UCL

STREET MOBILITY PROJECT
Toolkit

IMAGE © LIVING STREETS

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

EPSRC Engineering and Physical Sciences Research Council

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Street Mobility and Network Accessibility Project Summary

Busy roads carrying large volumes of motor vehicles can deter people from walking along them or crossing on foot, and so interfere with individuals' ability to access the goods, services, and people they need for a healthy life (often called 'community severance' or the 'barrier effect'). This also reduces the amenity value of streets as social spaces. Deterrence to active living particularly affects children, who are denied freedom to explore, play, and travel without adult supervision, and older people, whose slower walking speeds limit their ability to cross roads. In both cases, this reduces independence. Despite this, there has been a lack of tools to identify, assess, and study community severance caused by busy roads.

This project developed a suite of tools to assess and value the negative effects of busy roads on local residents. These tools were validated by triangulating findings from different data sources. The tools we have developed include:

- participatory mapping - engaging local residents and community members to provide qualitative data on the locality and their relationship with it;
- a health and neighbourhood mobility survey - to collect data from a random sample of local residents on their perceptions of walking around their area, and on their health and mental wellbeing;
- a video survey - to determine pedestrian and motorised traffic flows and pedestrian crossing behaviours;
- spatial analysis - to develop a sophisticated walkability map; and
- a stated preference survey - to value the disbenefits of community severance.

We also used existing tools, including street audits (to assess the quality of the pedestrian environment) and space syntax (a specialised form of spatial analysis). All these tools were tested in four case study areas: two in London, one in Southend, and one in Birmingham.

The study found that despite having a high walking potential, each of the main roads we studied was an unpleasant place for pedestrians to visit or cross, with high traffic levels and the associated air and noise pollution, as well as a lack and/or poor quality of pedestrian crossings. These conditions have a negative impact on the overall mobility and accessibility of local residents and on the quality of their walking trips. There is also evidence of severance having negative impacts on health and wellbeing, although the associations with specific characteristics of roads and motorised traffic are not very strong. The analysis showed coherent findings from the different measurement tools when applied individually. It also revealed interconnections between factors which contribute to severance.

The coherence of the qualitative and quantitative findings from the different tools supports the validity of the tools. Overall the suite of tools is reliable for assessing community severance in urban areas. The toolkit (www.ucl.ac.uk/street-mobility/toolkit) is available online for use by local communities, practitioners, and researchers. By providing valuations of the impacts of community severance on the local community, policy-makers and practitioners can also prepare business cases for funding to reduce severance.

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Acknowledgements

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We thank all those who helped with the development of this toolkit, particularly:

- local authority staff, community groups and residents in the case study areas; and
- potential users of the toolkit, from a wide range of disciplines and organisations, who gave valuable comments on the draft toolkit.

STREET MOBILITY PROJECT
Introduction

WELL-DESIGNED STREETS IN BRISTOL PARK ENCOURAGE PEOPLE OF ALL AGES TO WALK

IMAGE © LIVING STREETS

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

This document is an introduction to the toolkit that contains a number of tools we have developed so that local government and local communities can assess community severance in their area.

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INTRODUCTION

Most people want to live in pleasant areas that are clean and quiet, and where it is easy to walk or cycle around the neighbourhood. Busy roads can cause problems for people who want to walk along them or to cross them, and also for people living nearby. In addition to noise and air pollution, the main difficulties are caused by:

- the volume, or sometimes the speed, of traffic;
- too few crossings; and
- not enough time to get across.[1]

All these can be unpleasant, but they can be more than that too – they can affect people's health and wellbeing. The impacts can be direct, for example from air pollution. They can also be indirect: for example, health can be affected when busy roads separate local residents from goods, services, or other people. This barrier effect is sometimes called 'community severance'. The UCL Street Mobility team has developed this toolkit, offering a suite of research approaches to identify, assess and value this barrier effect or 'community severance'.

MOTOR TRAFFIC FORMING A BARRIER TO PEDESTRIANS CROSSING FINCHLEY ROAD

IMAGE © UCL STREET MOBILITY PROJECT

The Toolkit

This toolkit contains tools developed to help local government and local communities assess, and value the costs of, community severance in their area. Knowing what the problem is in more detail helps to make a case for change.

The toolkit is divided into eight sections, as follows:

Introduction (this section) provides background information about the purpose of this project. It includes a table summarising the various tools for assessing the barrier effects of busy roads and what resources are needed to use them.

[1] Other problems, such as poor quality pavement, poor lighting, and fear of crime can occur as well, but are not specific to busy roads.

What we know summarises the evidence about what 'community severance' is and how it affects people's lives, including their health and wellbeing. It also includes some references, for anyone who wants to read more about this. All work produced by UCL Street Mobility team members is available to all (open access). Where possible, we have used freely available sources for referencing other people's work, but access to some studies may be restricted.

The next five sections explain the tools we have created to help local government and communities measure the effects of busy roads (Participatory mapping, the Health and Neighbourhood Mobility survey, Video surveys, Valuation, and Walkability).

The last section describes other, existing tools that we have found useful (Space syntax, Street audits).

- What you want to find out and/or measure; and

Which tool (or tools) you use depends on:

- What resources you have available (time, people, expertise, money).

Table 1 (below) will help you decide which tool(s) to use. It lists the tools, describes what they are for, and what resources you need if you want to use them. Each of the tools can be used independently, but can also be used in combination with any of the other tools, and in any order.

For example, a community group might use participatory mapping and a street audit. A local authority might start with the Health and Neighbourhood Mobility survey and the valuation tool. A single tool can provide useful information, but using a range of tools will provide a more comprehensive assessment. The tools allow the problem to be broken down into smaller sections that can be dealt with by different people or groups. The toolkit also helps to forge links across sectors and departments. Local community groups and local government staff working together can produce the best information.

Certain people, such as children and the elderly, or those with physical or mental health impairments, may be particularly sensitive and vulnerable to the effects of busy roads. Several of the tools contained in this toolkit can be used to identify and assess such inequalities.

The tools will generally be used to measure the current barrier effect. However, some of the tools can be used to predict what the effects might be if there are changes. They can contribute to a vision of what streets can be like. They can also be used to monitor or evaluate the effects of interventions.

FINCHLEY ROAD UNDERGROUND STATION AND JOHN BARNES' DEPARTMENT STORE, 1978

Table 1. Tools in this toolkit, their uses, and the resources needed to use them

Tool	Why use it?	What resources are needed?			
		People	Expertise	Money	Time
Participatory mapping	To get local community members' views on the neighbourhood, including where they do and do not go, why, and how	Local community, NGO[2], social enterprise, university, local government, businesses	Helps but not necessary	£	🕑
Health & neighbourhood mobility survey	To find out the proportion of people locally who are affected by various problems, and which groups are particularly affected	Local community, NGO[2], social enterprise, university, local government, commercial organisation	Helps but not necessary	£	🕑🕑
Video surveys	To measure the amount of motor and pedestrian traffic using roads, and recording where people cross roads	Local government, university, commercial organisation	Siting the cameras; reviewing the films; interpreting the findings	££	🕑🕑
Walkability models	To assess the potential of an area for pedestrian travel	Local government, university, commercial organisation	Using data sources; software; very powerful computer	££	🕑🕑🕑
Measurement and valuation tool	To estimate the cost to local residents and society of the barrier effect of busy roads	Local government, NGO[2], university	Using data sources	£	🕑
Space syntax[3]	To show which street segments are most useful for connecting different areas, and how easy it is to walk from one place to another	Local government, university, commercial organisation	Using data sources; space syntax software; interpreting the findings	£	🕑🕑🕑
Street audits	To assess how pleasant and easy it is to walk around the area	Local community, NGO[2], social enterprise, university, local government, commercial organisation	Consistent assessment of each feature	£ to ££	🕑 to 🕑🕑🕑

[2] NGO: Non-Governmental Organisation (also called 'Third Sector' organisation, such as a local or national charity, or a community group).

[3] Resources listed are for creating a new model. Few resources and less expertise are needed to use an existing model.

Next steps: what happens after using these tools?

This toolkit has been produced to help local authorities and community groups identify, assess and evaluate community severance; it does not provide solutions. After using one or more of the tools you will know whether or not there is a community severance problem to solve, and how it affects different groups in the population. If you have used the valuation tool, you will also have an estimate of the cost of the effects of community severance on the local community.

Once you know the problem, there are a number of ways to begin to address it.

Potential solutions may be suggested by local residents or by local government staff, using their expert knowledge. Below, we list a range of organisations and further resources which may be able to offer you support in taking action to reduce or eliminate community severance in your area.

Reports

The Carnegie UK Trust and IACD (International Association for Community Development). *Assets in your community: Mapping exercise.* (A guide to conducting community mapping to help strengthen communities). https://www.foe.co.uk/sites/default/files/downloads/assets-your-community-mapping-exercise-48301.pdf

The **Healthy Streets** website contains a range of documents and other advice for 'Healthy streets': https://healthystreets.com/

Mindell JS, Cohen JM, Watkins SJ. *Health on the Move 2. Policies for health-promoting transport. Stockport:* Transport and Health Study Group, 2011. (An evidence-based report on the effects of transport on health and inequalities, and on the policy implications). www.transportandhealth.org.uk/?page_id=32

Data sources

The *Office for National Statistics* provides counts and percentages for particular characteristics, health conditions and the wellbeing of people living in neighbourhoods across the UK. https://www.ons.gov.uk/peoplepopulationandcommunity

The *Department for Transport* provides street-level traffic data for every junction-to-junction link on the 'A' road and motorway network in Great Britain. https://www.dft.gov.uk/traffic-counts/

Organisations that can provide support or information

My Community supports community-led projects and plans to build and strengthen communities across England through information, advice and funding. http://mycommunity.org.uk/take-action/getting-started/

Living Streets aims to get people of all generations to enjoy the benefits that walking brings and to ensure all our streets are fit for walking. https://www.livingstreets.org.uk/

Sustrans works with communities, policy-makers and partner organisations so that people can choose healthier, cleaner and cheaper journeys and enjoy better, safer spaces where they live, including helping with Safe routes to Schools. www.sustrans.org.uk

STREET MOBILITY PROJECT
What We Know

THE DOMINANCE OF CARS IN MANY TOWNS SUCH AS ROTHERHAM CAN MAKE TRAVEL FOR OTHER ROAD USERS UNPLEASANT

IMAGE © LIVING STREETS

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

This document contains evidence and our research to help local government and local communities understand more about community severance in their area.

