2022_24_Civil Eng Majumdar: Investigation of relationship between delivery motorcyclists’ riding behaviour, fatigue, sleep, heat-stress and traffic-related air and noise pollution

Supervisors: Arnab Majumdar (mailto:a.majumdar@imperial.ac.uk); Marc Stettler / Department of Civil and Environmental Engineering
Wen-Te Liu / Taipei Medical University, Taiwan

Department: Department of Civil and Environmental Engineering

In developing countries, the motorcycle is an important vehicle in urban mobility and its widespread use provides many with a means of social inclusion. Given its low acquisition and maintenance costs, and its speed and manoeuvrability, its increased use is also associated with the rise in demand for fast delivery. However, increasing urban traffic congestion greatly impacts motorcyclists. In particular, for delivery riders, having to operate their motorcycle in urban areas, which high concentrations of air pollutants and loud noise, may greatly affect their fatigue level and sleep patterns. Such effects are further compounded by seasonal variations in temperature, e.g. periods of extreme heat. Hence, traffic factors such as long-term air pollution and increased noise levels, as well as long term changes in changes in temperature, are potential risk factors that correlate to a motorcyclist’s fatigue and inadequate sleep. This in turn induces aberrant riding behaviours (ADBs), e.g. excessive speeding and hard braking. Such behaviours can ultimately result in road accidents leading to a loss of life. However, whilst there is a recognition of such relationships, their exact nature remains unclear and requires further investigation, prior to any mitigation measures.

This project, by using a novel combination of environmental, medical and transport safety methods aims to elaborate upon these relationships and involves the recruitment of delivery motorcyclists in Taiwan and the recording of relevant data. Taiwan is chosen as the area of study for this research as in its capital Taipei, there is a preponderance of motorcycle delivery riders with an associated poor road safety record due to ADBs. Furthermore, the supervisory team has experience researching the problem of poor sleep quality and fatigue and its association with ADBs for bus and taxi drivers in the country. First, participants will need to undergo the “gold standard” sleep examination for measuring their sleep profile. Then, the participants will be provided with a wearable device package, including a heart rate monitor watch, sleep measurement patch, and a pollution exposure measurement box for both air quality and noise. The participants will be required to wear these devices during their attendance schedule (i.e. delivery schedule) and during their sleep to collect the relevant parameters. Once they complete their daily schedule, riders will undergo an interview and a self-reported fatigue questionnaire. In order, to understand their riding behaviours, this project will employ a navigation application contained on the mobile phones of the motorcyclists. All the derived data will be analysed to examine the relationships among fatigue, sleep quality, riding behaviours, and personal exposure of air pollutants and noises. Furthermore, the recorded physiological signals obtained from a heart-rate watch, which serve as indicators for

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screening fatigue, and exposure level of pollutants will be utilized to establish a model for predicting the possibility of ABD occurrence. Recognizing the heat conditions in Taiwan, the periods of measurement will account for extremes of heat expected. Once the model for predicting ADBs has been developed, climate models will be further used to account for pollution and the temperatures expected in the future and predict the expected number and type of ADBs. Finally based upon this model, mitigation measures will be proposed to ameliorate fatigue, improve sleep and road safety.

The tasks of the research are:

1) **Data collection setup**: Selection and recruitment of the sample of motorcyclists, setup of data collection devices, collection of the data, interviews with the participants.
2) **Relationship investigation**: Use of the appropriate statistical methods to examine the relationship among collected variables (objective parameters: physiological parameters, driving behaviours, ambient temperatures and personal exposure of pollutants; subjective parameters: self-rated sleep quality and fatigue level).
3) **Model establishment**: Development of real-time models for predicting the possibility of aberrant driving behaviour (ADB) occurrence based on physiological parameters and personal pollutant exposure.
4) **Predicting ADBs given future environmental trends**: Using appropriate models of future environmental trends in Taiwan, predictions of the expected numbers of ADBs in various scenarios will be determined, and probed mitigation measures outlined.

**Skills and Requirements**: The ideal candidate will have a background in Engineering/Mathematics or Medical Health Science. An excellent background in mathematics and computational methods and programming is strongly desired. The PhD will involve periods of time to be spent in Taiwan collecting and analysing data. The student will be based at Taipei Medical University, with Dr Liu, and Taipei Medical University will provide the student with support and assistance with accommodation and costs of travel.

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