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Use and appropriation of space in urban public parks

GIS methods in social geography

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1 Introduction

This paper presents a quantitative approach to digital representation of human space use and appropriation in public parks. It shows that it is possible to calculate and visualize the use and appropriation of space quantitatively, whilst still remaining sensitive to issues of equality, accessibility and gender. In a case study in Zurich, Switzerland, three small urban public parks were systematically observed during the summers of 2005 to 2007. On the basis this data, several approaches proved to be feasible for the representation of actual use and appropriation of space, including potential processes of domination and exclusion (an aspect which at first was not immediately obvious). The paper conceptualizes and implements the appropriation of space at the micro level of individuals, using concepts from anthropology and environmental psychology, such as personal spaces and crowding. The vague boundaries of space usage and appropriation are not eliminated but explicitly addressed in the analysis and visualization. Concurrent to a visual exploration of the data, in a next step, detected patterns will be tested using methods from spatial statistics.

After presentation of the motivation and the objectives of the article, the current debate on quantitative versus qualitative methods is summarised. It is emphasised that GIS methods do not automatically imply positivist research, but instead provide opportunities for critical geographic research. Then, the current status of the research project is presented and some preliminary conclusions drawn.

2 Motivation, terminology and research objectives

The research project focuses on three specific urban parks in the city of Zurich and is part of the project «Sustainable Design, Management and Appropriation of Urban Public Parks» supported by the National Research Program 54 «Sustainable Development of the Built Environment» of the Swiss National Science Foundation. The aims of this project are to identify design and planning elements as well as management strategies that could foster a socially sustainable appropriation of public parks. Two teams make up the research cooperation. One team focuses on the social aspects of space appropriation (called SOSPA, see contribution of Kaspar & Bühler in this issue), while the project reported on here deals mainly with the visualization and analysis of space appropriation (called VISPA). Working in close collaboration, the two teams aim for an integration of qualitative and quantitative methods, expecting this synthesis of methods to be an important asset for the overall research project.

In this article, space appropriation is defined as the process by which each human constantly, whether consciously or unconsciously, lays claim to surrounding space. On the one hand, this happens in space considered personal, space in which intrusion by others can be seen as inappropriate. On the other hand, simply in doing something somewhere, space is appropriated, whether this be by reading or playing some ball game. In the public sphere of urban parks, these spaces and their appropriation engender a constant negotiation process with other, often unfamiliar, people. It is acknowledged that researchers from the social sciences may use the term «space appropriation» somewhat differently, involving more contextual information, as well as recognition of symbolic relationships between individuals and place (compare Kaspar & Bühler, this issue).

In the VISPA team, the key research objectives are the development of a model framework for the quantitative analysis of human space use and appropriation, and a toolkit of methods to support decision makers in improving the quality of life of citizens. These objectives require the integration of a theoretical and methodological background ranging from social geography, environmental psychology, and information visualization to geographical information science. The research approach follows a pragmatic, mixed methods line, using both qualitative and quantitative methods sequentially and iteratively as appropriate (Creswell 2003; Morgan 2007).

3 Spatial analysis with GIS and positivism

Quantitative geography consists of the analysis of numerical spatial data, the development of spatial theories and the construction and testing of mathematical models of spatial processes (Fotheringham, Brunsdon & Charlton 2000).

While it is generally accepted today that the physical world is symbolically structured by the social world

and society (Löw 2001; Werlen 1993), and inseparable from social processes and relations (Pavlovskaya 2006), it is not long ago that quantitative geographic research overemphasized space in a determinist, functionalist manner, searching for globally applicable laws. Reproduction of the natural and social world was reduced to a technical problem; errors were seen as the result of lack of technical skill or unintentional distortion (Pickles 1994). Consequently, quantitative geography is still strongly associated with positivist epistemology (Poon 2005; Sheppard 2001). Critics argue that quantitative methods reproduce geographies of primarily white, male, bourgeois power structures. For researchers advocating non-positivist knowledge production, qualitative methods have become an accepted strategy (Pavlovskaya 2006; Sheppard 2001). However, many simple spatial analysis functions are actually rather qualitative in nature. Visualization, for example, is a qualitative research approach well suited for use throughout the whole research process (Dykes, MacEachren & Kraak 2005; Gahegan 2005). Knigge and Cope (2006) see many similarities between grounded theory and visualization: Both are exploratory, iterative, pay attention to the particular and the general, allow multiple interpretations and acknowledge uncertainty.