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SUMMARY OF THE EVIDENCE

First we summarise what was already known about the 'barrier effect' of busy roads, sometimes called 'community severance'. On the following pages, we describe what we found in our study. References for some key studies are not open access but where possible we have used references that are widely available: we have provided URLs for these.

FIGURE 1: THE 'BARRIER EFFECT' OF TRAFFIC AND TRANSPORT INFRASTRUCTURE

IMAGE © UCL STREET MOBILITY PROJECT

What was already known

In 1972 Donald Appleyard and Mark Lintell published a study of residents on three streets in San Francisco.[1] They had found that people living on a street with little traffic knew most of their neighbours and had many friends on the street. However, similar people living on an otherwise comparable street, but with heavy traffic, knew few people and had very few friends on the street.

More detailed work was published in a book a decade later.[2] This showed that the amount of traffic in the street outside their home also affected people's living space – both the parts of their own home they could use comfortably, and the area of the street outside they considered to be 'theirs'. Both these sets of findings were also seen in a similar, more recent study in Bristol.[3] Other studies showed that children on busier streets were less likely to be allowed to play in the streets, which was bad for both their mental and physical development.[4]

Motor traffic has many effects on health. This includes injuries, the effects of pollution, and its role in discouraging people from being physically active in their everyday life. Recently, evidence

[1] Appleyard D, Lintell M. The environmental quality of city streets: The residents' viewpoint. *American Institute of Planners Journal*. 1972; 38:84-101.

[2] Appleyard D, Gerson MS, Lintel M. *Livable streets*. Berkeley: University of California Press, 1981. (recently reissued in a 2nd edition: 2012, Editor B. Appleyard)

[3] Hart J, Parkhurst G. Driven to excess. Impacts of motor vehicles on the quality of life of residents of three streets in Bristol UK. *World Transport Policy & Practice*. 2011; 17(2): 12-30. Available at: http://eprints.uwe.ac.uk/15513

[4] Mindell JS, Karlsen S. A review of the evidence on community severance and its impacts on health. *Journal of Urban Health*. 2012; 89:232-246. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3324603/

from around the world has also shown that although car users may spend more in a single visit, people travelling by bus, bicycle or on foot make more frequent purchases. Overall, car users spend less money in local shops than other people: improving pedestrian access makes economic sense for retailers too.[5,6]

Compared with other local effects of transport, the 'barrier effect' of major roads and other transport infrastructure on local communities (also known as 'community severance') has not been studied enough.[7] Moreover, most of the information available is in technical reports that can be difficult to access. We have therefore published a review of what is known about measurement of community severance.[8]

The barrier effect can make it difficult for pedestrians to cross the road (Figure 1). This particularly affects older people, children, and people with disabilities. It can deter people from walking for several reasons, such as the detours needed to reach a crossing point; the delays waiting for signals or gaps in the traffic; or extra inconvenience if a subway or footbridge is needed to get across. People may respond by using cars instead of walking or cycling, or even by staying at home if they have no alternative. Roads with a lot of traffic are also likely to have higher levels of air and noise pollution; problems with glare of lights or reduced visibility because of vehicles; and fear of injury. These can all make walking along them unpleasant.[8]

Walking and cycling (often referred to as active travel) have a range of benefits for physical and mental health and wellbeing, particularly through increasing physical activity.[9] Many studies across western Europe have shown that the benefits from this physical activity greatly outweigh any increase in exposure to air pollution or injury. If substantial proportions of the population move from car journeys to travelling by walking, cycling or public transport, this could also reduce air pollutant emissions and the risk of traffic injury.[10]

[5] Transport for London (2002). *The benefits of town centre pedestrian and public realm schemes*. London: Transport for London.

[6] Lawlor E. *The pedestrian pound: The business case for better streets and places*. London: Living Streets, 2015. Available at: https://www.livingstreets.org.uk/media/1391/pedestrianpound_fullreport_web.pdf

[7] Anciaes PR, Boniface S, Dhanani A, *et al*. Urban transport and community severance: Linking research and policy to link people and places. *Journal of Transport and Health*. 2016;3(3):268-277.

Available at: www.sciencedirect.com/science/article/pii/S2214140516302171

[8] Anciaes PR, Jones P, Mindell JS. Community severance: where is it found and at what cost? *Transport Reviews*. 2016;36(3):293-317. Available at: www.tandfonline.com/doi/full/10.1080/01441647.2015.1077286.

[9] Davis A, Cavill N, Wardlaw M, *et al*. 'Physical activity, trends in walking and cycling and the obesity epidemic.' Section Section II, Chapter 2 in Mindell JS, Cohen JM, Watkins SJ (Eds) *Health on the Move 2. Policy for health-promoting transport*. Stockport: Transport and Health Study Group. 2011. Available at: www.transportandhealth.org.uk/?page_id=32

[10] Bearman N, Singleton AD. Modelling the potential impact on CO_2 emissions of an increased uptake of active travel for the home to school commute using individual level data. *Journal of Transport and Health*. 2014;1(4):295-304. Available at: www.sciencedirect.com/science/article/pii/S2214140514000772

What our study found

We found that community severance affects people in the whole area around a busy road, not just those who live beside it. We have therefore created a new community severance definition:[11]

> **Transport-related community severance is the variable and cumulative negative impact of the presence of transport infrastructure or motorised traffic on the perceptions, behaviour, and wellbeing of people who use the surrounding areas or need to make trips along or across that infrastructure or traffic flow.**

We have confirmed in our case studies that large volumes of motor traffic make roads unpleasant for pedestrians, due not just to the vehicles themselves but also to the associated air and noise pollution. Pedestrian crossing facilities are generally inadequate: there are not enough of them, they are poorly designed, or they do not allow people enough time to cross the road safely. These problems can reduce the overall walking quality, mobility and accessibility for local residents (Figure 2). Each of the measurement tools we have developed, presented in this toolkit, confirmed these findings. They also revealed connections between the factors which contribute to community severance, showing that the suite of tools is reliable when used together.

Surprisingly, our research showed that the volume of motor traffic was more important than its speed in affecting local residents' mobility in their neighbourhood. Nationally, 15% of people (17% in urban areas) found the volume of traffic often or always affected their ability to walk round their area. In our four case studies it was 40% (figures adjusted for age). Not surprisingly, the nearer people lived to the busy road, the more they were affected.

FIGURE 2: MOTOR VEHICLES HAVE A RANGE OF NEGATIVE EFFECTS ON PEDESTRIANS

IMAGE © UCL STREET MOBILITY PROJECT

We also found that most people would prefer to walk further to a crossing with pedestrian lights, rather than use a subway or a footbridge.[12] In addition, many people choose not to cross, even if there is a cheaper shop or a bus stop in a cheaper travel zone on the other side of the road.[13]

[11] Anciaes PR. *What do we mean by "community severance"?* Street Mobility and Network Accessibility Series. Working paper 04, August 2015. Available at: http://discovery.ucl.ac.uk/1527807

[12] Anciaes PR, Jones P. *Pedestrians' preferences regarding signalised crossings, footbridges, and underpasses*. Street Mobility and Network Accessibility Series. Working paper 09, June 2016. Available at: http://discovery.ucl.ac.uk/1505651

[13] Anciaes PR, Jones P. *How do pedestrians balance safety, walking time, and the utility of crossing the road? A stated preference study*. Street Mobility and Network Accessibility Series. Working paper 08, June 2016. Available at: http://discovery.ucl.ac.uk/1505652

As part of our research we developed 'walkability' models for Birmingham and for London. These show which streets have the best access to public transport and are close to people and a good mix of shops, leisure and work places. The model for London was very good at predicting how many people actually walk in different areas.[14] Community severance seems to occur particularly around roads that have both high walkability and also high motor traffic levels.

'Walkability' does not measure how easy or pleasant it is to walk round the area, so we assessed the quality of the pedestrian environment using a formal, objective tool. However, we found that when we made a separate assessment of the experience of walking down each street in an area, the findings did not always match local residents' own opinion about their area, for example on issues such as pavement quality.

