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. In 2019 the team carried out an exploratory study into the contribution daily travel can make to daily PA. Associated benefits include improved life satisfaction, reduced traffic congestion and CO_2 emissions. 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 whether to join the study or to withdraw at any time, and provided signed informed consent. The research 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 can be divided into two main categories: ***activity enthusiasts*** – who use their commute or any travel as an opportunity to enhance their fitness and/or replace the need for PA during non-working hours; and ***constrained travellers*** – full-time employees, those working longer hours, and completing longer trip chains, which included accompanying family members to activities and household errands before and after work.

Most participants in the study lived at distances around 17km from their work. The average travel distance per day was 35.6 km and travel time 93.6 minutes, which is higher than the general population. Half the sample reported multimodal trip chains with an average of 3.74 legs, including 42% car travel, 10% PT, 30% cycling, and 18% walking.

An important aspect of the data collection was physical activity, measured in steps/distance, energy/intensity, 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 was 80.16 beats/min, with a standard deviation of 17.63 (N=37). Unsurprisingly, higher HRs were recorded and calories consumed for participants who walked and cycled compared with those using cars or public transport. The sample was moderately successful in achieving their daily target of PA (average of 21 min/day and energy use of 395 kJ/day). Active travel (including public transport) was associated with a higher enjoyment level (5.6) compared to car driving (5.3). Significant positive correlations were noted between the amount of active travel and healthy heart rate, which suggest that promotional programs should continue presenting the benefits of active travel.

The perceived high cost of public transport was an issue for most participants, particularly those in lower management and administrative roles. These roles offered few or no options for flexible working, largely due to the requirement to work predetermined hours. This was a key driver in their travel decisions.

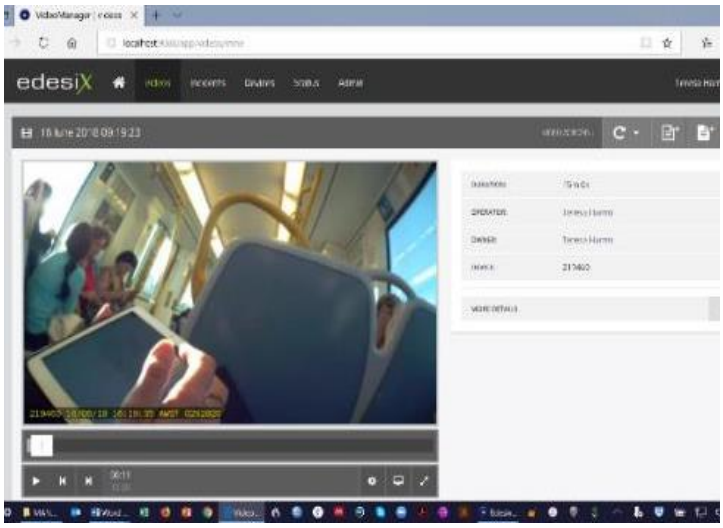
Camera footage collected by cyclists in the study generated lively debate around the safety challenges encountered, both in relation to negotiating vehicle traffic and the quality and maintenance of bicycle path infrastructure.

Methodological findings

The passive data collection devices revealed strengths and limitations. The Garmin **smartwatch** provided an accurate log of activity locations and timing (even if the incomplete tracks prevented reconstruction of the full-day diary) and has confirmed that travel makes a significant contribution towards daily PA. Contextual information gathered from the **video** footage and reconstruction **interviews** allowed cross-validation of the GPS data and activity recorded in the time use **diaries**, and a better understanding of participants' activity scheduling and motivations for using different modes of transport.

Consistently activating the smartwatch GPS was not always possible, resulting in some missing data. Improved reliability is required, and alternative devices that run passively and offer better user interface reliability and data integration are being researched. The camera data were of high quality and offered detailed recording of environmental and traffic conditions, particularly for cyclists.

Although comprehensive ethical guidelines were followed and the camera data fully encrypted, some participants voiced concerns. The footage captured by the wearable camera carried ethical and privacy issues, including the potential lack of informed (i.e. third-party) consent from people captured on camera, particularly when using public transport. Overall, participants considered the wearable camera more 'challenging' than completing the time use diary. The self-report diary records and 'objective' data from the cameras and smartwatches showed some important differences. More than half of the participants omitted activities from their time use diaries, including trips, which were captured in the video footage. In terms of validation, the camera and smartwatch (when GPS tracks were not missing) provided more precise and complete accounts of daily travel/commuting, but not other daily activities.



Conclusions

This study shows that active travel (even as part of multimodal PT travel) can be promoted as a physical activity 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 area.

Significant positive correlations were noted between the amount of active travel and heart rate, which suggest that promotional programs should continue presenting the benefits of active travel.

Easily and consistently activating the watch GPS was not always possible, resulting in incomplete study data. Alternative devices that offer better user interface reliability and data integration are needed. Regardless, 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.

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[1] *Planning and Transport Research Centre*. A research collaborative involving the University of Western Australia, Curtin University, Edith Cowan University, WA Department of Transport, Main Roads WA, WA Planning Commission and WA Local Government Association (WALGA), all based in Perth, Western Australia.

[2] Healthway, the Western Australian Health Promotion Foundation, operates under the Western Australian Health Promotion Foundation Act 2016 and funds activities relating to the promotion of good health, including health promotion research projects.