the challenges of conducting longitudinal studies over such time periods, only one measurement point in time was used. This means that subjects evaluated the perceived changes in a reflexive way, explicitly accounting for neither variations in the urban environmental conditions over time, nor changes in the residential composition due to moving behavior.

Ideally, future research would hold a panel of survey respondents over longer periods of time. Behavioral consequences, such as place-related engagement and moving behaviors, could then be included in a dynamic model of urban quality of life.

³ As an example: the city of Schaffhausen observed an increase in legal recourses against urban development projects of about 100% only in 2012 leading to a significant increase in expenditures for the urban planning department; Source: Presentation given by Jens Andersen, Head of urban planning, City of Schaffhausen, NFP65 conference, Lausanne, 2013.
life. Such prospective models should then be embedded within more general theoretical frameworks for changes to socio-technical or socio-ecological systems. First attempts to conceptualize urban change have already been presented within, for instance, transition management and the Human-Environment Systems framework (Roorda et al. 2012; Stauffacher and Scholz 2013).

The empirical analyses of this thesis built on correlational data and, hence, shed only limited light on causality. Despite thorough theoretical embedding, caution should be used in making inferences regarding causal relations among the tested variables. Moreover, this thesis builds on a context-specific case study. Implications drawn from our findings should be treated primarily as case-specific, which reduces their external validity beyond the population in the study region. Yet, the procedural findings, in particular, may still be valid indicators for other Swiss and European suburban regions of comparable types (e.g., regions that show, for example, comparable spatial and social characteristics, together with similar growth patterns). Both aspects (i.e., causality and external validity) could be addressed by setting up future research designs in the form of controlled, experimental studies, as outlined in the following Section 6.4.

Limitations in the external validity also point to the question of up-scaling from small scope study regions to larger scales. Up-scaling refers to the translation of analyses, or models from a source scale to a larger target scale (Kienast et al. 2006), a topic of increasing importance for instance in landscape ecology and urban systems modeling. In these contexts, scale refers not only to the spatio-temporal model boundaries, but also includes thematic categorizations such as specific vegetation or housing types. However, before considering procedures for quantitative model up-scaling a first useful step would be to replicate the analyses of this thesis on a larger (spatial) scale. This could for instance be done by using data from the Statistics on Income and Living Conditions (SILC) instrument. SILC delivers cross-sectional and longitudinal data on quality of life conditions in all European Union member states, including Switzerland. The Swiss sample covers 7000 households on a yearly basis. The survey data includes for example satisfaction measures for the local built environment, socio-economic data and information on the length of residency. Data from this sample could be a valuable reference for national and international comparisons of residential satisfaction with their urban environments in future analyses. Although the data is not yet provided by distinct spatial reference, future releases may then also allow for fine grained analyses of residents urban quality of life differentiated for instance by different settlement types (e.g. inner city district, suburban area).
In this thesis, specific factors influencing the urban quality of life were identified based on collaborations with stakeholders from the Limmattal region and on survey responses from residents of the two focus areas. The selection of stakeholders for the first research phase should be critically considered. Stakeholders were invited according to the degree to which they were affected by or able to affect the research topic, due to their professional background or their possible regional knowledge. Actors from practice and science had different areas of expertise (e.g., real estate development, transportation, architecture, landscape design, human geography). The heterogeneous group of experts from practice, together with an interdisciplinary team of scientists, faced considerable problems in framing a common research task and establishing a common understanding of key concepts applied during the research process (e.g., the concept of ‘urban quality’). Research should focus on identifying success factors for such inter- and transdisciplinary research procedures, with an emphasis on early project phases. The procedural concept for science-practice collaboration presented in the first study of this thesis constitutes a starting point for further studies on process design and process evaluation of transdisciplinary research settings.

6.4. Outlining further research options

A first line of future research concerns alternative approaches to modeling and evaluating urban changes in controlled, experimental settings. For instance, the image series applied in this thesis proved usefulness as an explorative measurement of how urban transformation is characterized, according to the visual perception of place changes. However, such images may also be generated as controlled visualizations of either existing or generic urban environments. This enables a manipulation of specific influencing factors (e.g., specific attributes of an urban infill program, such as the building density or the amount or height of trees) over time and a control over their particular place characteristics. Such visualizations could be a valuable starting point into applying virtual reality environments in further studies. Assessing urban scenes in virtual reality environments allows the simulation of actual user experiences and a more comprehensive and reliable assessment of future urban realms, for instance including audio-visual impressions and motion within the scene.