Additionally, the criticism ignores recent developments in quantitative research. The naturalist, positivist search for absolute, universal laws has been superseded by an acknowledgement of the importance of local variations. There is a clear trend from the «global» to the «local» (Fotheringham, Brunsdon & Charlton 2000). According to Sheppard (2001), the association of positivism and quantitative geography is not a necessary relationship, but a social product of disciplinary rivalries and debates.

Several researchers, influenced by Goodchild (1992), have taken up the challenge to place geographical analysis methods on a more solid theoretical foundation, discussing whether GIS is a tool or a science (Pickles 1997). There have been attempts at redefining what geographical information science is or could be, with research focusing on issues of relational views of geographic phenomena, uncertainty, qualitative reasoning, ontologies and semantics, and cognitive and usability issues (for an overview, see Fisher & Unwin 2005). Miller (2005) suggests a new, people-based perspective and methodological approach in GIScience. He contends that traditional place-based methods were developed under the constraints of scarce data and computing power. They ignored the spatio-temporal conditions of human existence and organization and were ill equipped to address many of the key questions regarding access to activities and resources. Kwan and Lee (2003) have used GIS for the analysis of gender-related research issues, while Yu (2006) employs a temporal geographic framework with GIS for the exploration and analysis of human interactions. The work presented here attempts to further contribute to the growing number of quantitative, post-positivist research projects.

4 Modelling space use and appropriation

In order to detect informal processes of exclusion and domination, it is imperative to develop a method to make the otherwise invisible conflicts in space appropriation visible. While research in sociology (Bourdieu 1991) and social geography (Werlen 2000) on space appropriation has focused on patterns at the spatial and/or meso-scale, most of the research dealing with individual human space use at the micro-scale has been conducted by anthropologists and psychologists (Altman 1975; Baldassare 1978; Freedman 1975; Goffman 1974; Hall 1966; Johnson 1987; Sommer 1969). To the knowledge of the authors, there has only been one quantitative spatial study on this aspect (Gedikli & Özbilen 2004), and the implementation thereof does not seem to reflect actual space use adequately. Others have mapped but not modelled human space use (Paravicini 2002). Studies from the leisure sciences dealing with conflicts in recreation facilities do not appear to be explicitly spatial in nature, relying often on post-hoc surveys. It is felt that they could benefit by modelling of park use (Andereck & Becker 1993; Marcouiller, Scott & Prey undated).

The model of space use and appropriation presented here consists of two basic elements: active spaces and passive spaces. Passive spaces are the space around us where unwanted, inappropriate intrusion of other persons can cause discomfort and anxiety. Hall (1966) termed these passive spaces «personal spaces», conceptualizing them as concentric distance zones around a person and taking differences between cultural groups into consideration. Baxter (1970) agrees and concludes from extended observations in natural settings, that age and gender can modify these interpersonal distances as well. The basic concept of personal spaces has been extended into the theory of proxemics, which includes additional factors such as types of spaces and behavioural categories (Littlejohn & Foss 2005). Here, the first modelling approach concentrates on informal personal spaces, with the distance zone determined by the activity type. Modifications such as fixed-feature space or the individual sociopetal-sociofugal axis (facing) are to be implemented later.

A newly introduced component is the concept of activity footprints, representing active spaces. Each activity requires a specific space termed the activity's footprint.

Their size and shape is estimated from literature and observations. It is important to note at this point that these estimations are grounded in empirical evidence, but are in need of refinement and more research before they can be considered accurate enough to contribute to a sufficiently realistic modeling of human space appropriation.

The assumption is that a potential for crowding and goal interference exists when personal spaces and (incompatible) activity footprints of other park visitors overlap. Consider the example in Figure 1 of two soccer players and a reader and their respective activity footprints and personal spaces. The assumption is that the reader is looking for an undisturbed reading experience and thus feels uncomfortable with a soccer player's unpredictable movements when the latter enters his or her social distance zone. The same would be true in reverse. However, the activity footprint of the reader is very small and the personal space claimed by the soccer players is small due to their dynamic activity – they might feel uncomfortable only by a foul of a fellow player. Therefore, there is no overlap between the reader's activity footprint and the players' personal spaces.

During extended observations in the public parks of Zurich totaling over 140 hours, activities were classified into seven main categories: Static solitary (sleeping, reading), static interactive (observing, talking, card games), eating (barbecue, picnicking), dynamic regular (football, badminton), dynamic irregular (running around), park infrastructure (park-specific playgrounds), and activities involving water. In addition to the activity type, the observers also recorded each visitor's assumed age, gender, and group affinity. The location and time of the activities were recorded by placing points at the approximate centre of activity, with the unique identifier (ID) of the park visitor, activity type and start time of the activity.

