PATREC

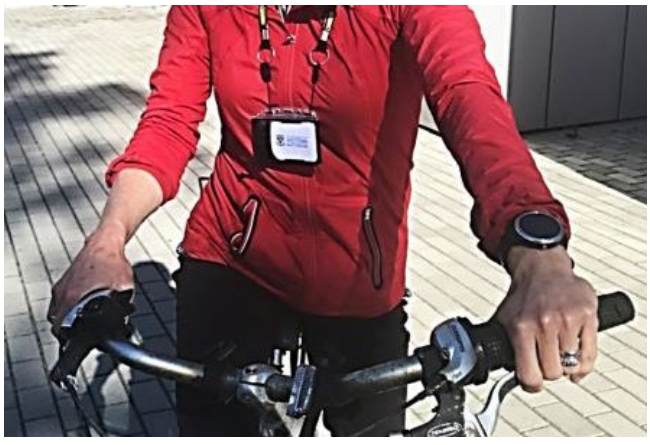
Using wearable technology to analyse daily travel behaviour

Key findings from a Perth 2019 study

Highlights

The benefits of daily physical activity are well-documented in the health literature. Daily commuting – particularly cycling, walking and using public transport – can contribute to the 150 minutes of moderate-to-vigorous weekly physical activity recommended by the Australian Department of Health. Associated benefits include improved life satisfaction, reduced traffic congestion and lower CO_2 emissions. In 2019, the PATREC team in conjunction with Heathway, carried out an exploratory study into the contribution daily travel can make to daily physical activity. There are significant differences between time use diary and travel recordings of the smartwatch and camera, which demonstrate their value for providing accurate travel behaviour data. Travel-related physical activity received a higher level of enjoyment. Two main categories of travellers were identified: physical activity enthusiasts and constrained travellers.

The study had two main goals. The first was to test and evaluate a unique combination of data collection instruments and techniques in order to capture and document travel-related physical activity. The second was to cross-validate data from wearable (passive) data collection devices with self-report time-use diaries.



A PATREC researcher participating in the experiment

The sample comprised volunteers mostly working at the WA Department of Transport on a full-time, 5 day week basis.

Sample description	Number/type
Size	52 volunteers
Gender	35 female
Age range	21-63 years
Occupation	Mostly full-time, office-based
Job type	Desk-based - sedentary
Qualification	43 have a degree
Family	22 had children living at home
Ownership	2/3 – own at least 1 bike; 5 – no car

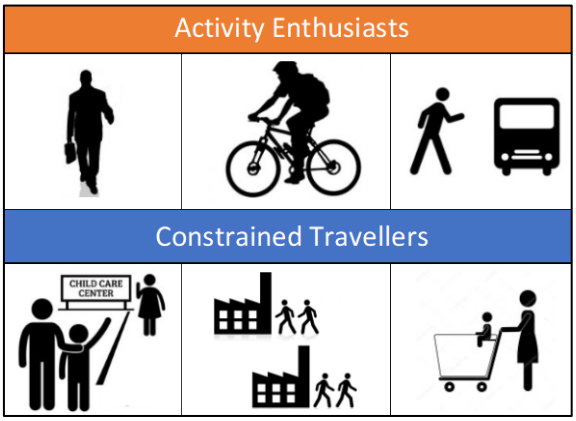
For the data collection, participants wore a smartwatch, wearable camera and completed a self-report time-use diary for two consecutive weekdays, followed shortly afterwards by a 40–50 minute face-to-face interview. The smartwatch (Garmin Vivoactive 3) gathered origin-destination information via GPS, trip mode and duration, heart rate, physical activity intensity, and other health data. The wearable camera (Edesix VB-200), worn only whilst commuting, provided detailed contextual video footage (no audio), which was used to help respondents recall their commuting over the two survey days during the post data collection interviews.

*The study received approval from the UWA Human Research Ethics Committee, without any specific concerns about gathering video footage.

Travel and physical activity findings

Respondents in this study were split into two main categories:

- *Activity enthusiasts* - who use their commute and other travel as an opportunity to enhance their fitness and/or replace the need for physical activity during their non-working hours; and
- *Constrained travellers* - full-time employees, those working longer hours, and/or completing longer trip chains, which often involved accompanying family members to activities and running household errands before and after work.



Key participant travel characteristics:

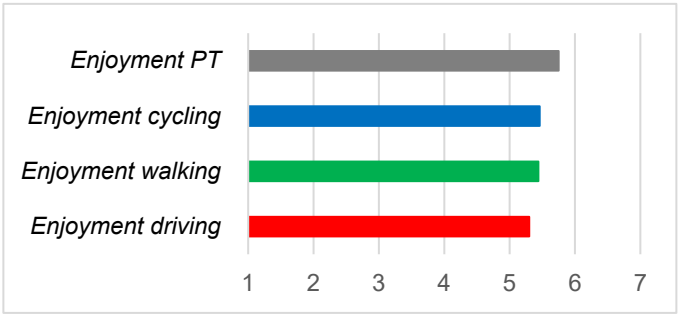
- most live at distances around 17km from work;
- average travel distance per day was 35.6 km and travel time 93.6 minutes;
- half of the sample reported multimodal trip chains with an average of 3.74 legs;
- 42% of all legs were by car only, 27% active travel, and the remaining by public transport with various access modes.

