Your phone knows the three places you visit each day

May 9 2013, by Matt Duckham

Your daily movements are simple, predictable and useful to know. Credit: Thuany Gabriela

We lead busy, complex lives. But how many different places will you visit today? And how many different ways could you organise your travel between those places?

The answer, according to a new study published in the *Journal of the Royal Society Interface* and using, among other measures, mobile phone data, is: not many!

An international collaboration led by MIT shows more than 90% of

people visit fewer than seven distinct places each day. And just 17 basic movement "motifs" (individual daily movement networks) are sufficient to describe 90% of our daily movement patterns.

These new results add to our understanding of the remarkable patterns that underlie human movement. Previous studies have already found strong patterns in larger-scale human movement over months or years, such as through analysis of the movement of $1 bills in the US.

This latest study, however, addresses our smaller-scale, workaday movement.

Mapping movement patterns

The study's results can be summarised in three main findings:

1) People visit remarkably few places in the course of their day. The average number of places visited was approximately three, with few people visiting more than six places in a day.

2) The paths people take between those few places are also highly constrained. The 17 movement "motifs" found in 90% of the daily movement can themselves be described using just four rules. These rules essentially describe the tendency of people to perform "tours" (visit several places in one round-trip) rather than multiple individual trips between places.

3) People vary little in their movement patterns over time. You are most likely to visit the same number of places and using the same movement "motif" tomorrow as you did today (even if the actual places you visit and routes you take are different).

Behind all these regularities is the fact that space constrains movement.

When we take into account where we must go (to work, to home, to bed), we have many fewer options for where we could go than one might think.

Back in the 1950s, the geographer Torsten Hägerstrand succinctly described this link between movement in space and movement in time, a topic now known as "time geography".

Today, we have the capability to generate much greater volumes of data than could have been imagined in the 1950s (the so-called "Big Data").

It is perhaps surprising, then, that two of the three data sets used for this study were collected using a technique that would have been familiar to Hägerstrand: travel and activity surveys.

In a travel survey, volunteer participants record their travel inventory over the course of a few days. Although the two surveys used in this work are large by travel survey standards, involving thousands of participants in Chicago and Paris, they are inevitably limited in their scope and size, being expensive and laborious to collect. In short, these two data sets are from the era of "Small Data".

Location tracking using mobile phones

The third data set used is the one likely to draw most attention, as it relies on data about the locations of Parisians' mobile phones. As everyone with a mobile phone should know, in order to be able to route calls to you, your phone company must track the location of your phone whenever it is turned on.

But this data does not relate to your exact location, only to the location of your nearest cell phone tower. In most urban areas, that will typically be 200 metres or less away from your actual location.

Credit: theIGI

In order to use the phone data, however, the researchers needed to apply considerable data cleaning and pre-processing. Only data about the cell locations of phone calls and SMS messages are typically available to researchers, and as a result only the most active phone users were included in the study.

To generate the patterns observed in the results, many small-scale movements between cells had to be ignored.

For example, repeated movements between neighbouring network cells (such as can occur between two ends of a building) were filtered out of the data.

Indeed, while this study does give us new insights into a smaller scale of human movement than previous work, such studies cannot (yet) tell us about the patterns of human movement between nearby buildings, within a single building, or even within rooms.

Such micro-scale information can be important: the distance between the dock and the jury box in a courtroom may be small, but it is significant.

What does this mean, then?

The results of the Interface paper have implications for many applications, such as planning our cities and transport systems, and controlling the spread of infectious disease outbreaks.

But they also have implications for our personal location privacy. Knowing that the range of human mobility patterns is so small and strongly correlated does potentially make it much easier to predict a person's future mobility patterns.

So what should you do if you want to make your own daily patterns harder to predict? According to the study results, you could try to visit more locations each day, in particular aiming to fit more than six distinct places into your daily itinerary.

More importantly, you might try varying the order in which you visit places day-to-day, changing the routine regularly.

But our complex and ordered lives rarely provide opportunities to, say, visit the pub for a quick drink after dropping the kids off at school in the morning, instead of going in the evening after work; or to add multiple back-and-forth trips to the gym during the work day.

For most of us, being stuck with complex lives means being stuck with

simple and predictable movement patterns.

More information: rsif.royalsocietypublishing.or … .1098/rsif.2013.0246

This story is published courtesy of The Conversation *(under Creative Commons-Attribution/No derivatives).*

Source: The Conversation