

Measuring & Observing Pedestrian Activity

Tracking Pedestrians in Norwich, Rouen and Koblenz

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Abstract

Context

In Toronto and Melbourne I presented the development of a method to track pedestrians using GPS. Finally, in June and October 2007 pedestrians visiting the historic city centres of Norwich, Rouen and Koblenz were monitored. In total over 1300 pedestrians were observed using GPS technology. With a questionnaire we were able to collect additional information about the visitor.

TU Delft, Department of Urbanism is partner in the European Union funded project "Spatial Metro" or "City on Foot". The goal of Spatial Metro is to improve city centres for pedestrians. Particularly for this project TU Delft has developed methods to observe and evaluate visitor experiences (Spek, 2007; <http://www.spatialmetro.org>).

Field work

TU Delft carried out field work for one week in each city. The GPS devices were distributed to shoppers during the day on two locations: both multi-layered parking facilities, one of them a shopping mall. The field work resulted in incredible insight in pedestrian behaviour. The visualisation of individual tracks into collective images shows the flows and densities of use. It highlights weak and strong places, vital and insignificant links in the urban tissue. With the questionnaire data it was possible to distinguish different kinds of uses based on origin, purpose, familiarity and duration, and on personal characteristics such as age, gender and group.

The results of the field work show that GPS is a powerful tool to observe and visualise pedestrian behaviour on the scale of the (inner) city (Spek, 2008a/b).



Norwich all activities
(st Andrews)



Rouen all activities
(Vieux Marché)



Koblenz – all lines
(Löhr-Center)

Biography

Stefan van der Spek is Assistant Professor for the Chair of Urban Design. He is coordinator of the Master-2 Urbanism, lecturers in the MSc and BSc and was researcher in the European Union funded project 'Spatial Metro'. The field of expertise is public space and movement of people. Key research is based on using tracking technologies to capture, visualise and analyse pedestrian movement.

Stefan did his Master in Architecture at TU Delft (1997). His final project 'Amstel Intermodal Centre' resulted in a PhD study within the TRAIL 'Seamless Multimodal Mobility' program, titled: 'Intermodal Transfer Points'. The thesis 'Connectors – the Way beyond Transferring' was published in 2003. Main issue was the design of walkable transport hubs.

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This paper describes the results of a series of pedestrian observation studies carried out in Norwich, Rouen and Koblenz. The goal of these studies was to observe pedestrian behaviour and to investigate pedestrian movement and experience in the city centres. The cities are engaged in improving the physical conditions and the experience of their city centres by investing in landscaping and engineering of public spaces, city beautification, wayfinding and in information and communication technology. (<http://www.spatialmetro.org>)

The purpose of the observation studies was to collect, evaluate and visualise the use of space in relation to investment based on descriptive research. The outcomes focus on a comparison between the context and real use. For the observation, a specific method using Global Positioning System devices capturing the movement of pedestrians was developed and put into practice. The recording of pedestrian behaviour was accompanied by a questionnaire adding background information on the participants. (Spek, 2008a/b)

WAY OF WORKING

Global Positioning System and Geographical Information System

The method of collecting data on pedestrian behaviour is based on the Global Positioning System (GPS). GPS is primarily a system for navigation and orientation. The GPS system makes use of a network of satellites in orbit which send signals to earth. A GPS device has the ability to receive these signals and compute its geographical position. The ability to store a sequence of positioning data at a determined time interval in a log file was used (Kustermans, 2006; Spek, 2008a/b; http://en.wikipedia.org/wiki/Global_positioning_system, accessed 21 Nov. 2007). The log file can be read out real-time or later and projected onto maps in a Geographical Information System (GIS). GIS has the ability to join different layers of information or different sources, but GIS also provides tools to process, model and visualize data (Nijhuis, 2008; http://en.wikipedia.org/wiki/Geographic_information_system, accessed: 30/11/2007).

Why tracking pedestrians

With traditional methods it is possible to gain insight into pedestrian movement (Shoval & Isaacson, 2006/2008; Nielsen & Hovgesen, 2004; Harder et al, 2008); http://en.wikipedia.org/wiki/GPS_tracking, accessed 21 Nov. 2007). However, this insight is limited to the scope of the method. Counting people at certain locations leads to insights into the density of the use of the public space only at these locations. Such methods do not collect information on journeys, patterns of use or route choices. Models could possibly estimate where people might walk. However, this would be based on a prediction, and not on an actual situation. Travel diaries might give insights in actual behaviour, but depend on the accuracy of people's minds (Spek, 2007; Janssens et al., 2008; Maat et al., 2008,). A case study in Delft showed that the ability of people to reproduce a walked route in a map is inadequate. The actual walking pattern based on GPS tracks deviated repeatedly from the drawn map (Spek, 2007).

Using GPS technology it is possible to acquire accurate and detailed insights into actual behaviour (Verbree et al., 2005). The technology will provide insights into the exact departure and return time, time spent at specific locations, destinations, the walked route or geographical route of the journey, the speed and the mode of transport (Shoval, 2007, 2008; Spek, 2008a/b).

Processing data

Data was collected from two different sources: track logs resulting in temporal-geographical quantitative information and questionnaires resulting in social-geographical qualitative information. Processing the data consisted of 5 steps: (1)

validation, (2) cleaning, filtering and repairing, (3) individual analysis, (4) collective analysis based on the questionnaire and (5) findings and conclusions. The results of processing are layered analysis drawings. A selection of these drawing will be used to illustrate the results.

The individual tracks themselves give an impression of use of the city when projected onto a map. Each individual track represents a person or group. Computations are required to create the collective image covering a selection of respondents. This can be established in GIS software where the tempo-graphical data was analysed using time-space density calculations which resulted in coloured density maps. Using the questionnaire, density drawings were made for different themes: (1) origin, (2) purpose, (3) familiarity, (4) duration, (5) age, (6) gender and (7) group composition.