Using video surveys, we found that pedestrian flows along busy streets are lower than we would expect, despite the presence of places pedestrians are likely to want to go to, such as bus stops.[15] In addition, high volumes of motor traffic also lead to more risky behaviour crossing the road, such as crossing outside designated facilities or too close to moving vehicles (Figure 3).[16]

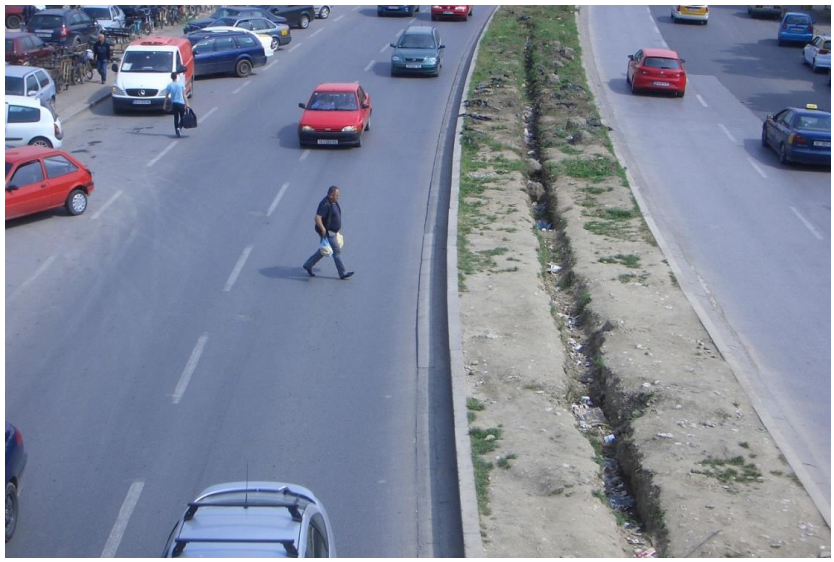

FIGURE 3: RISKY BEHAVIOUR BY PEDESTRIANS WHEN CROSSING THE ROAD

IMAGE © UCL STREET MOBILITY PROJECT

We also found that minor changes to road design could make walking trips much shorter and quicker, reduce the amount pedestrians are exposed to traffic, and could improve the quality of the street environment.[17]

[14] Dhanani AN, Vaughan L. Towards a walkability model for strategic evaluation of policy action and urban active transport interventions. 48th Meeting of the Universities' Transport Study Group (UTSG), 2016;48. Available at: https://iris.ucl.ac.uk/iris/publication/1188700/1

[15] Anciaes PR, Jones P. *The influence of motorised traffic on pedestrian flows – new insights using bus stop data*. Association for European Transport Papers Repository. 2015. Available at: https://abstracts.aetransport.org/paper/index/id/4702/confid.

[16] Anciaes PR, Jones P. *Irregular pedestrian crossing behaviour on a busy road in London: where, who, when, and how*. Paper presented at the 49th Annual UTSG Conference, January 2017. Available at: http://discovery.ucl.ac.uk/1538001

[17] Anciaes PR, Jones P. The effectiveness of changes in street layout and design for reducing barriers to walking. *Transportation Research Record* 2016; 2586: 39-47.

STREET MOBILITY PROJECT
Participatory Mapping

PARTICIPATORY WORKSHOP, BIRMINGHAM

IMAGE © MAPPING FOR CHANGE

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

This document contains information about one of the tools that we have developed so that local government and local communities can assess community severance in their area.

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PARTICIPATORY MAPPING

What it is

Participatory mapping is a way for groups and organisations to help improve the places that matter to them by producing information. The UCL Street Mobility project used it to record and share the local knowledge and understanding that people have about the patterns of traffic and the way roads are used in their own area.

Participatory mapping is a way to engage groups and individuals in the local community. It can be carried out rapidly, or through a longer and deeper engagement with individuals and groups, in which problems are identified and solutions proposed, and assessed for suitability and relevance. The project uses maps to help people visualise or analyse their local area by focusing on particular issues or questions, allowing people to share their understanding of their environment with others.

How to do it

Start by visiting the area to identify places where people gather (e.g. community centres, shopping centres, religious establishments), and which ones are in the right locations to contact people who live in the area being mapped. In addition, check available online information, for example the Census, to ensure that you are making contact with the different groups living in and using the area. Contact local community groups, housing providers, and religious groups and ask about regular meetings, then ask permission to attend some to get familiarity and trust. Consider how to reach under-represented groups through their social connections – e.g. a local establishment that they frequent such as a church or a mosque. In addition, consider recruiting 'community champions' who can reach out locally to people who do not attend meetings or are housebound.

COMMUNITY MAPPING WORKSHOP

After these early visits, a programme of community engagement should be carried out, in one or more of these three ways:

1. Rapid appraisal mapping, which involves stopping people in the street and asking them to spend a little time contributing information. The information can be captured on a medium-sized map or an aerial image of the area by asking participants to carry out a short task, such as marking problem spots for crossing the street, or tracing their planned route from home to local facilities. This can also be done in a shopping centre – or even by stopping people near a local traffic node (e.g. near a Tube station).

2. Longer community mapping workshops allow participants to discuss issues more fully. Here you can follow a more detailed process, such as the one depicted in the figure below. The process can involve working in groups, in a discussion over large scale maps or aerial images, printed so people can annotate them. Post-it notes and coloured stickers are recommended to mark places on the map of concern to the group. This process can then be followed up with detailed individual work to investigate areas identified (e.g. by collecting traffic counts, or recording household perceptions) and an additional workshop can be set up to share the results with the group. Online mapping tools can be used to collate and share the information. Such workshops are best held in a place that is familiar to the participants, such as a local library or a community centre.

3. In-depth individual interviews, often with participants in the rapid appraisal mapping exercise or from community groups, can provide deeper insights into issues emerging from the maps and rapid appraisals. These can be part of the later stage of the community mapping project, in which participants share detailed experiences about their area. The use of maps or aerial images allows participants to point to problem spots or to describe different characteristics of their environment, such as informal road crossing points or places where formal crossing provision is inadequate.

EXAMPLE OF MAP ANNOTATED BY COMMUNITY MEMBERS FOR PARTICIPATORY MAPPING

IMAGE © OPENSTREETMAP CONTRIBUTORS

Once the data are recorded on maps (either online or offline), they can be collated using a Geographical Information System (GIS) and analysed. Qualitative information and descriptions from the interviews can be classified into categories to visualise different issues across the area. This can be done by developing 'codes' – keywords that identify a specific statement or part of an interview. Work is usually needed to code and classify qualitative statements, and then to test how well the

coding works when it is used on different interviews or maps. A classification of the findings will then be produced. This can be used to visualise the information on a map, for example by indicating places that had positive comments – and those that had negative comments. Participants can then be asked in more detail about issues they raised concerning road traffic, pedestrian crossing facilities, use of public transport, social networks or neighbourhood boundaries.[1] The resulting map can be used to identify issues that are frequently mentioned by community members.

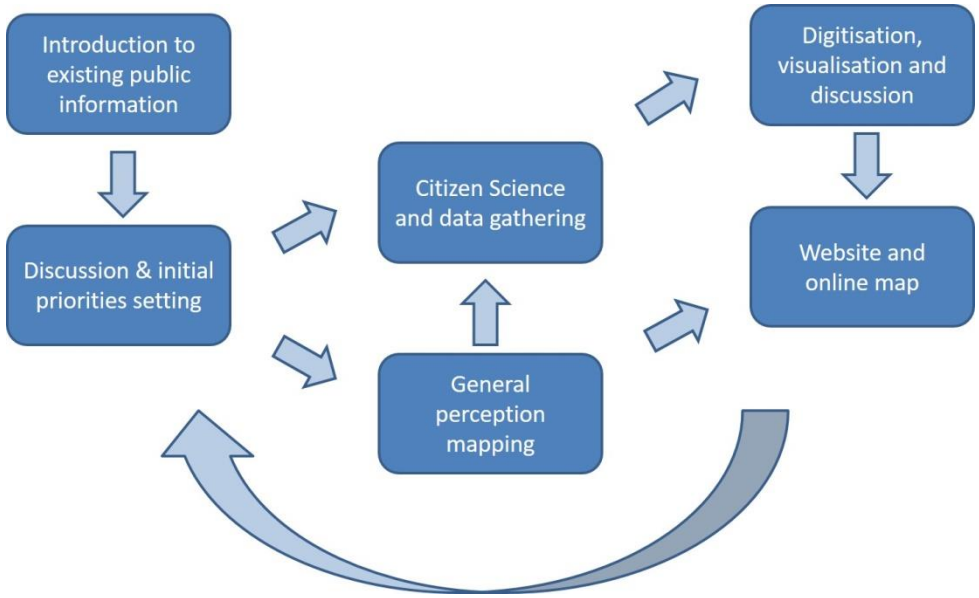


DIAGRAM SHOWING THE PROCESS OF PARTICIPATORY MAPPING

[1] For further information, see http://mappingforchange.org.uk/ and https://communitymaps.org.uk/welcome.

CASE STUDY: PARTICIPATORY MAPPING IN SOUTHEND-ON-SEA

To understand how local residents experience local mobility issues and the impact of major roads, we talked to 52 people from various addresses across the area. The activities varied from informal mapping sessions and street mapping surveys to in-depth participatory mapping workshops, in which people spent an afternoon working together to identify issues and mark them on a shared map.

The aim of this engagement was to explore people's views on Queensway (a large, main road), particularly whether it acted as a 'barrier' with negative impacts on physical and psychological wellbeing, particularly for older people. We also looked for any other factors which influenced people's walking behaviour around Queensway, for example potential fear of crime.

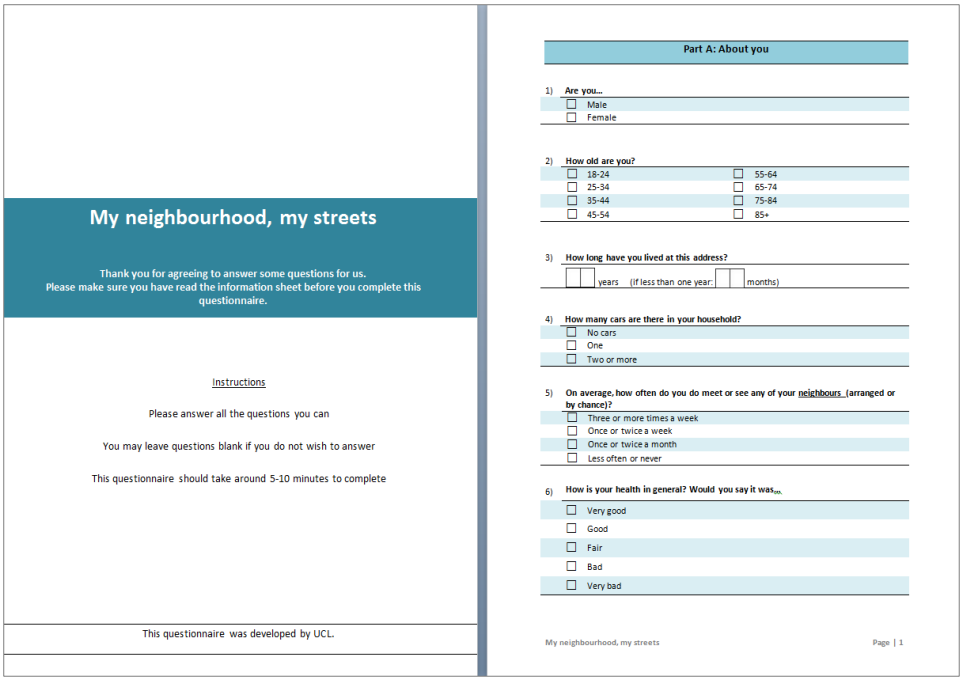
Participatory mapping was the method used in all these engagement activities. We used large A0 and A3 maps of the case study area as the starting point for a series of informal questions about participants' perceptions and experiences of Queensway and nearby areas. Participants were asked to think about areas they visited and liked, as well as those that they found problematic or avoided.

