



# Revisiting the impact of teleworking on activity-travel behavior using recent data and sequence-based analytical techniques

Konstadinos G. Goulias  
Rongxiang Su  
Elizabeth C. McBride

University of California Santa Barbara

## Project Objective

Assess the impact of telecommuting as a policy to reduce travel by private car.

## Problem Statement

Telecommuting and telework is the use of information and telecommunication technology (ICT) to replace the more traditional working at workplaces and traveling to work. In the 1970s telecommuting was envisioned as a policy tool in a Travel Demand Management (TDM) toolkit to help decrease congestion, air pollution, and waste of resources. Legislation and planning at many levels of government support telecommuting as a measure to benefit the public, employers, and employees. Is telecommuting as effective of a policy as it was envisioned 50 years ago?

## Research Methodology

This project demonstrates the use of motif and sequence analysis in tandem to analyze differences and commonalities between telecommuters and usual commuters. Motifs are networks of distinct locations visited in a day and the directional movements between them. Sequence analysis lines up the schedule of a person in a day and classifies each minute by the type of activity and travel of the person under examination. Figure 1 shows differences between telecommuters and commuters in their daily motif choices.

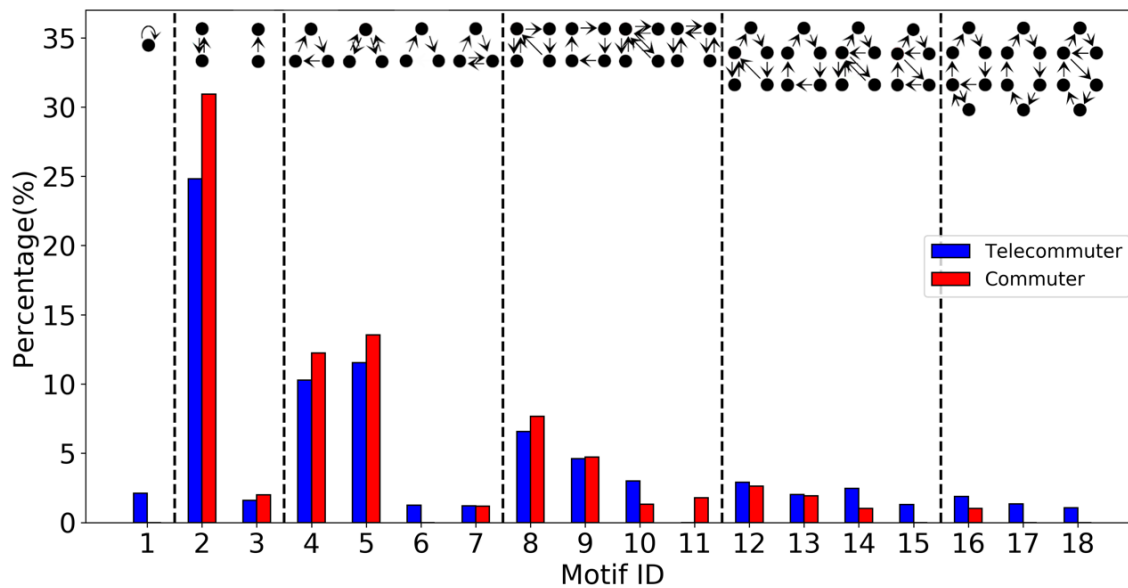


Figure 1. Percentage of human daily mobility motif patterns

## Results

In terms of substantive findings, telecommuters are by far more diverse in their allocation of time to places, activities, and travel. Approximately 20% of telecommuters stay at home all day during a workday, while only 8% of commuters do. Telecommuters that have at least one trip during their workday accrue more vehicle miles travelled and number of trips than their commuter counterparts. However, they drive alone less and tend to have more complex schedules visiting more locations. Within both groups, however, we have substantial variation in activity participation and travel. As expected, a substantial proportion of commuters display morning and afternoon peaks of arriving at and departing from work, and telecommuters do not show this pattern. In addition, telecommuters do not only perform work tasks from home, but, during a day they travel to a variety of locations to either visit customers and/or use their spatio-temporal schedule flexibility to perform work tasks from locations other than home. Similarly, seniors who enjoy higher activity and travel flexibility due to leadership of work positions or retirement use telecommuting in a variety of different ways. Using motif analysis, a particularly good tool for this type of analysis, we correlate the diverse daily mobility patterns with socio-demographic characteristics as well as built environment factors. We find that 15 distinct motifs can capture 82.17% and 86% of the total senior respondents on workdays and non-workdays, respectively. Seniors are more likely to have simple motifs with three or fewer distinct locations on non-workdays, while they present more complex motifs during workdays. Given 65% of the included seniors are retired, a large number of seniors present diverse and complex daily mobility patterns instead of staying at home all day. Seniors tend to drive alone more on workdays than non-workdays, and accordingly, they tend to have more carpooling trips on non-workdays. In addition, given the similarity between the urban core, urban district, and urban neighborhood in function and spatial proximity, there is significant heterogeneity in the daily mobility patterns among seniors living in these areas. In terms of the effects of built environment variables, we find that seniors living in areas with higher percentages of single-family housing units are most likely to stay at home on workdays. In addition, population density, employment density, intersection density, and job accessibility have no significant impacts on senior's daily mobility patterns.

