Special Issue on the theory, design and evaluation of behaviour change interventions in transport

With increasing realisation of how the way we travel affects our health (Khreis et al., 2016), the search is on for transport solutions that achieve safer and healthier travel behaviour. Safer and healthier ways of travelling can also be expected to bring about co-benefits, for example, in terms of reduced costs and environmental impacts. There is a broad spectrum of possible actions that can be taken to influence travel behaviour. These are often divided into structural (or 'hard') measures which involve modification of the physical or legislative structures that regulate the use of transport and psychological (or 'soft') measures which involve use of information dissemination and persuasion techniques (Graham-Rowe et al., 2011; Bamberg et al., 2011).

Structural measures are often expensive to implement and face public opposition due to the anticipated disruption they will bring to existing ways of doing things. Considerable hope has been vested in psychological measures as a means through which to encourage voluntary changes in travel behaviour without coercion and large expenditure. For example, in the UK, there has been a series of national programmes supporting town- and city-wide implementation of packages of soft measures (Sloman et al., 2010, refer to results from one of these programmes). A further boost in this direction was given by research in behavioural economics which caught the attention of public policy, identifying that individuals do not always act rationally and that small changes in choice architecture could be made to 'nudge' people into more socially desirable behaviours (Garcia-Sierra et al., 2015).

The role played by travel behaviour change in tackling global environmental and public health problems has been examined in a spate of research reviews (those focusing on behavioural change interventions to achieve more active travel include Ogilvie et al. (2007), Krizek et al. (2009), Yang et al. (2010), McCormack and Shiell (2011), Scheepers et al. (2014), and Brown et al., (2016)). These reviews and others bemoan the quality of evidence available – for example, Arnott et al. (2014), in reviewing behavioural interventions to reduce car use, concluded "*There is no evidence for the efficacy of existing behavioural interventions to reduce car trips*", and advocate that "*Future research should investigate alternative behavioural interventions in controlled studies using objectively measured outcomes which relate to sedentary behaviours and physical activity levels. Future studies should be informed by existing evidence, theory, and potential views of potential users*".

The main criticism of reviews is the lack of robust experimental research designs. It is our view that the priority for research in this area should not only be to assess whether expected outcomes occur, but also to understand how targeted groups respond to interventions and what processes of change take place. This is acknowledged by Bamberg and Rees (2017) who advocate the use of randomised experimental designs for future evaluations seeking to identify effect size, while also acknowledging that "*others may wish to understand mechanisms and processes involved in behavior change and use different study designs*".

In response to the limited evidence, and the calls for improved research designs, there have been valuable contributions in the last few years. For example, Ogilvie

and colleagues conducted a quasi-experimental analysis, using a cohort survey, of the impacts on travel behaviour and physical activity of the introduction of a new guided bus system in Cambridge (Heinen et al, 2015; Panter et al., 2015). A similar approach has been taken by Hong et al. (2016) in evaluating a light rail line in Los Angeles. Quasi-experimental evaluations have also been reported of new infrastructure provision specifically for active travel such as that by Goodman et al. (2014) of the Connect2 programme in the UK and that by Crane et al. (2017) for urban cycling infrastructure in Sydney, Australia. Meanwhile, Perez et al., (2017) have evaluated city-wide active transport policies in Barcelona using retrospective data collection and analysis.

These evaluations are adding to our knowledge on the behavioural impacts of interventions and how impacts vary by different population sub-groups. Perhaps lagging behind is the consistency with which theory is applied to select and design appropriate interventions, or to use as a basis for evaluation. Across behavioural domains, there has been growing recognition of the importance of theory in the development and evaluation of behaviour change interventions (e.g. see Craig et al., 2008; Glanz & Bishop, 2010). Behaviour change theories can help us understand how behaviour change interventions have their effects, advancing our knowledge of when and why behaviour change is (and is not) likely to occur. Previous studies in transport behaviour change have applied a range of theories, including Diffusion of Innovations (Rogers, 2003) which was found to be relevant to understanding cycling adoption (Nehme, et al., 2016), and extended versions of the Theory of Planned Behaviour (e.g. to promote planning self-regulation among drivers; Gwyther & Holland, 2015). However, overall, in transport behaviour change as in many other domains, the extent to which theory has been applied has varied widely. Arnott et al. (2014), for example, found very limited evidence of theory use in car reduction interventions.