The engagement was open ended, and we did not try to direct participants towards any particular issues or insist that they discussed only selected topics. Nevertheless several sites emerged from the discussions as especially problematic, making it difficult for participants to walk around the area. The nature of these issues varied for both physical and perceived characteristics. Participants commented predominantly on physical design, and on fear of crime and anti-social behaviour.

During these sessions we recorded over 400 statements about the local area, which were then analysed and integrated, producing a report on common views. For example, an issue that came up frequently was the perceived danger to pedestrians from motorised and non-motorised traffic, particularly bikes and skateboards, riding on the pavement. These were predominantly related to a particular site, a shared space outside Southend's Victoria Station.

The participatory mapping exercise in Southend-on-Sea demonstrated that with a limited investment in time, and using rapid mapping sessions, valuable and relevant information can be gleaned about local perceptions of busy roads and movement in the study area.

STREET MOBILITY PROJECT
Health and Neighbourhood Mobility Survey



My neighbourhood, my streets

Thank you for agreeing to answer some questions for us.
Please make sure you have read the information sheet before you complete this questionnaire.

Instructions

Please answer all the questions you can

You may leave questions blank if you do not wish to answer

This questionnaire should take around 5-10 minutes to complete

This questionnaire was developed by UCL.

Part A: About you

1) Are you...
- Male
- Female

2) How old are you?
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- 75-84
- 85+

3) How long have you lived at this address?
___ years (if less than one year: ___ months)

4) How many cars are there in your household?
- No cars
- One
- Two or more

5) On average, how often do you do meet or see any of your neighbours (arranged or by chance)?
- Three or more times a week
- Once or twice a week
- Once or twice a month
- Less often or never

6) How is your health in general? Would you say it was...
- Very good
- Good
- Fair
- Bad
- Very bad

My neighbourhood, my streets Page | 1

THE HEALTH AND NEIGHBOUROOD MOBILITY SURVEY

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

This document contains information about one of the tools that we have developed so that local government and local communities can assess community severance in their area.

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HEALTH AND NEIGHBOURHOOD MOBILITY SURVEY

Introduction

This section explains how to use the Health and Neighbourhood Mobility Survey. It is useful for finding out what proportion of local residents have problems from motor traffic, or have other problems walking around the local area. Analysis of information collected through the survey may also reveal health inequalities, such as whether people with mobility impairment are more affected by fast or heavy traffic than other local residents are. Details about how the questionnaire was developed are available on the project website.[1]

In brief, we used existing questions where available, validated for other surveys. New questions were tested with local residents in a different area of London by discussing what they thought the questions were asking ('cognitive testing'), then improving the questions, and trying them out ('piloting').

OLDER PEOPLE, IN PARTICULAR, MAY HAVE IMPAIRED HEALTH AND DISABILITY WHICH AFFECTS THEIR MOBILITY

The questionnaire

The questionnaire starts by asking about the person responding, including their age group, gender, and how long they have lived at their address. This information means that you can check whether the people who answer the survey are typical of people living in the area. It also allows you to see whether different groups (e.g. men and women, or older and younger people) have the same concerns, or are concerned by different things.

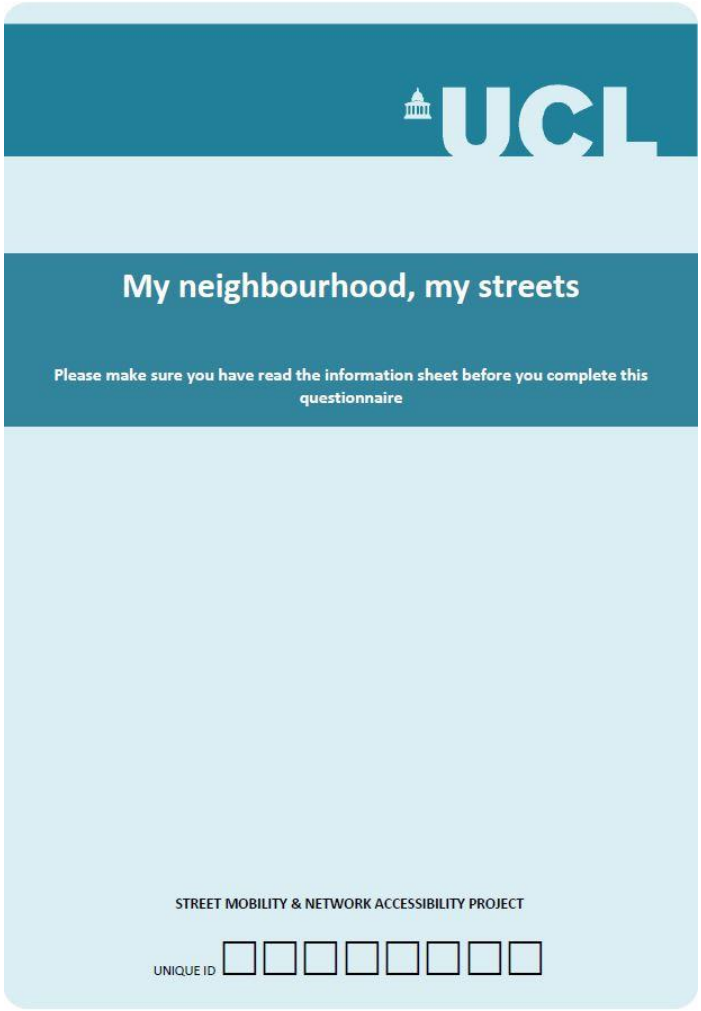
The questionnaire also includes a few questions about general health, and about disabilities that affect people's mobility. It then asks some specific questions about the effects of busy roads. First

[1] Scholes S, Boniface S, Stockton J, Mindell JS. *Developing a questionnaire to assess community severance, walkability, and wellbeing: results from the Street Mobility Project in London.* Street Mobility and Network Accessibility Series. Working Paper, 05 February 2016. Available at http://discovery.ucl.ac.uk/1474883/

there are questions about problems walking around the local area. Next, there are questions about the busiest local road.

You do not need to ask all the questions, only the ones you think will be important for your survey. We have provided the questionnaire as a Microsoft Word file, so that you can change it if you want to, as well as a pdf file.

The survey questionnaire can be downloaded for free from (www.ucl.ac.uk/street-mobility/toolkit). We ask that you notify us, at streetmobility@ucl.ac.uk, if you plan to use the survey, and to let us know what you found. This is so that we can tell the funders of our research (see the footer of this page) if other people have found it useful.



HEALTH AND NEIGHBOURHOOD MOBILITY SURVEY BOOKLET FRONT COVER

IMAGE © UCL STREET MOBILITY PROJECT

Conducting a survey

Excellent advice and detailed but simple instructions on conducting a survey, including sampling the local population, are available in the "*How to do a survey*" guide which you can download for free from our project website (www.ucl.ac.uk/street-mobility/toolkit).

It is modified from a freely available document produced by The New Economics Foundation about conducting a survey, including guidance on how to analyse the results and what to do with your findings (www.uknswp.org/wp-content/uploads/Measuring_well-being_handbook_FINAL.pdf).[2]

Generally, the more questions you ask, the lower the response rates, and the higher number of missing items. We have therefore not included questions on physical activity in the Health and Neighbourhood Mobility Survey, to limit completion time to 15-20 minutes. However, we have included a section in the "*How to do a survey*" guide on questions about physical activity.

Analysing the results[3]

In general, local communities will not need a full analysis of all the data you collect in the survey. You will need 'indicative' data, which is enough information to take to the local authority or another organisation, to show that something is a problem, and/or what proportion of the community is affected or concerned. You may want to know who is particularly affected – for example, older or younger people, men or women, people with a disability, or people from certain ethnic groups.

We have created a Microsoft Excel tool as one way to handle the survey data. You can use the Microsoft Excel file we have prepared. You can use this for data entry and for simple analysis. We have also prepared some instructions on how to tabulate the data and how to show some simple graphs of your results. You can download the Excel file and the *Instructions for analysis* Word file from www.ucl.ac.uk/street-mobility/toolkit.

[2] This Guide on conducting a survey was prepared with permission by the New Economics Foundation. It is based on Michaelson J, Mahoney S. *Measuring well-being. A short handbook for voluntary organisations and community groups*. London: New Economics Foundation, 2012.

[3] Local authorities will have the expertise to analyse their own data. This section is written for community groups.

CASE STUDY: USING THE HEALTH AND NEIGHBOURHOOD MOBILITY SURVEY IN FINCHLEY ROAD

The Street Mobility project wanted to find out how a particular 1km-stretch of Finchley Road, a busy arterial road running north from central London, might affect people living in the surrounding neighbourhood. This stretch of the road is a dual carriageway, with a central barrier that prevents people crossing except at a few designated points. We expected that residents' ability to get around on foot, and their health and wellbeing, might be affected by traffic, the layout and other problems with the road.