5 Analysis of space appropriation and potential conflicts

First, it is necessary to acknowledge the uncertainty associated with both data and analysis results. The multitude of terms used for describing uncertainty makes it necessary to briefly clarify and define the usage of the different aspects of «uncertainty» in the work:

- Inaccuracy: Errors made during the observations, concerning both spatio-temporal location as well as attributes.
- Incompleteness: Some of the details may not have been recorded.
- Vagueness of the boundaries of the personal spaces and activity footprints.

Pre-tests for intercoder reliability have shown a spatial inaccuracy of less than one meter, and a temporal inaccuracy of about one minute. A careful choice of attribute categories enabled a high accuracy. The data is almost complete, only minor details were omitted during busy periods. The spatial inaccuracy and incompleteness increase with activities that involve a lot of movement, since it was impossible to capture the exact space-time location of every park visitor at all times. The authors consider the inaccuracy and imprecision acceptable for the development and testing of the model and the analysis of the data. The vague boundaries were addressed by the main analysis method, Kernel Density Estimations (KDE). It is a well-researched spatial analysis method that fulfils the project's requirements and has been widely used for point data representing humans, although mostly at an aggregate or meso/macro-scale (Kwan & Lee 2003; Levine 2006). Detailed information on KDE can be found in several standard works on spatial analysis (Fotheringham, Brunsdon & Charlton 2000).

In Wahlenpark in the summer of 2006, 842 visitors were recorded during the observation period: 418 male, 402 female and 22 infants of unknown gender. Most visitors were adults (76%), with children totalling (17%) and teenagers and seniors 3.5% each.

Figure 2 shows an excerpt of the preliminary results of the data analysis: The original data (points) is displayed in the upper left. The other three figures show the density of visitors weighted by duration of stay in the form of surfaces: For all visitors in the upper right, for female visitors in the lower left and for male visitors in the lower right. The density surfaces are slightly elevated above ground to show the underlying park structure.

This visualization shows a specific distribution of visitors with clusters in physical space. Most activity for both male and female visitors is located in the left area of the park (playgrounds, tables and benches) and the lower park area (water basin). In contrast, male visitors have a higher density in the central open grassy areas and especially near the ball fence in the upper part of the park, whereas female visitors are almost not present there at all. This could support the hypotheses that male visitors use and appropriate open spaces more than female visitors, as noted by Paravicini (2002).

To detect potentials for conflict, further analytical steps are necessary, part of which have already been implemented and part of which are currently in progress. Thus, in a next step, the temporal dimension was included and overlapping activity footprints and personal spaces calculated. For each group of visitors,

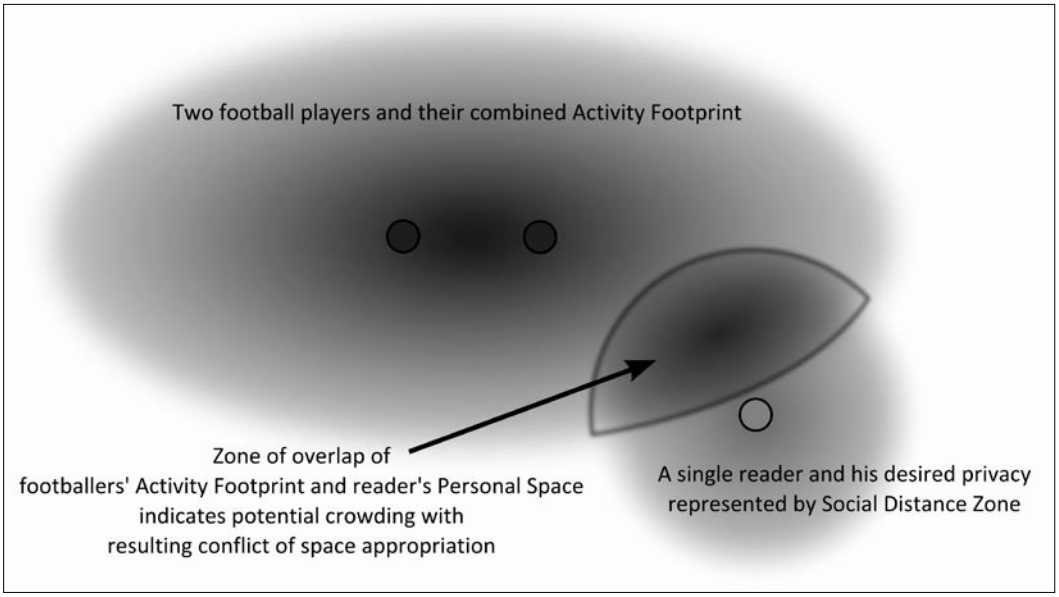

Fig. 1: Potential conflicts in space appropriation
Potentielle Konflikte in der Raumaneignung
Conflits potentiels en matière de l'appropriation de l'espace
Graphics: F.O. Ostermann