Consequently, in addition to conducting post-occupancy evaluations of buildings and urban areas, future research should pursue pre-occupancy simulations. Extending the focus of such studies beyond single building or block areas would also allow for a necessary analysis of the location context, for instance in terms of
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connectivity and accessibility. Such experiments should build on parameterized visualizations—that is, the objective characteristics of the presented alternatives could be altered according to quantifiable parameters. This would allow, for example, a substantiation of research on the perceptions of urban building density. Acceptable conditions of urban density could be identified, according to evaluations by different test groups. In addition, within simulated higher density environments, particular elements and characteristics of public space (such as inner courtyard characteristics or different green space typologies) could be evaluated with regard to their abilities to compensate for an increase in building density. Such research would fill in the knowledge gap regarding how configurations of the built environment—and, in particular, the specific characteristics of public spaces—contribute to human well-being (see, for example, Dempsey et al. 2012), in particular, when such studies would also include physiological outcome measures to substantiate potential stressing or restorative effects caused by certain environmental settings. From a practical point of view, the results of such approaches may also be interesting supplements for architectural competitions and participatory formats of planning.

A second research perspective on how to reflect on residents’ place experiences and place meanings extends the analysis of spatial variation, as conducted in Study Four of this thesis. People value places according to place experiences and ascribed meanings. Yet, studies that include quantified evaluations of place experiences in a spatially explicit format for different places (e.g., households, recreational places, meeting places) are still rare. Such research would offer valuable information about place-related activities and behavior (Kyttä et al. 2013). Consequently, future research should consider studies that combine the use of softGIS and diary approaches, which capture place experiences throughout the day (e.g., by using mobile applications for individual’s responses). SoftGIS techniques (also referred to as participatory GIS techniques) have recently been used for research into citizens’ place experiences in relation to structural characteristics of urban spaces, such as building density (Kyttä et al. 2013). Diary approaches, on the other hand, capture life experiences, behavioral activities, and moods throughout the day. For example, Kahnemann and colleagues (2004) presented the Day Reconstruction Method (DRM), a survey method used to assess how people spend their time and how they experience the (place) settings and activities of their lives. As people often experience different places for different daily activities, the combination of GIS and DRM methods may deliver new insights into urban quality of life at distinct spatial locations.
A third line of future research should account for the behavioral dimension of residents’ responses related to variations in urban quality of life. The scant existing research reveals inconsistent findings. Carrus and colleagues (2014) provided an overview for the concept of place attachment. Some studies provide empirical evidence for a positive relationship between place attachment, pro-environmental behavior, and supportive place engagement, while others demonstrate place attachment as a driver of oppositional and change-resisting attitudes. An improved understanding of the mediating role of place attachment as a driver for oppositional or supportive behavior towards place changes is particularly critical for highly contested infrastructures, such as large-scale energy infrastructures (e.g., locations for wind power plants or electric power lines). Conceiving these infrastructures as possible disruptions or consolidating elements towards residents’ place bonds could lead to a more comprehensive picture of acceptance or oppositional attitudes in research on future energy landscapes. Conducting such studies in a spatially explicit manner could, for example, map hot spots of potential acceptance and opposition in addition to an objective analysis of location potentials, which appears to be an avenue worth future study.

Finally, considering the procedural implications for stakeholder and citizen inclusion in urban development procedures, there still exists a serious lack of thorough evaluative research (Selle 2013). Future research should particularly contribute to the evaluation of the outcome effects of these procedures. Previous research on, for instance, deliberative participation has mainly focused on the participative procedures themselves. Research conducted on outcome evaluations should preferably be based on pre- and post-research designs. In other words, stakeholder expectations, process experiences and outcome responses should be measured and recorded at a minimum of two points in time. Insights into process effects and stakeholder requirements towards future processes may assist urban planning professionals in cities in finding a meaningful synthesis of the diverging actor interests. An initial study in the Swiss context unexpectedly pointed towards heterogeneous effects of the participatory processes (Menzel et al. 2013). The study noted that higher degrees of participation may also tend to hinder trust building among planning actors in relation to the degree of participation. The study concluded that future research should focus on how to improve the quality and outcomes of participatory processes, rather “than putting much effort in increasing the degree of participation” (p. 351).

In addition to lacking outcome evaluations of residents’ inclusions in urban development, processes among different scientific disciplines and stakeholders from practice also desperately lack thorough evaluations. The transdisciplinary
research process conducted in the first phase of this research project was meaningful for scientists’ acquiring of detailed knowledge about the place qualities of the Limmattal region. However, the impacts on the participating stakeholders and the possible decisions and adaptations arising from the common process remain subject to further study.

