Towards a Better Understanding of Footfall

Project Background

Since 2015 the Consumer Data Research Centre (CDRC) has worked with the Local Data Company to collect and analyse 'SmartStreetSensor' footfall data for research purposes. The data form part of the CDRC research data collections and are held in a secure data lab under strict access protocols.

Figure 1. The SmartStreetSensor locations

To date, the technology, the revealed footfall patterns and their relationships with other data have received extensive attention in three University College London (UCL) PhD theses:

- Estimating Footfall from Passive Wi-Fi Signals (Bala Soundararaj, August 2019)
- Towards a Comprehensive Temporal Classification of Footfall Patterns in the Cities of Great Britain (Karlo Lugomer, awarded June 2019)
- Retail Sales and Footfall (Terje Trasberg – thesis in preparation)

Analysis has been based on more than 650 sensors sited across 80 retail centres.

Region	Locations
Greater London	479
Scotland	118
Yorkshire and the Humber	114
South East	103
North West	98
South West	87
East Midlands	68
East Of England	49
West Midlands	39
North East	26
Wales	17
Northern Ireland	2

Table 1. SmartStreetSensor locations by region

Estimating Footfall from Passive Wi-Fi Signals (Bala Soundararaj)

There are many sources of footfall data based on different technologies, models and source data. The ability to understand the volume of passing footfall is a key indicator for retailers and is used for store location planning and store benchmarking. It is also used by property landlords, especially shopping centres, as a key reporting metric.

The research is the most comprehensive study into footfall data at a national level and for a pro-longed period of time. It looked into the biases and uncertainties of the data, including the range of the sensor, the frequency at which mobile devices generate probe requests, the way and rate at which mobile devices randomise their MAC addresses, the collisions caused due to the hashing of the MAC addresses and finally the gaps introduced by the failure of sensors. There is also an inherent bias to these data caused by mobile phone ownership in the population which varies across time, locations and demographic segments.

Consumer Data Research Centre

An ESRC Data Investment

UCL

Didobi

Towards a Better Understanding of Footfall

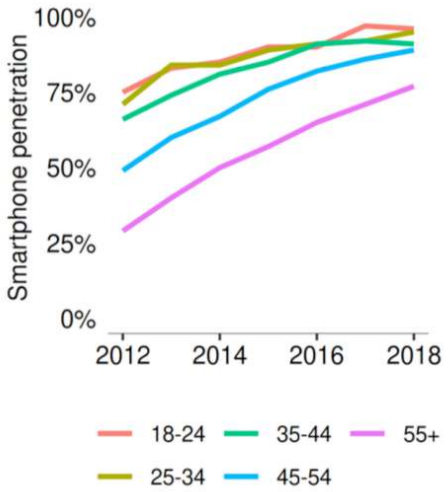


Figure 2. Smartphone penetration by age group in the United Kingdom (Source: UK edition, Deloitte Global Mobile Survey)

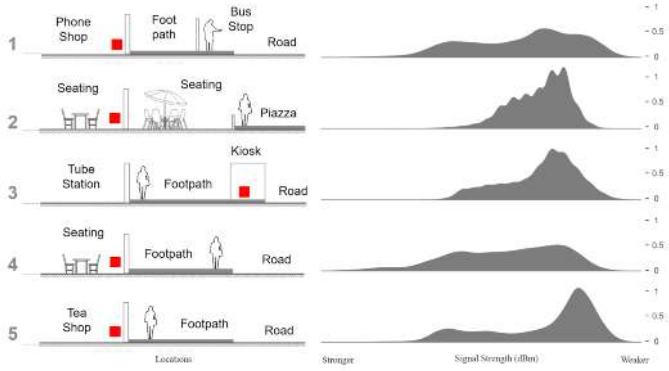


Figure 3. Distribution of signal strengths at selected study locations

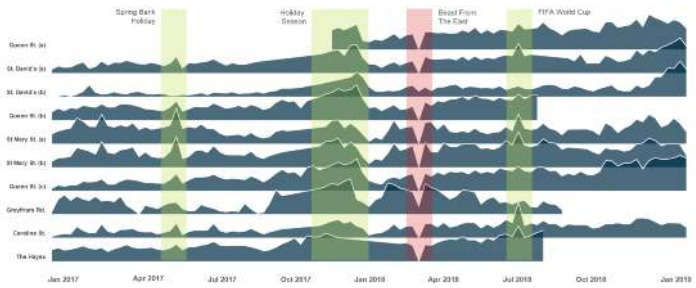


Figure 4. Normalised weekly footfall index at Cardiff locations, 2017- 2018

This research confirmed that wi-fi probe requests are a source of data from which data on ambient population and behaviour could be reliably extracted. Accurate footfall information can be obtained without personally identifying users.

A systematic literature review of c. 350 academic publication concluded that Wi-Fi was the most suitable candidate technology for collecting data on human presence and movement across the UK's retail centres. It was found to be a scalable, cheap, universal, and an easy way to collect large amounts of granular such data without depending on any other infrastructure. The review also identified ways of accommodating issues arising from the introduction of dynamic MAC addressing and disclosure control.