The mobility patterns and daily schedules will be most likely dissimilar in different settings due to national, cultural, policy, and infrastructure differences. One could imagine many potential differences in telecommuters' daily schedules between those in more developed environments where telecommuting has been a mature and relatively popular practice and those from less developed places that lack the ICT infrastructure making this option less popular. Transportation infrastructure also has important impacts on telecommuters' daily mobility patterns as well as daily schedules of activities and travel. People living in California mostly rely on automobiles than other transportation modes, which is confirmed in this study for telecommuters and commuters who drive alone the most and telecommuters who made at least one trip. They have 1.37 more VMT as well as 0.53 more trips in a day compared to commuters. Telecommuters living in neighborhoods where grocery stores, restaurants, gyms, and other types of activity opportunities are easy to access are presumably less likely to be selected over driving alone to activity opportunities with longer distances. Telecommuters living in rural areas with low accessibility to places are more likely to visit multiple places to fulfill their daily needs and drive longer distances. As documented in this study when we examine seniors, we find a variety of daily mobility patterns by different groups indicating a strong need to be socially engaged. Meanwhile, seniors in California still rely heavily on automobiles to meet their daily transportation needs. In other words, the findings unveil the deficiency of other transportation mode development and the constraints of automobiles on elderly's daily mobilities in California. In terms of transportation design in the future,

## Pacific Southwest Region UTC Research Brief

some emerging technologies have the potential to address problems regarding mobility constraints of single travel mode (mostly relying on automobiles) and improve overall mobilities. For example, in addition to improving current public transit by optimizing the route, adjusting the frequency, and so forth, municipalities and regional transportation authorities should consider complementing our current transportation system with Mobility as a Service (MaaS). The major components of MaaS schemes include intermodal planning, booking and payment functionalities, and multiple transport modes and mobility packages. MaaS enables the conventional modes of transportation to transform to mobility provided as a service. The main objective of MaaS is to offer mobility solutions based on people's travel needs. In United States, a variety of shared mobility services have recently launched to serve the specific needs of elderly passengers. We also expect a substantial increase in the adoption of telecommuting by companies as a reaction to Covid-19 pandemic and we also anticipate a large number of telecommuters will switch to either staying at home all day and not traveling or use patterns based on a single location (mostly home) with loop trips(same origin and destination). In fact, telecommuters with this pattern most likely work from home but take a walk during the workdays during the COVID-19 pandemic today. In addition, we will see a substantial increase in the telecommuters' patterns visiting multiple locations and moving around the city in less predictable ways. This is where MaaS can serve their patterns in a more sustainable way providing first and last mile services on demand. Action is needed now to avoid a return to the use of the private automobile and maybe a tendency to return to pre-COVID patterns.