WALL SEPARATING MOTOR TRAFFIC FROM PEDESTRIAN FOOTPATH IN FINCHLEY ROAD

To discover what effects Finchley Road had on people living nearby, we used our Health and Neighbourhood Mobility Survey questionnaire. We drew on a map the boundaries of the study area around the 1km-stretch of Finchley Road which we thought might be particularly troublesome for residents. Then we selected 1500 addresses at random from the area we had mapped. We posted a letter to these households asking residents to take part in the survey. Between June and August 2015 we visited the households, asking one adult at each address to complete a paper version of the questionnaire, returning to collect it a few days later if they agreed. We visited 313 households and collected 179 completed questionnaires, giving us a response rate of almost 60%. In addition, we had a further 30 responses from people in the area who had already answered our test version of the questionnaire.

Next we entered the residents' answers on the questionnaires into a computer database, giving each answer a numerical code, such as 0 for 'No' and 1 for 'Yes', for easier analysis. If the resident provided their address, we were also able to locate them on a map and see how their responses related to where they lived in the area - for example, nearer or further from the busy road.

This toolkit was developed by the UCL Street Mobility & Network Accessibility project team, funded by the Research Councils UK (RCUK) Lifelong Health & Wellbeing Programme

Table 1 shows some of our findings. We asked people, *"Thinking about your ability to walk to places in your local area, does the volume of traffic affect your ability to walk to places you'd like to go?"* The answer options were *"Never"*, *"Occasionally"*, *"Often"* or *"Always"*. We found that almost half of the people surveyed were at least occasionally affected by the amount of traffic (47%). We also found that over a fifth of people aged 55 and over were often or always affected by the amount of traffic (22%), whereas only one in 10 of people aged 18-54 years were affected this frequently (10%).

TABLE 1: NUMBER (PERCENTAGE) OF PEOPLE AFFECTED BY THE AMOUNT OF TRAFFIC

	Never affected Number (%)	**Occasionally affected Number (%)**	**Often or always affected Number (%)**
All people	109 (53%)	66 (32%)	30 (15%)
Aged 18-54	78 (61%)	37 (29%)	13 (10%)
Aged 55 and over	31 (40%)	29 (38%)	17 (22%)

After collecting and analyzing our data, we sent a short report of our findings to all survey participants who had asked to hear about the results. We also met with community groups in the case study area to present some of our results. The findings that around half of people surveyed were affected by traffic, and that older people appeared to be affected more, suggest that the local authority might need to investigate further, perhaps using some of our other tools, and take action to tackle community severance in the area.

STREET MOBILITY PROJECT
Video Surveys

ISSUES IN COMPLEX SIGNALISED CROSSINGS

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

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VIDEO SURVEYS

VIDEO SURVEYS CAN IDENTIFY CASES WHERE PEDESTRIANS DO NOT USE DESIGNATED CROSSING FACILITIES

IMAGE © UCL STREET MOBILITY PROJECT

What it is

This involves placing video cameras at particular points to film pedestrian and motor traffic. This is usually done for a 24 hour period or a 15-16 hour period (i.e. daytime).

Why it is useful

The information collected from video surveys helps to build a more detailed picture of who uses the road, when, and how. Taken together with results from a walkability model,[1] the comparison of the actual pedestrian flows along different roads with what might be expected from the walkability model can give an indication of places that pedestrians avoid. These may indicate where action is needed to improve the conditions for pedestrians and to facilitate more walking for travel in the area. The data collected can also be used to identify particular problems faced by pedestrians at different times of the day, which may be related to variations in the levels or types of motor traffic.

How to do it

Some local authorities will already have cameras in place. Otherwise, there are a number of companies that can place the cameras at agreed locations on an agreed date. Some of these companies will also analyse the data, for a fee.

Thought is required regarding where to site the cameras. This includes where each camera should be, and which way it should it face. The more cameras are used, the more information can be obtained. However, more cameras will increase both the cost and the amount of staff time required to view the video footage and analyse the data.

[1] See the section of this toolkit on Walkability models, also available at www.ucl.ac.uk/street-mobility/toolkit

The video footage can be used to record a number of items. Each of these will require a separate run-through for every camera:

- Vehicle flow (how many vehicles per hour or per day).
- Vehicle composition (the proportion of private cars; lorries; buses; coaches).
- Pedestrian walking flows (how many pedestrians per hour or per day).
- Pedestrian crossing flows: the number of pedestrians who cross at 'formal' crossings, (such as pedestrian signals, zebra crossings, footbridges, and underpasses) and at 'informal' crossings (which indicates where 'desire lines' are, where people want to cross the road, such as near a bus stop).
- Pedestrian crossing behaviour (where, when, and how people cross the road).
- Waiting times to cross the road.

Pedestrian data can be disaggregated by age-group, gender, and disability, if the quality of the video footage is good enough. However, this will increase the time required for the analysis.

A number of indicators can also be estimated from the raw data, for example, crossing ratios (the number of people crossing the road as a proportion of people walking along the road), or the number or proportion of people using the pavement who have an encumbrance, such as being in a wheelchair, using a mobility aid, pushing a buggy, or having luggage.

The cost of a video survey varies, depending on how much analysis is done in-house or by the company implementing the survey. There is a fixed cost of around £400 for setting up the cameras. Each camera then costs around £35 (for 15-16 hours). Basic analysis of the footage costs £25 per movement recorded (for example vehicles flowing in one direction, or pedestrians walking in one direction on one pavement). More detailed analysis (for example, of pedestrian crossing behaviours) costs more. These values exclude VAT and were valid in 2015.

Simplification

To make the analysis workload more manageable, the motor and pedestrian traffic counts can be done for parts of the day only, for example, for a 15 minute period during each hour (e.g. from 16 to 30 minutes past each hour), or without disaggregating the direction of the flow. The classification of motor vehicles and pedestrians can also be simplified (for example, vehicles can be counted simply as light or heavy). Vehicle and pedestrian flows can also be counted manually, without using video surveys. Data on the annual average daily vehicle flows in motorways and main roads can be downloaded from the Department for Transport's website.[2]

Further information

- Transport for London has produced a document, available online at: https://tfl.gov.uk/cdn/static/cms/documents/measuring-pedestrian-activity.pdf, describing methods for measuring pedestrian activity.

[2] https://www.dft.gov.uk/traffic-counts

CASE STUDY: USING VIDEO SURVEYS TO IDENTIFY BARRIERS TO WALKING IN WOODBERRY DOWN

Woodberry Down, in Finsbury Park, North London, is a neighbourhood bisected by Seven Sisters Road, a busy 3-lane road. We conducted a video survey in this area to measure the number of vehicles using the road, and the number of pedestrians walking along the pavements and crossing the road (at formal and informal crossing points). We also analysed where and how pedestrians crossed the road.

The survey used 15 cameras, covering the whole section of Seven Sisters Road being studied, and some parts of nearby streets that provided alternative routes to walking along Seven Sisters Road. The survey was carried out between 8am and 10pm on a weekday (Tuesday 16 September 2014). The number of vehicles and pedestrians was counted between 16 and 30 minutes past the hour, and extrapolated to estimate daytime totals.

The survey found that the number of pedestrians walking along Seven Sisters Road was lower than expected, considering that the road has several shops and bus stops, and is well connected to other roads. In contrast, minor roads parallel to Seven Sisters Road had relatively high pedestrian flows. This suggests some pedestrians avoid walking along Seven Sisters Road.

The analysis of pedestrian crossing behaviour also found that many pedestrians crossed the road away from formal crossings. This was especially evident along the parts of the road near bus stops. This shows that the existing crossings do not match the places where pedestrians want to cross. The behaviour of pedestrians who crossed away from formal crossing points was analysed in more detail. We found that a large proportion of these pedestrians had irregular crossing behaviours, such as stopping in the middle of the carriageway, walking along the central reservation, and changing their speed or their direction while crossing.

In conclusion, the video survey confirmed that busy roads are barriers to the movement of pedestrians, as it provided evidence that pedestrians avoid busy roads when there is an alternative route. It also showed that the lack of crossing facilities where pedestrians want to cross increases the likelihood that people will cross the road in dangerous locations.

IRREGULAR CROSSING BEHAVIOUR NEAR BUS STOP

STREET MOBILITY PROJECT
Walkability Models

LOOKING DOWN WHITEHALL FROM TRAFALGAR SQUARE.

IMAGE BY MARY HINKLEY © UCL MEDIA SERVICES – UNIVERSITY COLLEGE LONDON

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

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WALKABILITY MODELS

What they are

Walkability models[1] predict how easy it is for people to reach the places they want to walk to. It should be noted that 'walkability' does not measure how pleasant it is to walk these routes, but it is a good indicator of the potential for people to make these journeys on foot. Most walkability models include three factors:

- Residential density: how many homes there are in the area, or how many people live in the area;
- Land use mix: the variety of destinations available for people to go to, and how many there are; and
- Connectivity: this assesses how easy it is to walk between two places in the area. It can use standard distances along pavements and paths, or the number of junctions there are in a standard area ('junction density'). Other models use space syntax[2] to assess this.

Some models also include other factors, such as public transport accessibility. This measures the fact that people are more likely to use public transport and less likely to drive if they are in closer proximity to bus stops or train stations.

Why they are useful

Walkability models can be used by local government to ensure that the conditions for pedestrians are particularly good (pavement quality, lighting, greenery, etc.) in areas that have high walkability, particularly if budget cuts prevent good conditions everywhere.

They can also be used to identify areas of community severance, where the effects of busy roads reduce the likelihood of people walking for local trips. Community severance occurs where areas of high walkability occur in the same place as busy roads. Local government may wish to use walkability models to identify these areas as places to reduce traffic speed or traffic volume, or to improve the number of crossings and the time they allow for pedestrians to cross the road.