It has been demonstrated that this information on footfall can be used to characterising the form and functioning of retail areas and to detect changes over time. The effects of extreme weather and one-off events could be gauged, since these showed up as anomalies in footfall profiles. It was also demonstrated that detailed and continuous footfall volume information at locations could be used to estimate flows between them. This makes it possible to understand the nature of pedestrian flows between locations without attempting to track individual movements.

Towards a Comprehensive Temporal Classification of Footfall Patterns in the Cities of Great Britain (Dr Karlo Lugomer)

Making use of the extensive set of footfall measurements acquired by the SmartStreetSensor project, this case study tested whether different microsite locations in urban areas displayed different daily footfall patterns. Since this transpired to be the case, this research further investigated how similar retail sites could be clustered iaccording to similarities in observed footfall patterns during the week or at weekends.

The daily patterns were visualised in order to understand variations between Mondays through Thursdays versus Fridays (pronounced nightlife activity) and weekends (leisure activities).

Towards a Better Understanding of Footfall

605 retail locations were clustered based on similarity in the shapes of their daily footfall profiles. The analysis identified eight distinctive weekday (Monday – Thursday) clusters, shown below.

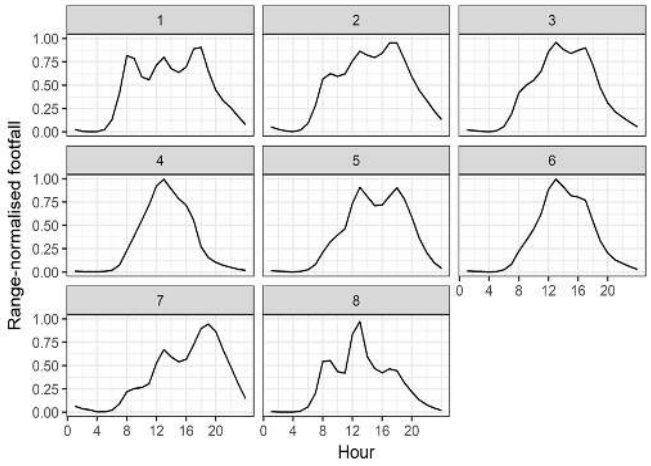


Figure 5. Weekday (Monday – Thursday) footfall profiles.

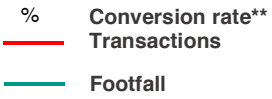
Cluster	Proposed Name	Cases	%
1	Commute and lunch	84	13.88
2	Gradual rise	80	13.22
3	Consistent afternoons	169	27.93
4	Midday top	119	19.67
5	One sided commute (quiet mornings)	29	4.79
6	Lunch time with minor afternoon commuter inflow	90	14.88
7	Quiet monrings busy evenings	19	3.14
8	Busy lunch times with both commuting peaks	15	2.48
Total		605	100.00

Table 2. Breakdown and descriptors of weekday footfall clusters

The case study concluded that there are significant differences in the time of day at which different locations are busiest. Understanding the different types of footfall patterns can shed light on the performance of specific locations and can assist retailers in planning when and how to operate their business.

Retail Sales and Footfall (Terje Trasberg)

The SmartStreetSensor project is also creating a better understanding of the impact of pedestrian flows on retail turnover.
The graphs below are taken from a case study, which looked at the correlation between hourly footfall and sales (number of transactions) at 62 retail stores of four participating retailers. Footfall and sales values are range-standardised by town allowing comparison between footfall and sales patterns in both locations. The conversion rate (shown as %) measures the conversion percentage of footfall that make a purchase (conversion rate= transactions/footfall x 100).



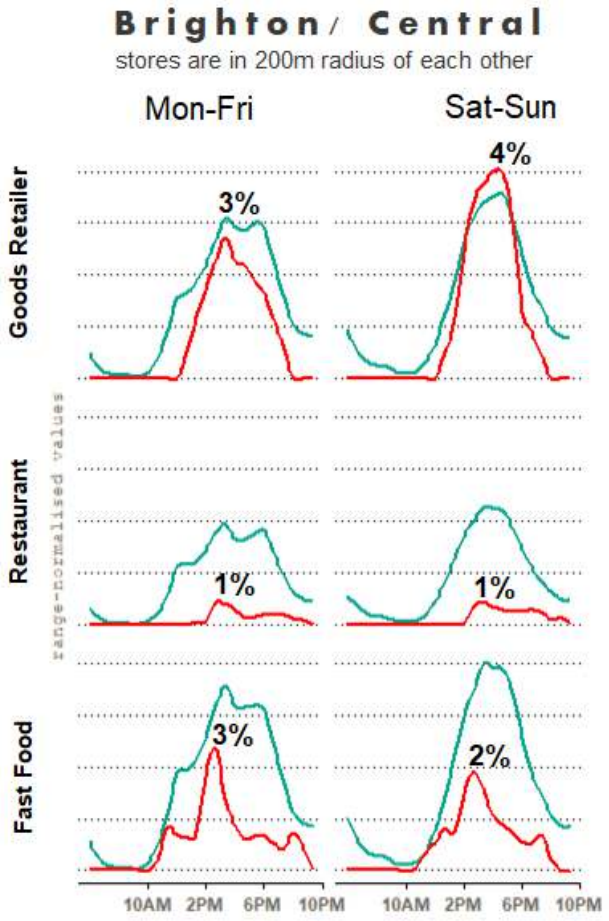


Figure 6. Site comparison footfall and sales patterns with sales conversion rates - Brighton