The analysis also includes the fabrication of conclusion maps. These maps summarize and elaborate the outcomes of the analysis drawings using three elements:

- (1) edge hard borders in the city which are hardly crossed
- (2) no-go area neglected parts of the city within the range of the access point
- (3) attractors main destinations, buildings and spaces/places

Field work

For the Spatial Metro project, the main target group is visitors of the city centre. The main points of interest are shopping (retail) or leisure (culture, heritage, drinking, dining). The most feasible way of collecting as much data as possible within a short period of time is to distribute and collect the tracking devices at an access point to the city. Access points are e.g. train terminals, bus stations and parking facilities. Parking facilities assure that people will return to their cars and thus return the device. This way of working meant that no GPS devices were lost. The drawback was that only visitors arriving by car were recorded. (Spek, 2008a)

Acknowledgement

The collection of data was initiated by the Spatial Metro project and partly financed by European Regional Development Funding (ERDF) through the Interreg IIIb community initiative. The project is called City on Foot in Germany. All data were collected anonymously. All outcomes should be considered as results of the way of working and limited to the cooperating population. The outcomes only represent the activities of the participants from two parking facilities and do therefore NOT represent the overall behaviour of visitors or pedestrians in the city centre.

RESULTS Norwich



Image 1: Norwich St. Andrews –all valid tracks of seven days

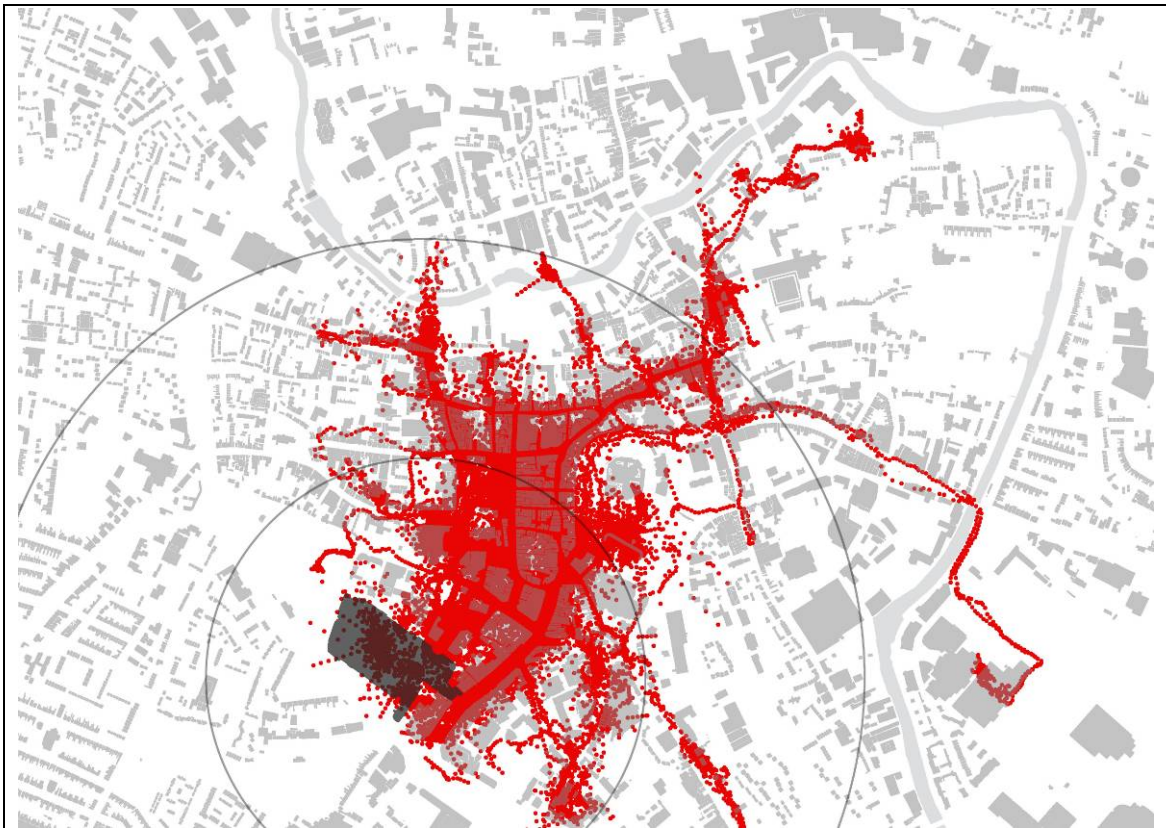


Image 2: Norwich Chapelfield –all valid tracks of seven days

Norwich St. Andrews

The fieldwork in Norwich was carried out in June 2007. The first distribution point was located at St. Andrews car park on the northern side of the historic city centre. Most of the car park (1000 cars; 2005) is used by commuters, but specific spaces are reserved for shoppers. The car park is open 24/7. The fieldwork facilities were located near the southern exit on the route to the city centre. This car park is an ideal starting point for destinations around St. Andrews Plain and the Norwich Lanes shopping district. In total, 370 people responded resulting in 173 directly useable tracks (see Image 1).

The origin of the respondents at this location was generally local (84%), although regional visitors were also represented (11%). As expected, the main purpose was shopping (80%), followed by leisure (12%). Most respondents were regular visitors (80%), followed by occasional visitors (18%). People generally stayed in the city centre 2-4 hours (48%), with 40% staying for a shorter period. The people mainly took Exchange Street to the centre, directly in front of the exit and leading to the market and the main shopping street. Alternative routes were along St. Andrews Street and Charing Cross. The return route was generally the same

Norwich Chapelfield

The second distribution point was located in the Chapelfield Mall (1000 cars; 2005), located on the southern side of the historic city centre. The main focus of the car park is shopping and leisure. Access to Chapelfield Car Park is limited from 8am to 10pm. This car park is an ideal starting point for destinations on the southern side of the city centre. The distribution facilities were located near the main exit to the car park in the central hall. In total, 270 people responded resulting in around 80 directly useable tracks (see Image 2).