two kernel density estimates were calculated: One for the personal spaces and one for the activity footprints. Assuming that there are no conflicts of space appropriation within one group of visitors, for each visitor group the prevalent activity type was chosen as group activity. The authors adjusted parameters controlling the spread (bandwidth) and height (volume or population) of a group's kernel density estimate to account for the activity-specific sizes of activity footprints and personal spaces. For each moment in time, each group's activity footprint was checked against the personal spaces of all other groups via map multiplications, so that only overlapping grid cells would retain any value at all. It is important to note here that this method does not «smooth over» individual park visitors: Since the values are multiplied, even a single park user can be represented by a high space appropriation and potential conflict if in proximity to a larger group of other park visitors. Another benefit to the analysis is the fact that the probability surface generated by kernel density estimations also ameliorates the problem of inaccurate and incomplete data: The closer to the centre of activity (represented by the original point), the more probable and intense this space is used by the park user. It is also important to remember that the parameter values at the current stage of research are assumptions derived from own experience and observations, and have yet to be verified in the evaluation process and refined accordingly.

In a final step, the findings will be synthesized with results gained through the analysis of interviews with park visitors (done by SOSPA), to see where there are similarities and discrepancies.

6 Conclusion

In this paper, spatial analysis methods are applied at the micro-scale of individuals. The goal is to examine the appropriation of space in urban public parks. Extensive field observations in several parks in Zurich, Switzerland, were conducted over the span of three years, with database records taken of the location, assumed age, gender, and activity of park visitors. Based on research in environmental psychology, a model was developed that represents human space use and appropriation building on the two concepts of personal space and activity footprints. Arguing that quantitative spatial analysis methods remain a valid tool for non-positivist research, the model was implemented using kernel density estimates for the spatio-temporal analysis of the observed