Specific examples

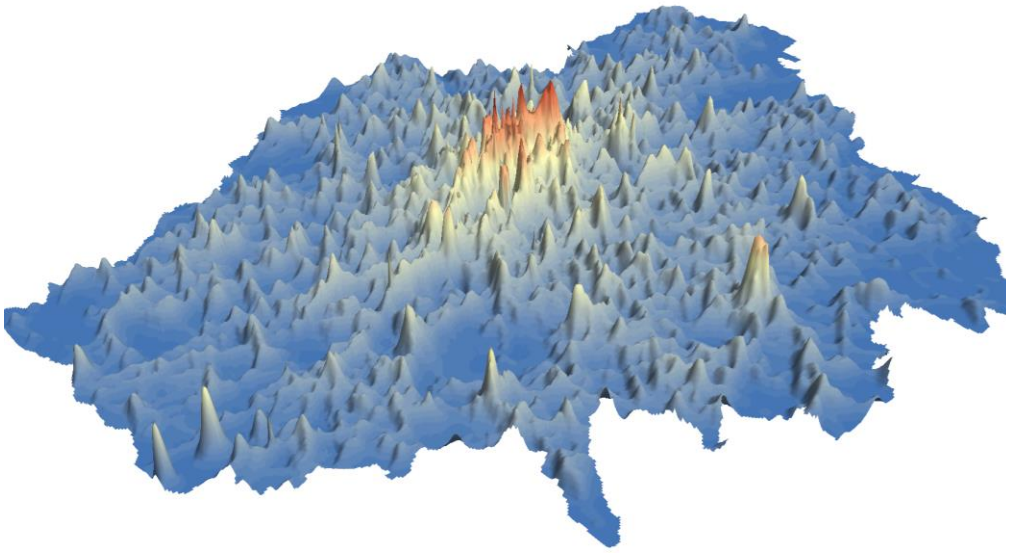
Two different walkability models for London have been created by members of the *Street Mobility and Network Accessibility* research team. Both have been validated using data on walking.

The walkability model developed by Dr Ashley Dhanani uses a multi-layered approach.[3] It measures land use diversity, taking into account all types of use, including all the floors in a building, as well as intensity of that land use, as well as public transport accessibility and office land use intensity. This means that the model includes a large variety and a high number of potential walking destinations. Street network accessibility is then assessed using space syntax[2] methods. The model represents walkability values as continuously varying, while most models use administrative boundaries for their data and modelling. See image below of whole London walkability model.

[1] Frank LD, *et al*. Linking objectively measured physical activity with objectively measured urban form - Findings from SMARTRAQ. *American Journal of Preventive Medicine*. 2005;28:117-125.

[2] See section on space syntax in this toolkit. Available at: www.ucl.ac.uk/street-mobility/toolkit.

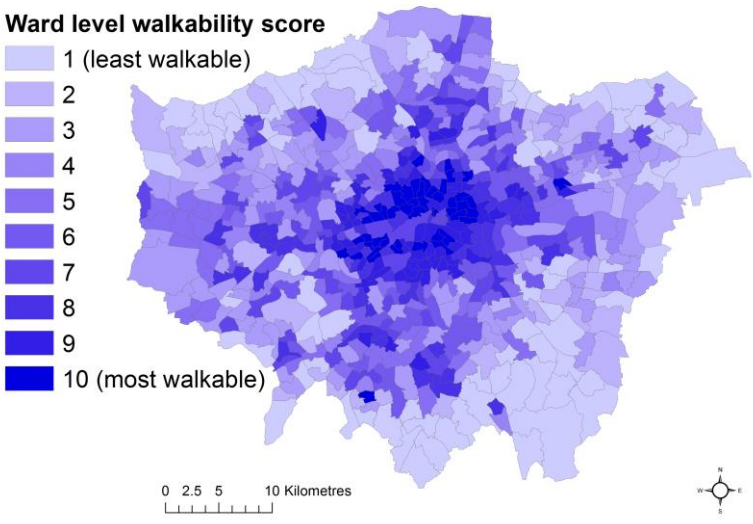
[3] Dhanani, A. N., & Vaughan, L. (2016). Towards a walkability model for strategic evaluation of policy action and urban active transport interventions. *48th Meeting of the Universities' Transport Study Group (UTSG), 48*. Available at: https://iris.ucl.ac.uk/iris/publication/1188700/1



LONDON WALKABILITY MAP COLOURATION: RED (HIGH WALKABILITY) TO BLUE (LOW WALKABILITY). HEIGHT IS ALSO RELATIVE TO WALKABILITY VALUE

This model has been proven to predict observed pedestrian demand (based on a large database of measured pedestrian activity across London), accounting for 82% of the difference in walking activity levels between areas. The model has also been produced for Birmingham (see case study below), and is currently being developed for the whole of the UK. The walkability models themselves are not publicly available, but for further information about the models, their applications and access to them please contact ashley.dhanani@ucl.ac.uk.

Dr Jemima Stockton's model is based on the first three factors listed above.[4] An Excel spreadsheet with the walkability score at local government, ward, or Census output area is available at at www.ucl.ac.uk/street-mobility/toolkit.



MAP OF WALKABILITY DECILE SCORES ACROSS LONDON CENSUS AREA STATISTIC WARDS, WITH A SCORE OF 1 INDICATIVE OF BEING IN THE LOWEST 10% OF WARDS FOR WALKABILITY

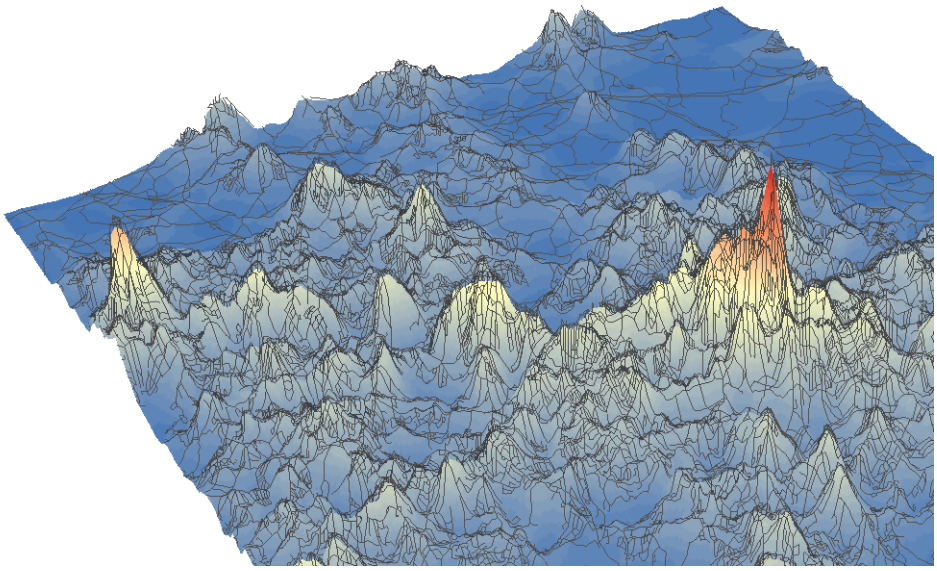
[4] Stockton JC, *et al.* Development of a novel walkability index for London, United Kingdom: cross-sectional application to the Whitehall II Study. *BMC Public Health.* 2016;16:416. doi: 10.1186/s12889-016-3012-2. Detailed maps of London for each of these administrative scales and more detailed explanations can be downloaded from http://discovery.ucl.ac.uk/1457527/

CASE STUDY: WALKABILITY MODELLING

Walkability modelling was used in several instances across the Street Mobility project. This section describes how it was used to identify potential areas with community severance. Birmingham was chosen as the location for one of the project's case studies. While the project team had some knowledge of Birmingham and local traffic issues, we needed to identify a small and appropriate location using objective methods that considered Birmingham as a whole, without any preconceptions about the city.

A walkability model was constructed to objectively assess the walking potential of all the streets in Birmingham and the surrounding area. The model accounted for transport accessibility, street network structure, land use diversity and residential density. It allowed us to assess the potential for walking to take place in every Birmingham street. To then understand the likelihood of community severance occurring, we added data on the volume of motorised traffic, the most likely cause of severance, (annual average daily flow (AADF) from the Department for Transport). This enabled us to identify places with both high motorised traffic levels and high walkability: these are locations where the traffic and pedestrians may come into conflict.

All areas that were in both the top 10% for walkability and top 10% for traffic flow were identified. These then formed the shortlist for possible case study locations. The locations were then examined in more depth, and discussed with people familiar with the areas. Using this process we selected Stratford Road, in south Birmingham, as a study area for the project. This demonstrated that the walkability model, when used in conjunction with other datasets, was a useful and valid approach for objectively identifying potential community severance.



BIRMINGHAM WALKABILITY MAP (ZOOM-IN, SHOWING CITY CENTRE PEAK). COLOURATION: RED (HIGH WALKABILITY) TO BLUE (LOW WALKABILITY). HEIGHT IS ALSO RELATIVE TO WALKABILITY VALUE.

STREET MOBILITY PROJECT
Valuation Tool

ROAD CHARACTERISTICS: VEHICLE LANES, CENTRAL RESERVATION, TRAFFIC VOLUMES, TRAFFIC SPEEDS

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

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MEASURING AND VALUING THE NEGATIVE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

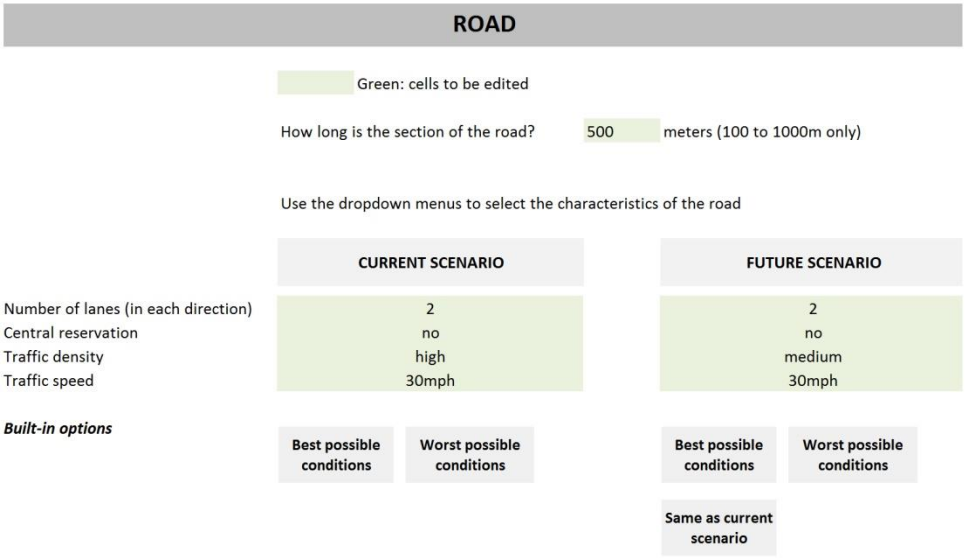
What it is

This tool calculates the potential negative effects of busy roads on pedestrian behaviour, and estimates the monetary value or cost of those effects, for different road designs and traffic conditions, and groups of people. The tool will be available for download before the end of 2017.