The origin of the respondents at this location was generally local (80%), although regional visitors were also represented (17%). There were scarcely any national or international visitors at the location. As expected, the main purpose was shopping (90%), followed by leisure (8%). Most respondents were regular visitors (72.5%), followed by occasional visitors (27.5%). People generally stayed in the city centre for 2-4 hours (45%), with 40% staying for somewhat shorter periods. The main routes taken leaving the car park and returning to it were the same, namely in the direction of Gentleman's Walk. The main destinations were the shopping streets leading to Norwich Lanes and Tombland. In comparison to St. Andrews, the response was far lower, and there were more regional visitors, more shopping as the main purpose, more occasional visitors and people generally stayed for a slightly shorter period.

Rouen

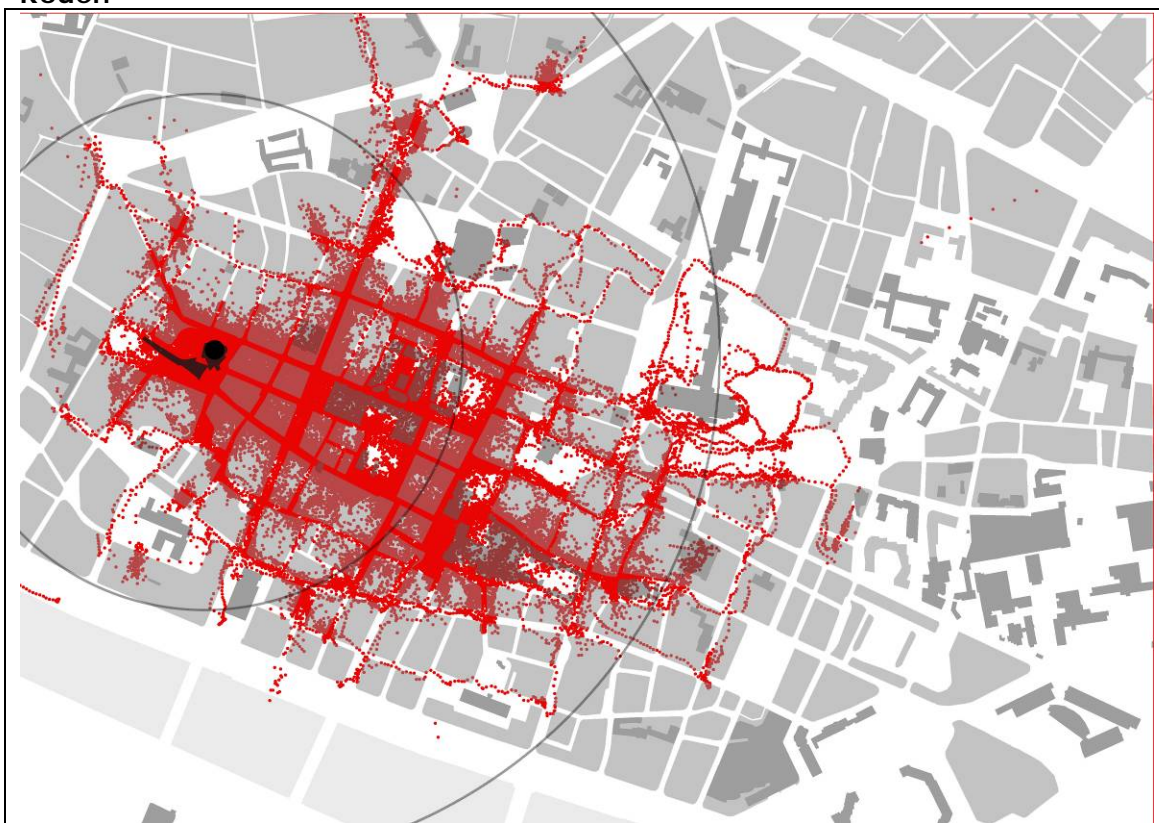


Image 3: Rouen Vieux Marché –all valid tracks of seven days

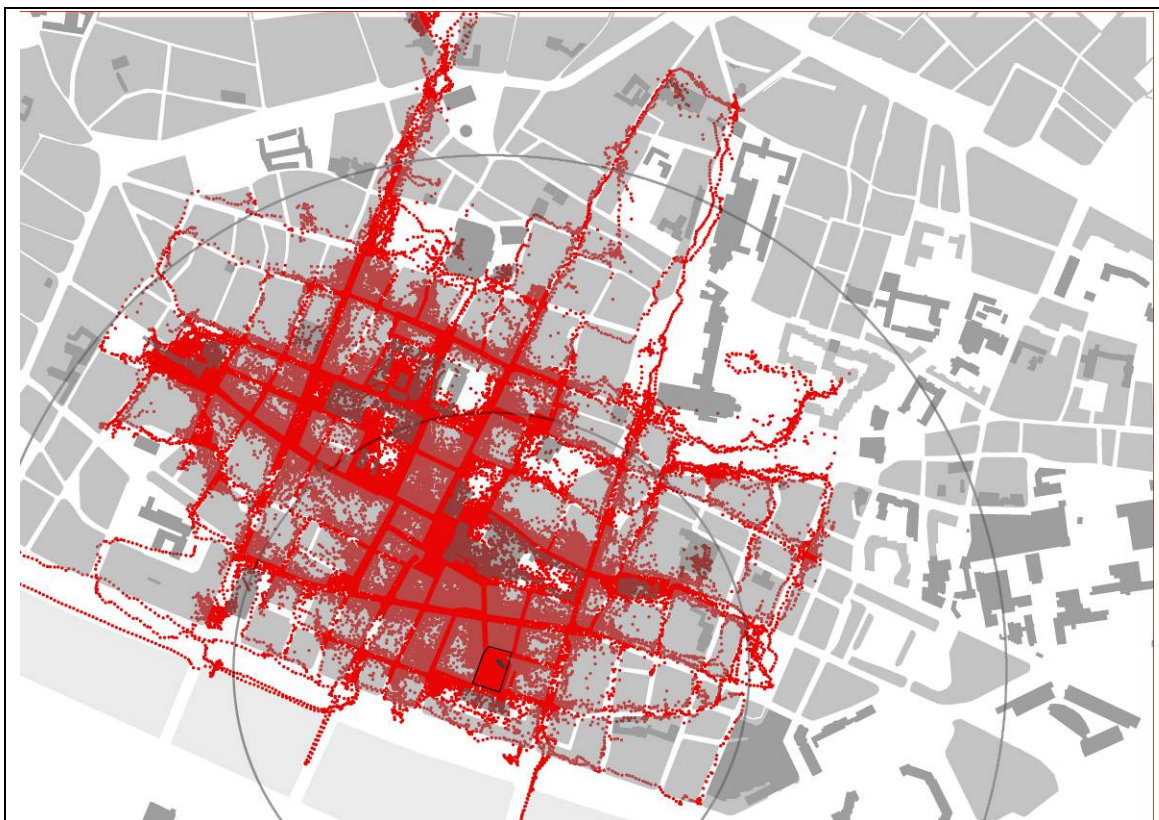


Image 4: Rouen Haut Vieille Tour –all valid tracks of seven days

Rouen Vieux Marché

The fieldwork in Rouen was carried out in October 2007. The first distribution location was located at Vieux Marché car park on the western side of the historic city centre. The fieldwork facilities were located near the pedestrian exit of the garage. The car park is located in the main pedestrian area, which makes it an ideal starting point for the main cultural and commercial destinations. In total, 240 people responded resulting in 150 directly useable tracks (see Image 3). The origin of the respondents at this location was generally regional (46%), although local visitors were highly represented (37%). As expected, the main purpose was shopping (69%), followed by leisure (18%). Most respondents were regular visitors (64%), followed by occasional visitors (25%). People generally stayed in the