Key participant physical activity characteristics:

Variable	Mean	Std. dev.
Heart rate (beats/min)	80.2 (resting 61-70)	17.6
Av. energy/activity (kJ)	395	148.7
BMI	24.8	3.7
Self-reported health status (1 to 5 scale)	4.30	0.7

Physical activity was measured in steps/distance, energy (kilojoules), and heart rate (beats/minute). The sample included a range of individuals, with average performances as follows:

- Higher heart rates were recorded and more calories consumed for participants who walked and cycled compared with those using cars, motorcycles or public transport;
- Significant positive correlations were noted between the amount of active travel and healthy heart rate, which suggest that promotional programs should continue endorsing the benefits of active travel.
- Perceived high cost of public transport was an issue for most participants, particularly those in lower management and administrative roles who had no or limited options for flexible working. This was a key driver in their travel decision to use car.
- Camera data collected by cyclists who participated generated lively debate around the safety challenges encountered, both in relation to negotiating vehicular traffic and the quality and maintenance of bicycle path infrastructure.
- Interviews highlighted that juggling between work and family commitments was the main reason for reliance on car driving.
- Active travel (including public transport) was associated with higher levels of self-reported enjoyment compared to car driving.



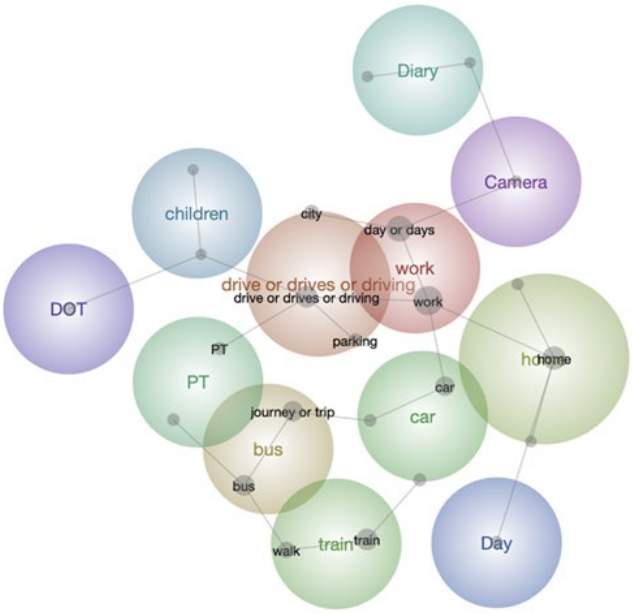
Comparison of enjoyment level by mode of travel

Data collection method findings

The passive data collection devices revealed both strengths and limitations as follows.

- Garmin *smartwatch* provided an accurate log of activity locations and timing and confirmed that commuting is a significant contributor towards daily physical activity;
- Contextual information from the *wearable camera video* footage and reconstruction *interviews* helped us not only to cross-validate the GPS tracks and daily activity with reports from the *time-use diaries*, but also to better understand activity scheduling and motivations for various mode choices;
- More than half the participants neglected to record some activities from their time-use diaries, including trips, that were captured in the video footage;
- Participants were moderately successful in achieving their daily target of physical activity (average of 21 min/day and energy consumption of 395 kJ/day).

- Easily and consistently activating the watch GPS was not always possible, resulting in incomplete travel data.
- The camera data were of high quality and offered detailed recordings of environmental and traffic conditions, particularly for cyclists;
- Detailed images captured by the wearable camera carried a number of ethical and privacy issues for some participants;
- Using a wearable camera was considered more difficult than completing the self-report time-use diary, although the diaries showed substantial differences from the passive data collected by the devices.



Conceptual map from text analysis

Conclusions

This study shows that:

- Active travel (even as part of multimodal public transport travel) can be promoted as an intervention to promote physical activity;
- Smartwatches, in addition to continuous monitoring, can provide prompt feedback and reporting for wearers which may increase motivation and reinforcement for physical activity;
- The quality of data collection was substantially enriched by the wearables;
- Active travel provides high levels of enjoyment;
- Policy interventions should account for individual circumstances, as many households (primarily those with children) have substantial constraints in their travel, affecting the mode choice.

Challenges:

- Participant compliance;
- Cost of specialised skills and substantial time for testing different techniques for harmonising different types of analysis.

Yet, the precision and enrichment brought by the combination of devices outweigh the costs and using combined passive data collection 'kits' should be an ongoing line of inquiry.

Acknowledgements

This research was supported by funding from a Healthway grant, as well as by PATREC and the Centre for Time Use Research at the University College London. Assistance from the WA Department of Transport in recruiting volunteers to participate in the survey is gratefully acknowledged.

Contact

Planning and Transport Research Centre
The University of Western Australia (M087)
35 Stirling Highway, Crawley, WA 6009
+61 8 6488 3385
patrec@uwa.edu.au
https://patrec.org/

Teresa Harms
E: teresa.harms@uwa.edu.au

Cate Pattison
E: cate.pattison@uwa.edu.au

Doina Olaru
E: doina.olaru@uwa.edu.au