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Variability in baseline travel behaviour as a predictor of changes in commuting by active travel, car and public transport: a natural experimental study

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ABSTRACT

Purpose: To strengthen our understanding of the impact of baseline variability in mode choice on the likelihood of travel behaviour change.
Methods: Quasi-experimental analyses in a cohort study of 450 commuters exposed to a new guided busway with a path for walking and cycling in Cambridge, UK. Exposure to the intervention was defined using the shortest network distance from each participant's home to the busway. Variability in commuter travel behaviour at baseline was defined using the Herfindahl–Hirschman Index, the number of different modes of transport used over a week, and the proportion of trips made by the main (combination of) mode(s). The outcomes were changes in the share of commute trips (i) involving any active travel, (ii) involving any public transport, and (iii) made entirely by car. Variability and change data were derived from a self-reported seven-day record collected before (2009) and after (2012) the intervention. Separate multinomial regression models were estimated to assess the influence of baseline variability on behaviour change, both independently and as an interaction effect with exposure to the intervention.
Results: All three measures of variability predicted changes in mode share in most models. The effect size for the intervention was slightly strengthened after including variability. Commuters with higher baseline variability were more likely to increase their active mode share (e.g. for HHI: relative risk ratio [RRR] for interaction 3.34, 95% CI 1.41, 7.89) and decrease their car mode share in response to the intervention (e.g. for HHI: RRR 7.50, 95% CI 2.52, 22.34).
Conclusions: People reporting a higher level of variability in mode choice were more likely to change their travel behaviour following an intervention. Future research should consider such variability as a potential predictor and effect modifier of travel and physical activity behaviour change, and its significance for the design and targeting of interventions.

1. Introduction

Changes in mode of transport have the potential to increase levels of population health. A reduction in car travel may reduce carbon emissions and injuries (Woodcock et al., 2009), whereas active travel – walking and cycling – is associated with higher levels of physical activity and can provide a sufficient level of activity to contribute to health gain (Chief Medical Office, 2011).

Studies in various domains of health-related behaviour change suggest that existing behaviour predicts future behaviour. For example, the number of cigarettes smoked by an individual predicts the likelihood of smoking cessation (Hymowitz et al., 1997) and alcohol intake in adolescence is correlated with alcohol intake in adulthood (Paavola et al., 2004). Recent studies of active travel have found that time spent in active commuting at baseline is associated with changes in active commuting time (Panter et al., 2016), that the mode of transport used for commuting at baseline is associated with changes in the shares of trips made by active travel and by car (Heinen et al., 2015a), and

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that mode choice at baseline predicts the use of new transport infrastructure (Goodman et al., 2013). More generally, habits of using a specific mode of transport are a strong correlate of (active) travel behaviour and thought to hinder behaviour change (De Bruijn and Gardner, 2011; Aarts et al., 1998; Bamberg and Schmidt, 2003; Gärling and Axhausen, 2003).

However, characteristics of travel behaviour other than the baseline value of the outcome of interest may be at least as strong a predictor of behaviour change. In particular, baseline variability of mode choice, which is in a way the opposite of habit, may correspond with a higher inclination to change. Here, we use 'variability' to refer to the level of variation in modes of transport used by an individual within a certain period, and 'change' to refer to a shift towards or away from a given mode of transport over time.

Several theories and models have expressed the idea that behaviour change involves moving through different phases. A commonly applied model is the transtheoretical model (Prochaska et al., 1992; Prochaska and Velicer, 1997), although other stage-based models may be more appropriate for a given type of behaviour (Sutton, 2002). For example, Jones and Sloman (2003) describe a model with seven phases: awareness of a key issue, acknowledging relevance, perception of options, evaluation of options, making a choice, experimental behaviour, and habitual behaviour. This conceptualisation assumes that a period of experimental behaviour precedes the establishment of new or even habitual behaviour. In this context baseline variability may be seen as a characteristic of an experimental phase which precedes a phase of more established behaviour.

Baseline variability may also increase an individual's self-efficacy to use particular modes of transport. Self-efficacy refers to confidence in the ability to perform a certain behaviour and is thought to drive behaviour change (Bandura, 1986; Strecher et al., 1986). Variability in mode choice at baseline may therefore correspond with higher levels of self-efficacy to use several different modes of transport.

Not all environments are equally supportive for all modes of transport. Cross-sectional studies have shown that characteristics of the built environment are associated with differences in travel behaviour (Handy et al., 2002; Ewing and Cervero, 2010), and a small number of more recent intervention studies (e.g. Goodman et al., 2014; Hooper et al., 2014) provide stronger evidence for causal effects of environmental changes on travel behaviour (Nice, 2014; McCormack and Shiell, 2011). It is conceivable that individuals with greater baseline variability in commute mode choice may be more likely to change their behaviour in response to environmental changes than those who show less variability at baseline.

We aimed to increase our understanding of the relationship between baseline behaviour and behaviour change over time, using the opportunity presented by an intervention study to discriminate between variability and change. Previous results from our own natural experimental study have shown that changing the built environment by constructing new transport infrastructure can result in changes in mode choice (Heinen et al., 2015a) and use (Panter et al., 2016) in commuters. In this paper, we investigate whether variability in mode choice at baseline increased the likelihood of change in the share of commuting trips made by different modes of transport, both independently and as a modifier of the effect of exposure to the intervention. An independent effect would indicate that indivdiuals who are more variable have a higher likelihood of changing their travel behaviour. A significant interaction effect would indicate that if individuals are more exposed to an intervention, they have a higher likelihood of changing if they are also more variable in their baseline behaviour – in other words, that individuals who are more variable may be more sensitive to interventions. We tested the effect of variability in an intervention study to discriminate between variability (short or long-term random changes) and change (non-random change in behaviour).

2. Methods

2.1. Setting

Data were collected in Cambridgeshire, UK (123,900 inhabitants) (ONS, 2011). The city of Cambridge has a comparatively affluent and well-educated population, and 28% of commuting trips are made by bicycle (ONS, 2011).

Fig. 1. The Cambridgeshire guided busway.