city centre less than 2 hours (57%), with 35% staying for longer periods. The main route people took when walking to the centre was Rue du Gros-Horloge, directly leading to the Gros-Horloge ending at the Cathedral. Alternative routes were two parallel streets, namely Rue Saint-Lô and Rue Rollon. The route back was generally the same. The main destination was the shopping area between Vieux Marché and the Cathedral.

Rouen Haut Vieille Tour

The second distribution location was located at Haut Vieille Tour car park on the south-eastern side of the historic city centre, directly south of the Cathedral. The fieldwork facilities were located near the main pedestrian exit of the garage. The car park is not located in the pedestrian area, but is relatively close to the main cultural and commercial destinations. In total, 180 people responded resulting in over 130 directly useable tracks (see Image 4).

The origin of the respondents at this location was both regional (42%) and local (39%). The car park is also used by international visitors (11%). As expected, the main purpose was shopping (66%), followed by leisure (21%). Most respondents were regular visitors (58%), followed by both occasional visitors (22%) and people on a first-time visit (20%). People generally stayed in the city centre for less than 2 hours (50%), with 38% staying for longer periods of 2-4 hours. The main route people took to walk to the centre was Rue de L'Epicerie, directly leading to the Cathedral. Most other alternatives were also used. Remarkably, the route back varied significantly to the route taken in. The main destinations were the Cathedral and from there Vieux Marché via the Rue du Gros-Horloge. In comparison to Vieux Marché, the response was lower, but the origin of people was more or less identical; the same applies to the respondents' purposes. In Haute Vieille Tour, more respondents were new visitors and people tended to stay for longer periods.