Why it is useful

The tool can be used to obtain quantitative indicators of community severance, suitable for inclusion in formal transport appraisal, which currently only uses qualitative measures to assess severance (DfT WebTAG Unit A4.1). The tool can estimate the barrier effect of busy roads and the effectiveness of different types of policy intervention in reducing severance, for example alterations to road design, measures to control traffic levels or reduce traffic speed, and changes in the type or spacing of pedestrian crossing facilities.

The results can also be used in a 'distributional impact appraisal' (WebTAG Unit A4.2), since they can be broken down by age, gender, and other characteristics.



SCREENSHOT OF AN INPUT PAGE OF THE VALUATION TOOL

This toolkit was developed by the UCL Street Mobility & Network Accessibility project team, funded by the Research Councils UK (RCUK) Lifelong Health & Wellbeing Programme

How to do it

The inputs for the tool are:

- *Road and traffic conditions in a given road segment*: number of lanes for motorised vehicles, presence/absence of a central reservation (median strip), traffic levels (low, medium, or high), and average traffic speeds (10, 20, or more than 20 mph).
- *Pedestrian crossing facilities*: type of crossing (signal controlled, footbridge, or subway) and the location of these facilities on a road segment.
- *Local population*: data on the population living within a defined walking distance of the road (both overall profile and broken down by gender and age group).

The outputs are:

- *Severance index:* a measure of the 'disutility' for pedestrians who would like to cross a road with the traffic and design characteristics as defined in the inputs.
- *Value of severance:* an indication of the monetary cost of that disutility per trip, for different population groups.
- *Willingness to walk further:* how many minutes pedestrians are willing to walk, on average, to avoid crossing a road with particular characteristics.
- *Crossing behaviour*: the probability that someone would do any of the following in the absence of road crossings, on roads with particular characteristics:
  - Cross the road;
  - Walk further to cross using a crossing facility;
  - Avoid crossing.

All these outputs can be broken down by age, gender, walking trip purpose, and other personal and situational factors.

The user can assess the impacts of a potential intervention by comparing the current scenario with a different scenario, altering road and traffic conditions, or the type and spacing of crossing facilities.

Resources needed

Users need the information necessary for filling the inputs section: local road and traffic conditions; existing type and location of crossing facilities and population characteristics – readily available from Census data.

Further information

The tool will be provided with a user guide.
For further information, contact p.anciaes@ucl.ac.uk or peter.jones@ucl.ac.uk

STREET MOBILITY PROJECT
Other Useful Tools

COMPLEX CROSSING IN SWISS COTTAGE, LONDON

March 2017

STREET MOBILITY PROJECT TOOLKIT: MEASURING THE EFFECTS OF BUSY ROADS ON LOCAL PEOPLE

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OTHER USEFUL TOOLS

In our Street Mobility and Network Accessibility project, we used a number of pre-existing tools to produce information about our case study areas. We also used this information to test the new tools that we developed, checking that what we found agreed with and/or added to the other information we had collected. These pre-existing tools are available from other organisations. Some need special expertise and some require payment. We are therefore not providing these tools on this website.

Since we cannot provide the tools themselves, we describe in this section what they are, why they are useful, and where you can find further information on them. The tools we describe here are street audits and space syntax.

1. STREET AUDITS

EXAMPLE OF ISSUES FOUND DURING STREET AUDITS: POOR LEGIBILITY AND LIGHTING

What it is

Street audits assess the quality of the pedestrian environment. Distinct from walkability,[1] which looks at the potential of an area for walking to places, street audits consider how pleasant and easy it is to walk in an area.

Why it is useful

Street audits can identify barriers to walking created by physical elements of the road, or by lack of provision for pedestrians. Using a formal audit tool means that data is collected in a uniform way. The data recording form is also a reminder of all the different aspects to consider and assess.

[1] See Walkability section of this toolkit, also available at www.ucl.ac.uk/street-mobility/toolkit

How to do it

The first step is to create a model of the pedestrian network representing the 'links' and road crossings that can be used by pedestrians:

- Links include pedestrian pavements along roads and streets, as well as 'cut throughs' (e.g. parks, shopping centres, stations, car parks). On main roads, the pavement on either side should be shown separately. For quieter streets, a single link can often be used to represent conditions on both sides of the street. Links are usually divided into a new section at each junction, but can be shorter if land uses or the pedestrian environment vary within that section.
- Crossings include signalised crossings ('pedestrian lights'), 'zebras' (non-signalised priority crossings), other crossing provisions (e.g. traffic islands) and likely locations for 'informal' crossing created by pedestrian 'desire lines' (e.g. near bus stops).

The second step is to assess the quality of the links and crossings using a systematic method, such as PERS.

Pedestrian Environment Review System (PERS)

PERS is a formal audit tool for assessing the quality of the pedestrian environment. This tool was developed by TRL (Transport Research Laboratory).[2] It assesses:

- 14 aspects of links (the pavement between one junction and the next): effective width, dropped kerbs, gradient, obstructions, permeability, legibility, lighting, tactile information, colour contrast, personal security, surface quality, user conflict, quality of the environment, and maintenance.
- 12 aspects of crossings: crossing provision, deviation from desire lines, performance, capacity, delay, legibility, legibility for sensory impaired people, dropped kerbs, gradient, obstructions, surface quality, and maintenance.
- Other, more specific, aspects of pedestrian infrastructure and environment: public spaces, public transport waiting areas, interchanges, and routes.

Each aspect is scored on a seven-point scale from -3 (worst) to +3 (best) conditions, with 0 for neutral. The overall scores for each link and crossing are obtained by using TRL's recommended weightings.[3] The PERS tool can be adjusted to local circumstances or to the objective of specific planned interventions by changing the weightings used to combine the attributes. For example, if the intervention is aimed at improving walking conditions for individuals with mobility restrictions, a higher weighting could be assigned to tactile information, colour contrast, and surface quality.

Street audits are labour-intensive. For example, it took a researcher one whole week to assess our 2km^2 study area of Finchley Road in London, which included 159 links and 57 crossings.[4]

Some third sector organisations (non-governmental organisations, NGOs) provide alternatives to PERS, involving local communities. Sustrans organises *Big Street Surveys*[5], enabling school children to explore their local area; Living Streets organises *Community Street Audits*.

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[2] Clark SD. *Identifying and prioritising walking investment through the PERS Audit Tool*. Walk 21, New York, 2009.

[3] A licence is required from TRL to use PERS. This currently costs £1,495+VAT. This payment provides access to the TRL software for recording the data and scoring and weighting the attributes, and to further documentation. Further information: https://trlsoftware.co.uk/products/street_auditing/pers

[4] The collection of data can also be simplified by using web-based images such as Bing Maps Streetside and Google Street View. These images can be used at a preliminary stage, to identify the main problems faced by pedestrians or the streets that have the worst conditions. The main stage of the audit, done on-site, can then collect information only about the attributes related to these main problems and in the streets identified on-line.

[5] www.sustrans.org.uk/our-services/who-we-work/teachers/big-street-survey

Community Street Audits
Living Streets, a charity that promotes walking, organises Community Street Audits, to evaluate the quality of streets from the viewpoint of the people who use them. The audits involve small groups of local residents, traders, councillors and officers. The resulting reports have been used to secure funding to put improvements in place, as well as contributing to master plans for longer term projects. Costs are variable but on average, a Community Street Audit costs around £7,500.[6]

CASE STUDY: USING STREET AUDITS TO IDENTIFY BARRIERS TO WALKING IN FINCHLEY ROAD

Finchley Road is a busy 3-lane road in North London. In the UCL Street Mobility project, we focused on the section of the road crossing the neighbourhood of South Hampstead. Street audits were conducted to identify and assess barriers to walking that were not directly related to road traffic.

Case study

The first stage of the audits was to construct a model of the pedestrian network. This included 133 links (pedestrian pavements or paths) and 57 crossings (designated crossing facilities or 'desire lines' where people crossed the road although it was not a formal crossing). These links and crossings were then assessed using the Pedestrian Environment Review System (PERS). This system scores every link and crossing on a seven-point scale, from -3 (worst) to +3 (best) conditions, with 0 for neutral.
The audits identified problems faced by pedestrians when using crossings. For example, the image on the cover of this section shows a signalised crossing that is complex to use because the road must be crossed in numerous stages, and the various crossing points are not aligned.

The audits also identified several problems for pedestrians walking along Finchley Road, including obstructions and user conflict near crowded and narrow areas such as at bus stops and entrances to underground stations, as shown in the photograph below left.