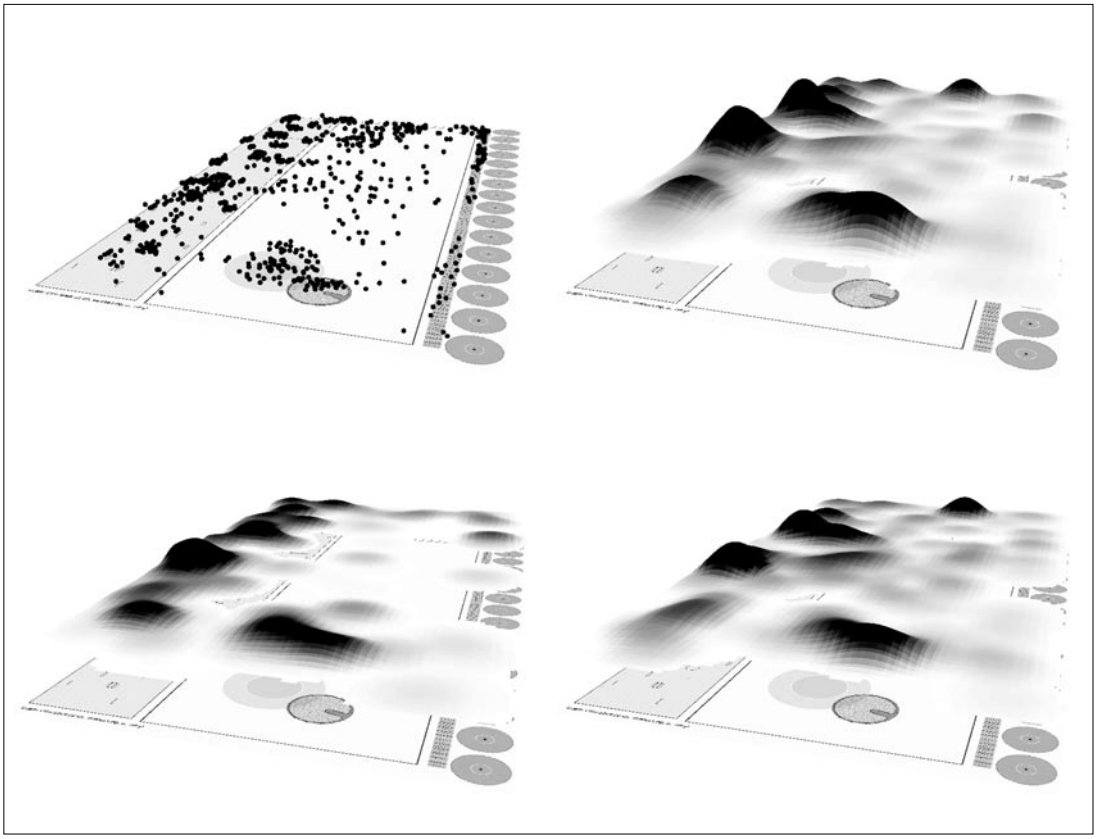

Fig. 2: Wahlenpark 2006 (Zurich, Switzerland) – density surfaces
Wahlenpark 2006 (Zürich, Schweiz) – Dichteoberflächen
Wahlenpark 2006 (Zurich, Suisse) – surfaces de densité
Graphics: F.O. Ostermann

park use. It is concluded that the probability surface generated by kernel density estimations is an adequate representation of the specific vagueness of human space appropriation as it remains sensitive to individual park visitors. The paper also shows that it is possible to use quantitative methodology of geographic information science and the tools of geographic information systems for a critical geography research project.

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Summary: Use and appropriation of space in urban public parks. GIS methods in social geography
The research objective is the analysis of the appropriation of space in urban public parks. For this purpose, extensive field observations were conducted in several parks in Zurich, Switzerland, over the span of three years, with records made of the location, assumed age, gender and activity of park visitors. Based on research in environmental psychology and anthropology, a model was developed building on the two concepts of «personal space» and «activity footprints» to represent space appropriation. In line with the view that quantitative spatial analysis methods remain a valid tool for critical, non-positivist research, the model was implemented using kernel density estimations for the spatio-temporal analysis of the observed park use. It is argued that the probability surfaces generated by kernel density estimations are an adequate representation of the specific vagueness of human space appropriation as they remain sensitive to the presence of individual park visitors.

Keywords: public parks, space appropriation, proxemics, quantitative spatial analysis, systematic observations

Zusammenfassung: Nutzung und Aneignung von Raum in städtischen öffentlichen Parks. GIS-Methoden in der Sozialgeographie
Das Forschungsziel ist die Analyse der Raumaneignung in öffentlichen städtischen Parks. Über drei Jahre hinweg wurden in drei verschiedenen Parkan-

lagen in Zürich, Schweiz, Beobachtungen durchgeführt. Dabei wurden das Alter, das Geschlecht und die Aktivitäten der Parkbesuchenden direkt in einer geographischen Datenbank erfasst. In diesem Artikel wird gezeigt, dass quantitative räumliche Analysemethoden ein geeignetes Werkzeug für nicht-positivistische, kritische sozialgeographische Forschung sein können. Basierend auf Forschungsergebnissen der Umweltpsychologie und Sozialanthropologie wurde ein Modell entwickelt, das auf zwei Konzepten basiert: persönliche Räume und Aktivitätsspuren. Dieses Modell wurde mittels Kerndichteschätzungen umgesetzt, um die raum-zeitliche Nutzung der Parks zu repräsentieren. Die erzeugten Wahrscheinlichkeits- und Dichteoberflächen sind eine adäquate Abbildung der spezifischen Unschärfe menschlicher Raumaneignung und bleiben sensibel gegenüber der Präsenz einzelner Parkbesucher und -besucherinnen.

Schlüsselwörter: öffentliche Parks, Raumaneignung, Proxemik, quantitative räumliche Analyse, systematische Beobachtungen

Résumé: Usage et appropriation de l'espace dans des parcs publics urbains. Les méthodes SIG en géographie sociale
L'objectif de la recherche est d'analyser l'appropriation de l'espace dans les parcs publics urbains. Les auteurs ont effectué des observations de terrain dans différents parcs à Zurich (Suisse) pendant trois ans, en enregistrant dans une base de données l'âge, le sexe et les activités des visiteurs des parcs. Le modèle développé a pour but de représenter l'appropriation de l'espace sur la base des recherches en psychologie environnementale et en anthropologie. Il est construit à partir de deux concepts, à savoir celui de l'espace personnel et celui de l'empreinte des activités. Convaincus que les méthodes d'analyse spatiale quantitatives sont un outil valable pour conduire des recherches non-positivistes, les auteurs ont implémenté le modèle en utilisant les estimations de densité de kernel pour les analyses spatio-temporelles de l'utilisation des parcs. La surface de probabilité générée par les estimations de la densité de kernel est une représentation adéquate du caractère vague de l'appropriation de l'espace humain et reste sensible à l'individualité des visiteurs du parc.

Mots-clés: parcs publics, appropriation de l'espace, proxémique, analyse quantitative spatiale, observations systématiques

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