Koblenz

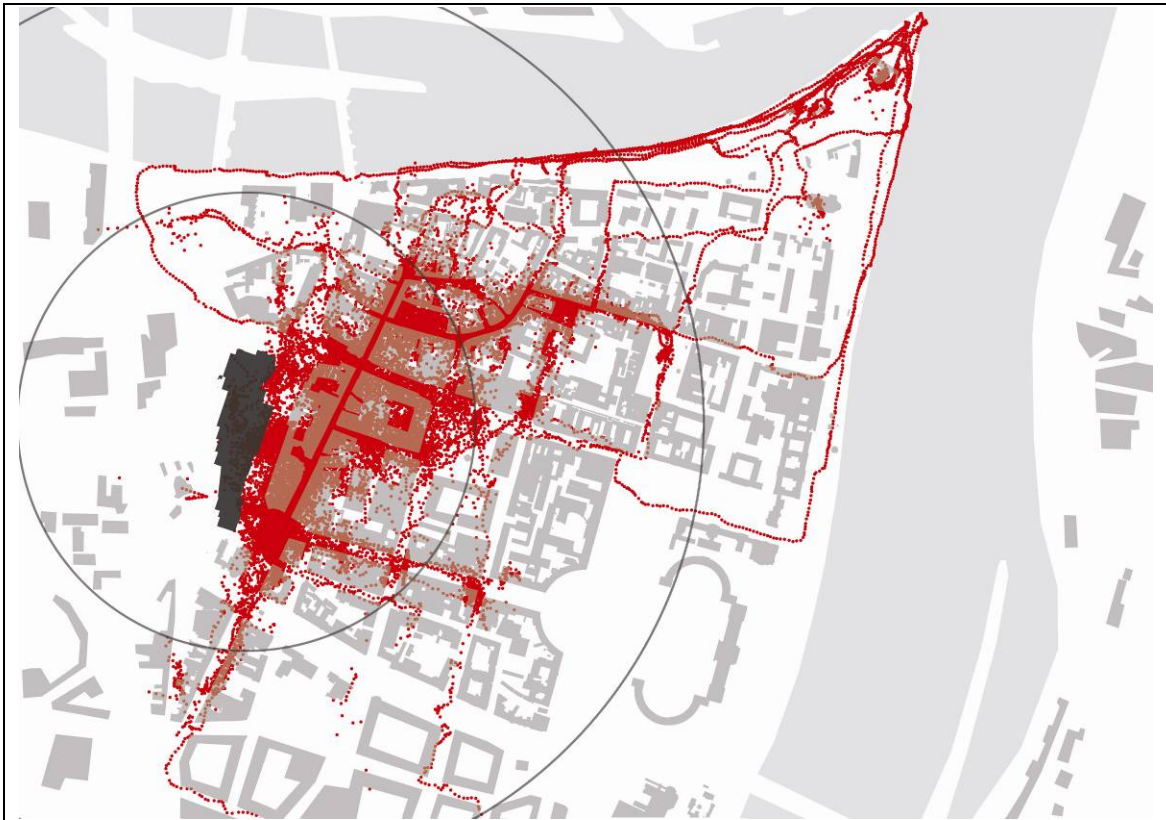


Image 5: Koblenz Löhr-Center –all valid tracks of seven days



Image 6: Koblenz Görresplatz–all valid tracks of seven days

Koblenz Löhr-Center

The fieldwork in Koblenz was carried out in October 2007. The first distribution location was located at the Löhr-Center - a car park on the roof of the main shopping mall on the western side of the city centre. The fieldwork facilities were located near the main pedestrian exit of the garage. The mall is located on the edge of the pedestrian area and is relatively close to the historic city centre, but the main tourist destinations such as the riverfronts are beyond reach. The mall has three exits: one on the Southside to Löhr-Rondell, one in the middle on the western side and one on the northern side of the building which connects to a pedestrian tunnel. In total, 180 people responded resulting around 100 directly useable tracks (see Image 5).

The origin of the respondents at this location was mainly regional (60%). National and international visitors also use this car park (20%). As expected, the main purpose was shopping (75%), followed by leisure (22%). Most respondents were occasional visitors (50%) but the location is also used by new visitors (20%). People generally stayed between 2-4 hours (58%) or less than 2 hours (26%). A large group only uses the car park to access the city (40%), but the car park is also used for the mall itself – 33% of all visitors stay in the mall for over one hour. The exit people mainly took when walking to the centre was the Western exit directly leading to the Löhrstrasse. However, the route back varied significantly to the outbound route. The main destinations were within a range of 400 metres, and were mainly on the Löhrstrasse – the shopping street.

Koblenz Görresplatz

The second distribution location was located at the Görresplatz underground car park on the eastern side of the city centre between the shopping district and the waterfront. The fieldwork facilities were located near the main pedestrian exit of the garage. The car park is located in the pedestrian area and is relatively close to the main cultural and commercial destinations. In total, 120 people responded resulting in around 100 directly useable tracks (see Image 6).

The origin of the respondents at this location was mainly regional (54%). A fair number of national and international visitors also use this car park (38%). The main purpose was shopping (48%), directly followed by leisure (43%). Most respondents were new visitors (40%), followed by both occasional visitors (32%). People generally stayed in the city centre between 2-4 hours (51%), with 36% staying for shorter periods of less than 2 hours. The main route taken on leaving the location led to the shopping streets via the Firmunstrasse. However, remarkably enough, the route back varied significantly to the route in. People tended to browse their way back to the car park leaving a sprawled pattern of use. In comparison to the Löhr-Center the response was lower but more profitable. The origin of people in both locations was mainly regional, although Görresplatz had a greater number of national and international visitors. This factor affects the purpose statistics; in comparison to Löhr-Center, virtually twice the number of visitors to Görresplatz had leisure as their purpose, a number almost equal to that for shopping. In Görresplatz, far more respondents were new visitors, but people tended to stay for shorter periods.

