PATREC PERSPECTIVE – April 2020

USING WEARABLE TECHNOLOGY TO ANALYSE DAILY TRAVEL BEHAVIOUR

Key findings from a Perth 2019 study

The benefits of daily physical activity (PA) 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 PA 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.

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

The **sample** included 52 volunteers (35 female) aged between 21 and 63 years, primarily full-time staff from various metropolitan locations within the WA Department of Transport. All participants had desk-based (sedentary) jobs and only five worked from home one or two days a week. Most participants (43 out of 52) had a degree and nearly half (22) had children living at home. Just over two thirds had at least one bike for travel or recreational use and five did not own a 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*. Participants were free to decide where to participate in the study or to withdraw at any time, and provided signed informed consent. The study received approval from the UWA Human Research Ethics Committee, without any specific concerns about gathering video footage. The smartwatch (Garmin Vivoactive 3) gathered origin-destination information via GPS, trip mode and duration, heart rate, PA 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.

Main 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 PA during the non-working hours; and ***constrained travellers*** - full-time employees, those working longer hours, and completing longer trip chains, which often involved accompanying family members to activities and running household errands before and after work.

Most participants in the study live around 17km from home to work. Average travel distance per day was 35.6 km and travel time 93.6 minutes, higher than for the general population. Half of the sample reported multimodal trip chains with a mean of 3.74 legs, including 42% car travel, 10% public transport (PT), 30% cycling and 18% walking.

35 Stirling Highway, Crawley, WA 6009 https://patrec.org/

An important element of our data collection was active travel, measured in steps/distance, energy (kilojoules), and heart rate (HR). The sample included a broad range of individuals with various fitness levels (average of 4.3 on a scale up to 5; sd = 0.74) and BMIs (average 24.8, sd = 3.6). The average HR while commuting was 80.2 beats/min, with a standard deviation of 17.6 (N=37). Unsurprisingly, higher HR were recorded and more calories were consumed with participants who walked and cycled; compared to those using cars, motorcycles or PT modes. The sample was moderately successful in achieving their daily target of PA (average of 21 min/day and energy consumption of 395 kJ/day). Active travel (including PT) was associated with higher levels of self-reported enjoyment (5.6 out of 7) compared to car driving (5.3). Significant positive correlations were noted between the amount of active travel and healthy HR, which suggest that promotional programs should continue endorsing the benefits of active travel.

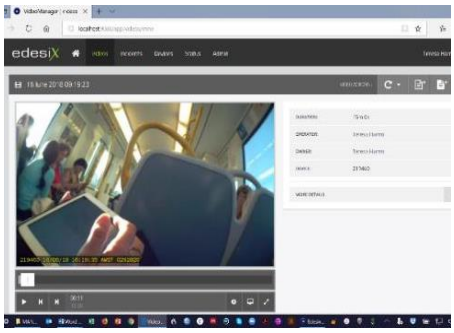
The perceived high cost of PT was an issue for most participants, particularly those in lower management and administrative roles; who had no or limited options for flexible working or a requirement to work predetermined hours. This was a key driver in their travel decisions.

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.

Methodological findings

The passive data collection devices revealed both strengths and limitations. The Garmin **smartwatch** provided an accurate log of activity locations and timing (even if the incomplete tracks prevented us from reconstructing the full day diary) and has confirmed that commuting is a significant contributor towards daily PA. The 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 of the participants neglected to record some activities from their time-use diaries, including trips, that were captured in the video footage. Notably, the rounding of the durations to 5 min (the smallest timeslot of the diary) means that in-vehicle travel time was often underestimated, whereas the access and egress times, as well as transfers between travel modes were overestimated by 2.2 min.

Easily and consistently activating the watch GPS was not always possible, resulting in incomplete travel data. Improved reliability will be required for future studies, and alternative devices which that offer better user interface and data integration have been identified. The camera data were of high quality and offered detailed recordings of environmental and traffic conditions, particularly for cyclists.



Although comprehensive ethical guidelines were followed and camera data was fully encrypted, some participants quite reasonably observed that the detailed images captured by the wearable camera carried a number of ethical and privacy issues, including the potential lack of informed consent of others captured on camera, especially the lack of informed consent from other commuters when used on PT. Overall, using a wearable camera was considered more 'demanding'/'challenging' than completing the self-report time-use diary, although the diaries showed substantial differences from the passive data collected by the devices. In terms of validation, the camera and smartwatch (when GPS tracks were not missing) provided more precise and complete accounts of the participants' daily activities and travel.

Conclusions

This study shows that active travel (even as part of multimodal PT travel) can be promoted as a PA intervention. In addition to continuous monitoring, smartwatches can provide prompt feedback and reporting for wearers which may increase motivation and reinforcement for PA. However, participant compliance, cost, and specialised skills and substantial time for testing different techniques for harmonising different levels of analysis – spatially and temporally - are non-trivial aspects that call for additional research in this space. Significant positive correlations were noted between the amount of active travel and HR, which suggests that promotional programs should continue presenting the benefits of active travel. Easily and consistently activating the smartwatch GPS was not always possible, resulting in incomplete research study data. Improved reliability is therefore required, and alternative devices have been researched which offer better user interface reliability and data integration. Nevertheless, it is our conclusion that 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.