OBSTRUCTIONS AND USER CONFLICT IN FINCHLEY ROAD (LEFT)

POOR QUALITY LINKS IN THE NORTHWEST PART OF THE STUDY AREA (RIGHT)

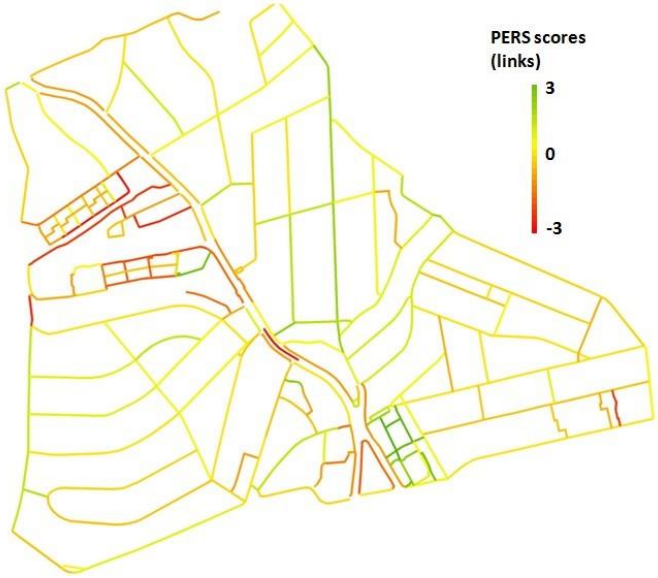
IMAGE © UCL STREET MOBILITY PROJECT

The availability and quality of the links (or footpaths) are particularly poor in the north-west part of the study area, due to the presence of several railway lines, car parking areas and large "big box"

[6] Further information: Contact Richard Mullis on 020 7377 4909 or Richard.Mullis@livingstreets.org.uk or visit https://www.livingstreets.org.uk/what-we-do/projects/community-street-audits.

stores. All the pedestrian links in this area have low PERS scores. The photograph above right shows an example of these links, with evident problems of poor cleanliness, legibility, and lighting, as well as issues of personal security. The clustering of these poor quality links in this area represents an additional community severance effect, compounding the severance caused by high motorised traffic levels along Finchley Road itself.

Overall, the quality of pedestrian links is highly variable, as shown in the map below. Some links have fairly high positive scores, while others have negative scores approaching the minimum of -3.



PERS SCORES OF PEDESTRIAN LINKS IN THE FINCHLEY ROAD STUDY AREA

2. SPACE SYNTAX

What it is

A key driver of pedestrian movement around towns and cities is the structure and connectivity of streets. These are the spaces that people occupy and move through, and where we come into contact with one another. This form of contact is essential for social interaction and for economic transactions. The structuring of space – the result of urban and architectural design – is therefore very important for how people, businesses and communities function and interact. The spatial structure can improve social function and the experience of street spaces, but can also cause it to fail if poorly designed. Space syntax is a set of research methods that aims to represent and quantify these structural properties of space. It is used to investigate the relationship between design and social function. Space syntax street network modelling in the context of this toolkit is used to analyse street layouts and likely pedestrian movement patterns. It can also be used to predict the impact of urban design changes on movement flows[7] and social engagement. Space syntax research has led to new, fundamental understanding of the relationship between urban design, infrastructure and walkability,[7] use of public space, and longer term social outcomes.[8] For assessing community severance, space syntax can be used to measure potential accessibility, which can be compared with actual patterns of use.[9]

[7] Space Syntax Ltd. Comparative study of space use patterns following the re-design of the public space. *Space Syntax Ltd*. 2004.

[8] Vaughan L, Arbaci S, The challenges of understanding urban segregation. *Built Environment*. 2011;37:128-138.

[9] For an example, see the Video surveys section of this toolkit, also available at www.ucl.ac.uk/street-mobility/toolkit.

Why it is useful

Space syntax methods[10,11] can be used to analyse the structure of street networks. This shows which roads and pathways are most important for both street activity and movement through the area. This method of spatial analysis considers the geometry and connectivity of the network as independent variables in shaping pedestrian and motorised transport. It considers only the configuration of the street network, not any other factors that might encourage or discourage pedestrian travel.

Space syntax theories of the interaction between people and space suggests that the way people move through urban streets depends on how streets are related to each other in a network, and the way that people think about, and thus move through this network. Other assessments of street networks use distance along possible routes, proximity to destinations, or the number of junctions in a specified area amongst other measures. Space syntax considers the local street network within the larger spatial context. For example, movement and networks within one area are affected by how these networks connect to the street network of the wider urban area.

Further information

The software for space syntax analysis can be downloaded for free from www.spacesyntax.net/software/, but it requires some expertise in interpreting the results. If you are interested in the walkability model (which incorporates space syntax), contact Dr Ashley Dhanani at the UCL Space Syntax Laboratory: ashley.dhanani@ucl.ac.uk.

Local authorities generally already have access to the data that are needed for space syntax analysis, such as the Ordnance Survey Integrated Transport Network and Open Roads datasets. Services can also be commissioned from external agencies, such as Space Syntax Ltd. (www.spacesyntax.net).

CASE STUDY: USE OF SPACE SYNTAX NETWORK ANALYSIS IN WOODBERRY DOWN

This case study describes one of many applications of space syntax network analysis. In this instance: to plan camera placement for pedestrian and vehicular observations across a neighbourhood.

Space syntax network analysis methods were used in several ways during the Street Mobility project, including as part of the walkability modelling and in planning observational studies. One key application was to analyse accessibility patterns in the street network. Space syntax analysis measures the 'centrality' of networks by using software to measure the shortest routes between origins and destinations. The results from the analysis show which streets are most likely to be travelled along. The following section describes how space syntax was used in planning camera positions for recording the movement of pedestrians and vehicles.

In the Woodberry Down case study area, in North London, video cameras were used to record vehicular and pedestrian flow, as well as pedestrian characteristics and behaviours. The aim of the cameras was to record the busy main street and the surrounding streets, to understand how flows and behaviour varied based on the street characteristics. Space syntax analysis identified a range of different street types, based on their importance for flows of people in the case study area.

[10] Hillier B, et al. Metric and topo-geometric properties of urban street networks: Some convergences, divergences and new results. *Journal of Space Syntax*. 2010;1:258-279.

[11] Hillier B, Vaughan L. The city as one thing. *Progress in Planning*; 67:205-230.

As the image below shows, the space syntax analysis highlighted the routes that were most central, and cameras were then positioned to cover these streets as they were most likely to experience high pedestrian numbers. Back street locations, marked blue on the map, were also chosen as they were likely to have fewer pedestrians. This allowed the cameras to record behaviours across a range of street types. This method of choosing camera locations can be used for smaller areas, such as the Woodberry Down case study, for larger areas such as boroughs, or even across entire cities.

WOODBERRY DOWN CASE STUDY SPACE SYNTAX ANALYSIS

COLOURATION: RED (HIGH CENTRALITY) TO BLUE (LOW CENTRALITY)

Street Mobility and Network Accessibility publications

GLOSSARY

Community Severance Glossary – A list of terms used by different academic disciplines as well as relevant institutions and policy instruments. Available online for free download: http://discovery.ucl.ac.uk/1540248/

JOURNAL PAPERS

Anciaes, P.R., Jones, P. (2016) The effectiveness of changes in street layout and design for reducing barriers to walking. *Transportation Research Record* 2586, 39-47. Available online: trrjournalonline.trb.org/doi/abs/10.3141/2586-05

Anciaes, P.R., Boniface, S., Dhanani, A., Mindell, J.S., Groce, N. (2016) Urban transport and community severance: linking research and policy to link people and places. *Journal of Transport and Health 3(3), 268-277*. Available for free download from: www.sciencedirect.com/science/article/pii/S2214140516302171

Anciaes, P.R., Jones, P., Mindell, J. (2016) Community severance: where is it found and at what cost? *Transport Reviews* 36(3), 293-317. Available for free download from: www.tandfonline.com/doi/full/10.1080/01441647.2015.1077286

Mindell, J.S., Anciaes, P.R., Dhanani, A., Stockton, J., Jones, J., Haklay, M., Groce, N., Scholes, S., Vaughan, L. (2017) Using triangulation to assess a suite of tools to measure community severance. *Journal of Transport Geography 60*, 119-129. Available for free download from: www.sciencedirect.com/science/article/pii/S0966692316305026

Dhanani, A., Tarkhanyan, L., Vaughan, L. (2017) Estimating pedestrian demand for active transport evaluation and planning. Transportation Research A 103, 54-69. Available online: www.sciencedirect.com/science/article/pii/S0965856416305353

PROJECT WORKING PAPERS
(all are available on the UCL website for free download)

Anciaes PR, Boniface S, Dhanani A, Groce N. (2014) *Initiating dialogue between stakeholders and establishing a common language for community severance through cross-disciplinary workshops.* http://discovery.ucl.ac.uk/1443591

Anciaes PR, Jones P, Mindell JS. (2014) *Quantifying community severance – A literature review.* http://discovery.ucl.ac.uk/1461385

Anciaes PR, Jones P, Mindell JS. (2014) *The value of the barrier effect of roads and railways – A literature review.* http://discovery.ucl.ac.uk/1461386

Anciaes PR. (2014) *What do we mean by "community severance"?* http://discovery.ucl.ac.uk/1527807

Anciaes PR, Jones P. (2016) *Pedestrians avoid busy roads: evidence from video surveys and bus stop data.* http://discovery.ucl.ac.uk/1496266

Anciaes PR, Jones P. (2016) *How do pedestrians balance safety, walking time, and the utility of crossing the road? A stated preference study.* http://discovery.ucl.ac.uk/1505652

Anciaes PR, Jones P. (2016) *Pedestrians' preferences regarding signalised crossings, footbridges, and underpasses.* http://discovery.ucl.ac.uk/1505651

Cleary J. (2016) *Review of non-academic literature and resources relating to Community Severance.* http://discovery.ucl.ac.uk/1540330/

Scholes S, Boniface S, Stockton J, Mindell JS. (2016) *Developing a questionnaire to assess community severance, walkability, and wellbeing: results from the Street Mobility Project in London.* http://discovery.ucl.ac.uk/1474883

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Further copies of this toolkit can be requested from streetmobility@ucl.ac.uk

This toolkit can also be downloaded as a single file or as separate sections from www.ucl.ac.uk/street-mobility/toolkit.

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