CONCLUSIONS Norwich

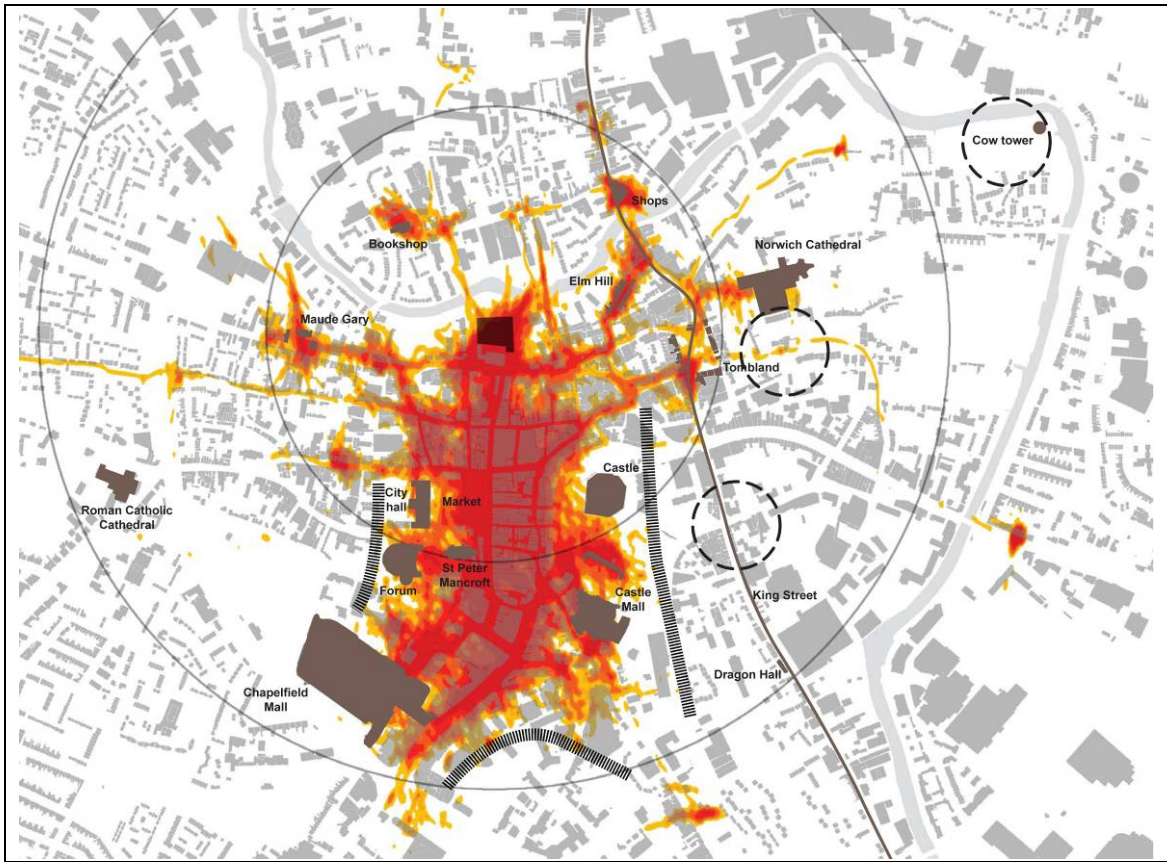


Image 7: Norwich St. Andrews –density analysis of primary purpose shopping

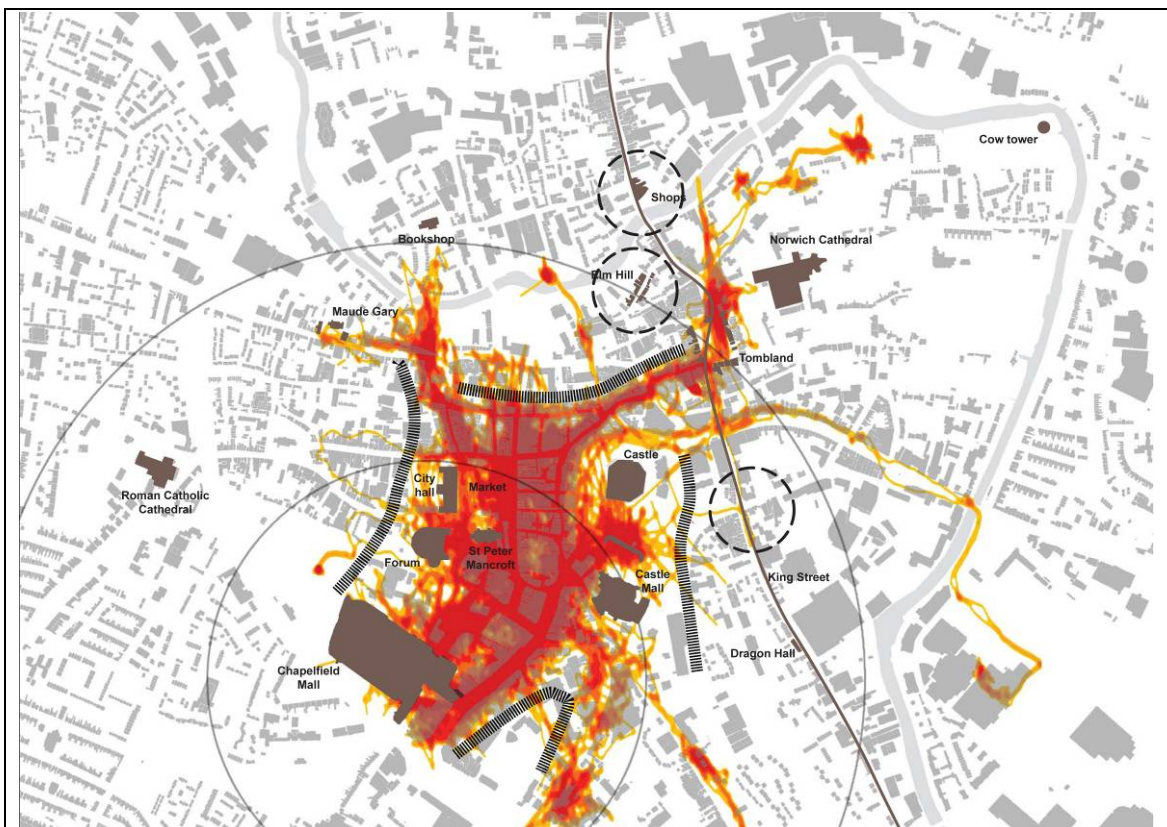


Image 8: Norwich Chapelfield –density analysis of primary purpose shopping

Norwich St. Andrews /shopping

The main visitors participating in the study carried out at St. Andrews were identified as shoppers (79%) visiting the city centre regularly or occasionally. Most of them stayed for 2-4 hours (50%) or less (40%). The main type of shopping indicated by the respondents was fashion and luxury (50%) followed by non-daily shopping (28%). Remarkably, daily-needs shopping was also significant at this location (10%). The area visited mainly covered the main shopping streets from St. Andrews to Chapelfield, a distance of 800 metres, bordered by the City Hall and Forum on one side and the Castle and Castle mall on the other. Surprisingly, the destinations also included some satellite locations within a range of 400 metres. The Chapelfield Shopping Mall is clearly also a destination. Neglected or scarcely visited areas were King Street, Tombland and the area behind the Norwich Cathedral including the Great Hospital and the Cow Tower. (Spek, 2008a)