6.5. Final comments

Integrating residents’ perspectives more frequently into urban development procedures demands competencies in facilitating and managing such processes. Process guidance needs to build on several dimensions of expertise, such as (a) professional expertise in spatial planning and urban design; (b) in-depth knowledge regarding particular urban contexts, including embedding in multiple spatial scales and the temporal aspects of urban change; and (c) moderating, mediating and guiding skills for multi-stakeholder procedures. Such procedures may build on different concrete formats, such as workshops, survey evaluations, expert hearings, panel discussions, and site observations. They will also certainly include diverse stakeholder interests, along with explicit or implicit aspects of influencing power. Successful process facilitation, therefore, often demands someone in an unintentional and neutral role, with strong analytical and negotiation skills (Susskind 1999). However, the current practice of participatory planning is often lacking of such competencies. For example, participatory future workshops on contested urban development projects are often moderated and directed by representatives of the involved parties, such as the city administration (Selle 2013; Susskind et al. 2010). Yet, the city administration has its own preferences and does not represent a neutral facilitator. On the other hand, professional process moderators often lack specific local knowledge or urban planning competence.

Only recently, Rambow (2012) emphasized the increasing demand for civil society to be comprehensively informed and, where appropriate, included in debates at early stages of planning processes. Assuming a further increase in contested urban development projects, particularly when considering the densification strategies of Swiss agglomerations, the related debates and facilitation demands may require adaptations to the academic education of planning and urban design professionals. Particular communicative and process design skills have, thus far, been only rarely introduced into curricula for architectural and planning education (e.g. in Germany, Rambow 2012). In a survey among urban planning professionals in Finland, over 90% of planners supported the statement that planners should be trained in conflict management (Peltonen and Sairinen 2010). The authors
concluded that there is a growing recognition that “the role of mediator in conflict situations could and should be an extension of the planners mandate, duties and skills — and thus a legitimating factor for the planning profession as a whole” (p. 333). However, the reduction of the planning professional’s role to one solely of mediation is too narrow. An important competence lies in the translation of cooperative and deliberative debates on urban conditions into concrete spatial concepts. This is a functional role that Kurath referred to as “relational urban design” (Kurath 2011, p. 550).

One way to implement such competencies in the academic education of planning professionals could be through increases in case study learning, together with partners from practice on real urban transformation cases. The transdisciplinary case study at ETH Zurich is one such example. For instance, in the year 2013, master students from different scientific disciplines were confronted over the course of one semester with an urban transformation challenge in the Swiss city of Zug (Moser et al. 2014). The case required students to cope with contested land use and urban design tasks, including collaborations with diverse local stakeholders. Such a format aligns with Rambow’s argument (2012) for a stronger involvement of “real users or building contractors” in academic design studios in order to promote “awareness of various expectations and background knowledge” (p. 309).

Opening up future generations of planning professionals to the integration of residents’ and stakeholders’ perspectives may well be worth a try, in the pursuit of securing the future urban quality of life. Obviously, the planning paradigms and market forces of the last decades have failed to prevent the further uncontrolled sprawling of the Swiss landscape. In the light of the trade-offs that are expected to occur through the mandatory densification of urban living spaces, a more dynamic and interrelated understanding of urban quality of life, based on a strong actor inclusion, offers a meaningful future option.
Concluding remarks

References


Places in transformation: integrating residents’ perspectives and spatial characteristics into the assessment of urban quality of life


Additional publications and presentations

Peer-reviewed articles in scientific journals


Peer-reviewed conference proceedings and presentations


von Wirth, T., Stauffacher, M., Grêt-Regamey, A. (2013) Influence of urban transformation on place attachment and residential satisfaction – testing perceived and objective predictors, accepted at the 10th Biennial Conference on Environmental Psychology for the Session: Built Environment, Magdeburg [D]

Epprecht, N., von Wirth, T., Blumer, Y., Stünzi, C. (2013) Innovative transportation systems: Acceptability of transitions beyond current mobility regimes in suburban neighbourhoods; accepted at the 4th International Conference on Sustainability Transitions for poster session; Zurich [CH]


Publications for stakeholders (Scientific reports)


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Contact

ETH Zurich
Institute for Environmental Decisions (IED)
Natural and Social Science Interface (NSSI)
Universitätstrasse 22, CHN J 70.1
8092 Zurich, Switzerland
Tel: +41 44 632 7584
E-Mail: timo.vonwirth@env.ethz.ch
Internet: http://www.uns.ethz.ch/people/science/vwirtht