Consumer Data Research Centre

An ESRC Data Investment

UCL

Didobi

Towards a Better Understanding of Footfall

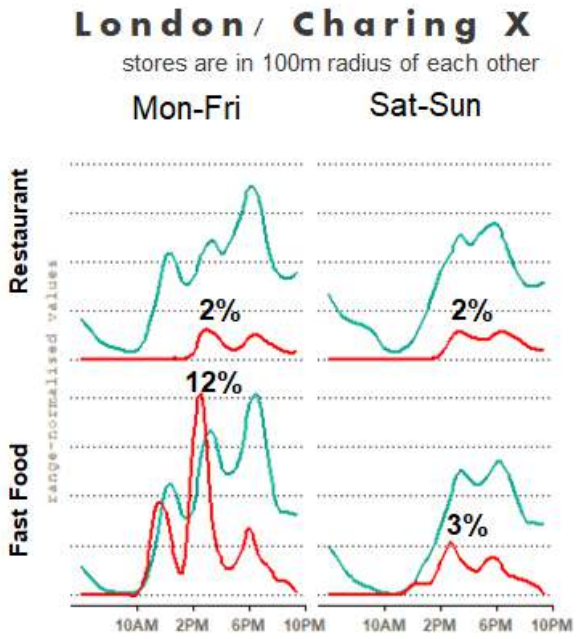


Figure 7. Site comparison footfall and sales patterns with sales conversion rates - London

The graphs reveal that retailers tend to experience similar sales patterns across locations (e.g. Fast Food - major lunch peak), but that these do not always correlate with footfall patterns (e.g. Fast Food- high footfall but low sales in afternoons). Furthermore, sale volumes and conversion rates are more dependent upon differences between retail centre than on footfall volumes (e.g. similar footfall volumes, but different sales outcomes in Brighton and London).

This suggests that footfall should be analysed in the context of its spatial surrounding in order to understand and define the true "economic footfall" which benefits the retailer.

Value of the Research

The research conducted to date has validated the data capture methodology and technology, established the daily footfall pattern variance through location profiles and looked at the relationship between footfall and retail sales by location.

Footfall as a metric on its own has increasingly less significance due to the changing nature of places and the changes in consumer behaviour. Economic Footfall, consumers visiting and transacting, is the real metric that needs further research. Through an understanding of this by micro store location linked to traditional benchmarks such as demographics and socio-economics (town profiles) there will be a better understanding of the economic opportunities for retailers. In turn the ability to understand this at a wider town level will enable an understanding of footfall patterns and behaviours that are more or less economically beneficial to the retailers.

How this changes over time as our towns change makes this an interesting long term research challenge with the opportunity to carry out further research into wider data of footfall movements such as GPS or in app tracking as well as linking the role of footfall in in-store and online transactions thereby establishing total customer and location value.

"The form and function of our towns and cities are changing rapidly. Having an understanding of the social, economic and environmental factors driving these changes is key to how we repurpose and reinvigorate these places. Communities, councils and commercial interests need to have a common evidence base from which to make decisions and it is research such as this that is a key contributor to informing this requirement.'

Matthew Hopkinson, Didobi

Towards a Better Understanding of Footfall

About the organisations involved.

The Consumer Data Research Centre
The CDRC was established by the UK Economic and Social Research Council in 2014 as part of phase two of the Big Data Network, It aims to:

- Contribute towards ensuring the future sustainability of UK research using consumer data
- Support consumer related organisations to maximise their innovation potential
- Drive economic growth

CDRC brings together world-class researchers from the University of Leeds, University College London, University of Liverpool and the University of Oxford to offer a range of expert services to a wide range of users. www.cdrc.ac.uk

University College London
UCL is London's leading multidisciplinary university, with more than 13,000 staff and 42,000 students from 150 different countries. Founded in 1826 in the heart of London, UCL opened up education to some of those who had previously been excluded from it. This research has been conducted in the Department of Geography. www.geog.ucl.ac.uk

Didobi
Didobi is a Strategy and Data Consultancy that works with real estate investors, landlords, occupiers and local authorities in the implementation and use of data. Didobi is an Industrial Research Partner to UCL and one of its directors, Matthew Hopkinson, is a Visiting Industrial Professor at UCL. www.didobi.com