Norwich Chapelfield /shopping

For Chapelfield too, the main type of shopping indicated by the respondents was fashion and luxury (63%) followed by non-daily (21%). Shopping for daily needs was therefore only marginally represented at this location (4%). The visited area mainly included the main shopping streets from Chapelfield till The Lanes within a range of 600 metres, bordered by the City Hall and the Forum on one side and the Castle and Castle mall on the other. The destinations also clearly include Tombland at a distance of 800 meters and surprisingly, the more incidental destinations of Great Hospital and Riverside. Neglected or scarcely visited areas were King Street and parts of Norwich Lanes; Lobster Lane and Bedford Street function as the borders of the visited area. (Spek, 2008a)

Rouen



Image 13: Rouen Vieux Marché –density analysis of regular visitors

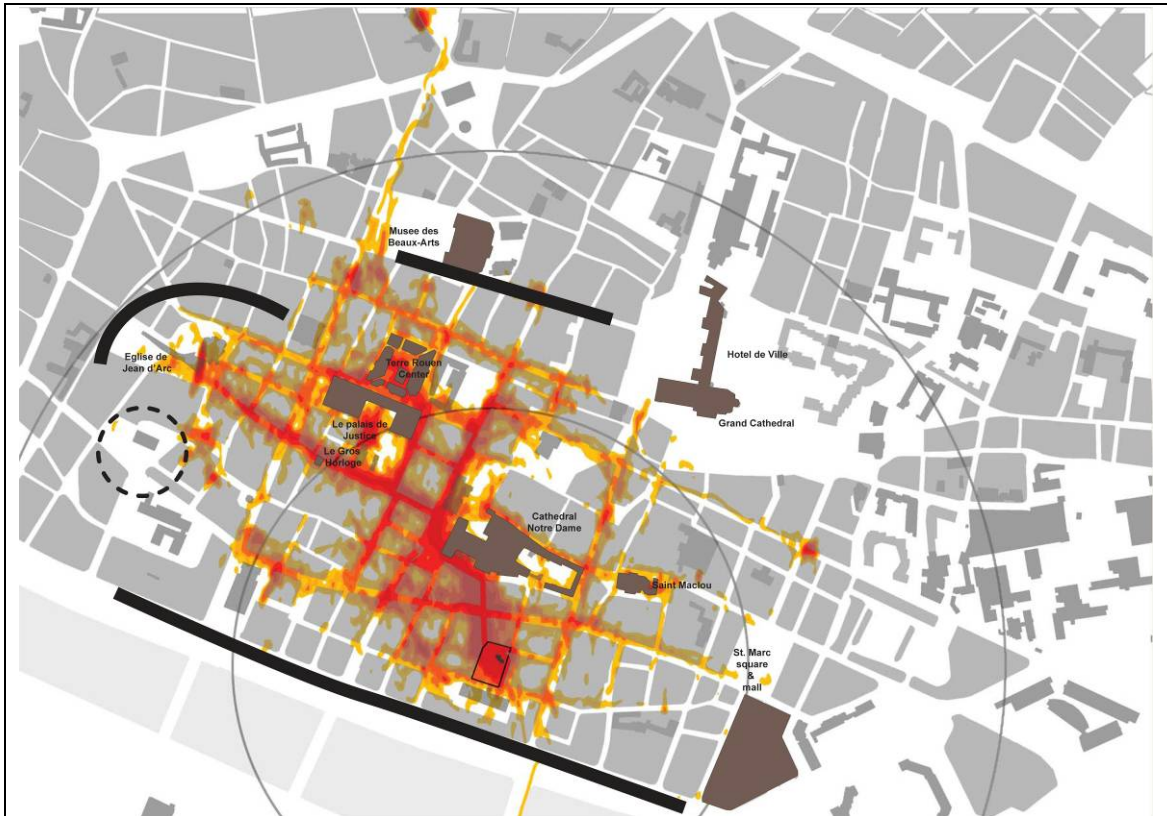


Image 14: Rouen Haute Vieille Tour –density analysis of regular visitors

Rouen Vieux Marché /regular

The main group of respondents starting from Vieux Marché were regional visitors (50%) whose primary purpose was shopping. The main purpose of the shopping was fashion and luxury (42%), followed by non-daily shopping (21%), other (22%) and daily shopping (15%). The main routes through the centre for this group were Rue du Gros-Horloge, Rue Rollon and Rue Saint-Lô. Rue de Jeanne d'Arc functions both as a divider and border and Rue du Bec mainly as a border. The maximum reach of the visitors starting from Vieux Marché was approximately 400 meters. Only some reached the Hotel de Ville at approximately 800 meters. Neglected spaces were Place Vendrel and Hotel de Ville. Remarkably, the waterfront was completely ignored by the participants. (Spek, 2008a)

Rouen Haute Vieille Tour /regular

The main group of respondents starting from Haute Vieille Tour were regional visitors (42%), followed by local visitors (39%). 90% of both groups consisted of shoppers. The reasons for shopping were almost identical to Vieux Marché, except for daily shopping which was only 10% at this location. From the car park, the main route to the city centre was along the Rue de L'Épicerie to the Cathedral and along the Rue du Gros-Horloge. From here, people tended to stroll around. On their way back, people tended to take the shortest route leading to a sprawled image. The main routes through the centre for this group were Rue du General Leclerc, Rue du Gros-Horloge and Rue de Jeanne d'Arc. The maximum reach of the visitors starting from Haute Vieille Tour was approximately 600 meters. Only some reached the Eglise de Jeanne d'Arc at approximately 600 meters. Neglected spaces were again Place Verdrel and Hotel de Ville. Remarkably, the waterfront was completely ignored by the participants. (Spek, 2008a)