This is partly a consequence of the theories that might be applied in this field seeking to explain prevailing behaviour rather than behavioural change – for example, the ecological model of Sallis et al. (2006). However, there have been propositions of theoretical frameworks which explicitly consider processes and paths of behavioural change. Ginja et al. (2018) have proposed the Behavioural Ecological Model and explain how it can be used to consider active school travel intervention designs. Bamberg et al. (2011) used the self-regulation theory of hypothesised stages of the process of behavioural change to identify seven different intervention types which could be used in personalised travel planning programmes.

We were interested to see whether intervention design can be improved by field testing of theory-based intervention designs. Up to now, it is our view that interventions have largely been designed based on past practice and intuition. We felt it timely to bring together current research that is seeking to formulate and assess different behavioural change interventions aimed at safe and healthy transport outcomes and to see how they are contributing to advancing our ability to choose appropriate solutions.

Given this context, we invited papers on the theory, design and evaluation of behaviour change interventions in transport aimed at improving safety or health. Papers could have emphasis on more than one of these aspects (theory, design and

evaluation) and should have practical insights on future policy, practice and research. We received a diverse set of contributions covering varied types of interventions. Eight papers are published in the special issue. We next discuss the contributions of these eight papers, while also noting other recent papers in the *Journal of Transport and Health* contributing to this field of knowledge.

Overview of the papers

At the heart of most challenges facing transport researchers and professionals is the development of interventions that lead to meaningful, sustained behaviour change - whether in road safety (e.g. among school-aged children in Tanzania, as in Perego et al.) or active travel (e.g. among parents on the school-run, as in Lucken et al.).

The papers selected for this special issue are diverse in objectives and approaches, covering both 'hard' and 'soft' measures, including information (Lucken et al.) and training (Perego et al.), incentives (de Kruijf et al.), new infrastructure (Bird et al. & Keall et al.), new travel options (Heinen et al.), speed restriction schemes (Turner et al.) and changes to the built environment (Curl et al.).

Methodologically, it is worth noting that most of the included papers used cohort surveys with subjective data. There are clear advantages to this type of approach, but we echo the concerns that several of the paper authors raise around self-reporting (e.g. in Heinen et al.). In the context of testing a road safety intervention to assist cyclists, a paper by Götschi and colleagues in Volume 8 of the *Journal of Transport and Health* reports a study using a combination of subjective measures (perceived safety obtained through interview survey) and objective measures (passing distance measured using video technology) to assess its impact (Götschi et al., 2018).

Several of the papers note the difficulties associated with conducting a robust evaluation with access to all the relevant data, particularly in the context of changes to the built environment (e.g. in Curl et al.). This is a theme also highlighted by Prati et al. in Volume 9 of the *Journal of Transport and Health* who noted that insufficient data was available on relevant behaviour in order to effectively assess the impact of legislation requiring cyclists to wear high-visibility clothing in Italy.

Role of hypothesis-testing and theory in the papers
The eight papers in this Special Issue test a variety of hypotheses and draw on a range of theories for the purpose of intervention development, testing, and evaluation.

Two of the papers involve small-scale experiments to test the theoretical rationale of behavioural change interventions. The paper by Lucken et al. tests the simple hypothesis that priming parents with information about the health benefits of active travel to school will increase the perceived feasibility of their child(-ren) actively travelling to school. It found that this was not the case in their field experiment. Perego et al. tests whether a traffic psychology training programme results in increased reflection among school children of road safety hazards and ability to identify them. In their case this was supported by their field experiment data. Another example is the work of Mandic and colleagues, reported in Volume 8 and 9 of the

Journal of Transport and Health, which tested whether a cycle skills training programme for children influenced knowledge, confidence and behaviours relating to cycling (Mandic et al., 2018a,b). They found training increased cycling related-knowledge and confidence but only when it involved on-road training did it increase the rate of cycling to school.