Koblenz Löhr-Center /region



Image 17: Koblenz Löhr-Center –density analysis of regional visitors



Image 18: Koblenz Görresplatz –density analysis of regional visitors

Koblenz Löhr-Center /region

The origin of the visitors was determined on the basis of the questionnaire. The regional visitors (60%) showed a very distinctive pattern of use. In the image, the main shopping street Löhrstrasse running North-South can be recognized as the major pedestrian artery. From there, people tended to spread into other streets, such as Altlöhrtor and Pfulgasse in the direction of Zentralplatz or via Am Plan in the direction of Görresplatz. Generally, main turning points were Am Plan and Zentralplatz. Zentralplatz was only partly visited. All exits of the shopping mall were used, but the primary exit was the middle exit along the Hohenfelderstrasse. The visited area matched the shopping district, except for the Schlosstrasse, which runs from the southern exit of the shopping mall in a line directly leading to the palace. The regional respondents failed to visit the cultural buildings and heritage sides, such as the palace, the waterfront, Deutsches Eck or the historic city centre. The regional visitors indicated that their primary purpose was shopping (84%) or leisure (12.5%). The results were similar to the visualisation of shopping. The main range was 400 metres, with a single arm up to 800 metres. (Spek, 2008a)

Koblenz Görresplatz / region

The regional visitors starting from Görresplatz (54%) also showed a very distinctive pattern of use. Most of these visitors were shoppers (64%). The pattern was partly identical to the Löhr-Center, but use of the section between Görresplatz and Am Plan was more intense. The visitors tended to proceed westward to the main shopping streets such as Firmungstrasse, Entenpfuhl and Löhrstrasse. From there, different routes were taken back to the car park. Alternatives were Pfulgasse, Altlöhrtor and Schlosstrasse. The Schlosstrasse was scarcely used and when used, people only walked along short stretches, looking for short cuts back to the original location. The Löhr-Center and waterfront were also destinations. The Zentralplatz is a centrally situated square and is part of the route. The square is potentially a significant public space and attractor in the middle of the city centre. People seem to walk further distances from Görresplatz, but compared to Löhr-Center, the spatial borders or so-called edges are the same. Especially the area north of the Firmungstrasse and thus directly north of Görresplatz is a barrier which is scarcely crossed. (Spek, 2008a)

REFLECTION

The tracking and questionnaire data give good insights into the behaviour and background of a large group of various types of visitors to the city centre. The technology makes it possible to collect and visualize data of movement. The background data provides the opportunity to select data and focus on specific themes and aspects. Using this method, it becomes clear that people behave in different ways in these historic European city centres. Different programme (functions) are available, as well as different ways to access the city and different networks to use the city as a pedestrian.

Application of the results.

In *Norwich*, various design issues can be mentioned. St. Andrews seems to be well-integrated its surroundings and contributing to the city. Especially Exchange Street has become a key access street into The Lanes. Chapelfield on the other hand seems to rely on connections to the north alone. The route between Chapelfield Mall and Gentleman's Walk is not consistent. The Chapelfield Gardens and the area around the bus station are scarcely used and scarcely directly accessible. More integration could be useful to activate these opportunities. Remarkably, King Street and Prince of Wales Street were both scarcely used by the respondents. It might be that the participating population is not attached to these areas, and that tracing visitors arriving at the railway station would show a different response. Still, in combination with Tombland as a turning point, the position in the network of the historically rich King Street could be improved. New access or arrival points on the eastern and western side would create new access streets. Finally, the investments in St. Andrews Plain should be part of a strategy to attract people to the area and connect smoothly to other areas such as Tombland and The Lanes. (Spek, 2008a)

In *Rouen* a frame has been developed based on strategic routes (the lines), nodes (the stations) and access or arrival points (the gateways). The frame is strengthened by a light master plan, the illumination of key buildings and guiding people safely at night. The GPS tracking study indicates several issues. One of these is the neglect of the waterfront. A new route along the water has been suggested, but connections to the current urban tissue are required to improve the waterfront's attractiveness and accessibility. The Rue du General Leclerc offers High Quality Public Transport (TEOR), but is scarcely used by pedestrians. It is a border area between the pedestrian zone and waterfront. The Rue de la Republique is a barrier and due to the intensity of the traffic, not a pleasant route for pedestrians. Finally, the area around the Musee des Beaux-Arts is not well-integrated into the routes followed by the participants on their visits to the city centre. The area has an interesting public square. (Spek, 2008a)

Finally, in *Koblenz* the Spatial Metro investments are part of a strategy for the Bundes Gartenschau in 2011. Up to the present, the research results have shown a limited use of the network and public spaces in the city centre; pedestrian activity is located in the main pedestrian streets. The Spatial Metro investments include essential upgrades of the current shopping streets for pedestrians. Other investments are crucial with a view to completing this work and providing a consistent system of public spaces and programmes. Essential projects are the Schlosstrasse and Zentralplatz. Further redevelopment is necessary to upgrade the waterfront and connect it better to the city centre and historic city. A first essential step has been set by redesigning the Löhrrondell, the key location connecting Schlosstrasse, Löhrrstrasse, Löhrr-Center and the new railway station. (Spek, 2008a)

CONCLUDING REMARKS

GPS tracking offers a rich instrument to gain information about processes in our cities, particularly pedestrian movement (Spek, 2008a/b). New technologies and software are under constant development. Certain issues have to be addressed to improve the efficiency of the instrument (Schaick, 2008b). The technique opens new views for the practice of urban design and planning and for the application of the techniques in practice (Schaick, 2008a; Shoval, 2008).

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