The paper by de Kruijf et al. (Editors' choice), which draws on a large, longitudinal dataset to examine the effects of an incentive programme to increase e-cycling in The Netherlands, sets out to elucidate the factors determining e-bike use frequency. It looks at the role of anticipated emotion, based on the Extended Model of Goal-directed Behaviour (EMGB; Perugini et al., 2000). The authors report that that the incentive programme was successful in increasing e-bike use, but the benefits of this shift (i.e. impact on traffic, environment, and health) were mixed. The emotional dimensions included (as per the EMGB) did not explain mode shift in this study.

Heinen, et al. report the findings of a natural experiment in which a bicycle-sharing scheme was implemented in Brisbane, Australia. For this study, the Transtheoretical ('stages of change') Model (Prochaska & DiClemente) was used in data collection and analysis. The findings of this study do not support the effectiveness of this scheme in increasing cycling behaviour, and suggest no association between proximity to the bicycle-sharing system and individuals reporting higher stages of change.

Bird, et al. retrospectively apply an extended version of the Theory of Planned Behaviour (eTPB) (Ajzen, 1991) to predicting walking and cycling behaviour change using a UK population-based sample of adults. Their findings provide partial support for the eTPB model, with evidence that baseline attitudes, perceived behavioural control, intentions and habit strength are positively associated with behaviour change but not in a consistent way across different types of behavioural change.

The paper by Turner et al. reports on the development of a programme theory, developed iteratively through stakeholder consultation, for understanding the processes through which 20 mile per hour (mph) speed restriction schemes impact on health outcomes. This study demonstrates the importance of engaging with a range of stakeholders, and its findings can be used to underpin future robust evaluations of 20mph schemes. In a similar vein, the paper by Witten et al. (2018) in Volume 9 of the Journal of Transport and Health reported on how collaboration between different parties involved in a street-redesign project strongly shaped the implementation of the project. This implies that evaluations of behavioural change interventions cannot just focus on the relationship between measures and outcomes but need to account for the messiness of implementation processes.

Findings such as those reported in this set of papers can advance our knowledge of 'what works', for the purpose of intervention design, and also improve our understanding of processes of change, thereby advancing theory development and evaluation. The role of theory in these papers is perhaps this special issue's most important contribution.

Findings contributed by the papers

The included papers cover a range of target behaviours and populations. It is clear from these papers that changes in different active travel behaviours (for example, walking vs bike sharing vs e-bike use) are likely driven by different factors, and that the effectiveness of specific intervention components will not always translate across behavioural domains. A common finding among several of the included papers relates to the need to focus in on a specific target group. For example, de Kruijf and colleagues conclude that incentive-based interventions should focus on populations who are not engaged in active travel, and who are in poorer physical health; this may be the group whose behaviour is most difficult to change, but also the group for whom the need is greatest. The need to specifically target those groups who stand to benefit most is echoed in several of the other papers, including Curl et al., Heinen et al. and Keall et al.

The findings of several of these papers are useful in advancing our knowledge of which interventions do *not* have the desired effect on behaviour change. For example, Lucken and colleagues report that, in line with previous research, providing information about the benefits of active travel is insufficient to change parents' perceptions of its feasibility. Findings such as these are crucial to advancing our growing body of knowledge relating to what *doesn't* work; this is particularly important for intervention components that continue to be commonly implemented in practice.

In conclusion, most important to note in our view is the theory-based approach that is evident in many of these papers. From developing theory in consultation with stakeholders (Turner et al.), to retrospectively fitting theory to the evaluation of an infrastructure change programme (Bird et al.), these papers demonstrate the importance of comprehensive theory use. The range of theoretical approaches evident in these studies highlights that the use and application of theory is complex and not necessarily linear, and can be relevant at all stages of the intervention life-cycle.

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