

Nudging Towards A More Efficient Transportation System:

A Review of Non-pricing (Behavioural) Interventions

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Abstract:

We review Transportation Demand Management strategies through the conceptual lens of Behavioural Economics, focussing on non-pricing (behavioural) interventions often known as nudges. We identify promising precedents, evaluate their impact and stability, and nominate strategies that might be applicable in the Melbourne context.

TABLE OF CONTENTS

1. INTRODUCTION	3
2. BEHAVIOURAL ECONOMICS AND NUDGES – AN OVERVIEW.....	4
3. TRANSPORTATION DEMAND MANAGEMENT AND BEHAVIOURAL ECONOMICS	8
3.1 Pricing TDM Measures	9
3.2 Non-pricing TDM Measures.....	9
4. METHODOLOGY AND ASSESSMENT.....	10
5. CRITICAL REVIEW OF NUDGE INTERVENTIONS IN TRANSPORTATION	13
5.1 Limited Rationality	13
5.1.1 Perceptions	13
5.1.2 Improving choice architecture by addressing loss and risk aversion	15
5.1.3 Defaults	18
5.2 Limited Self-Control	19
5.3 Limited Self-Interest or Social Preferences.....	19
5.4 Incentives.....	20
5.5 Gamification-Oriented Incentives.....	21
6. SUMMARY OF BEHAVIOURAL INTERVENTION STRATEGIES	22
7. VICTORIAN CONTEXT.....	23
8. CONCLUSION AND RECOMMENDATIONS.....	24
REFERENCES	28
APPENDIX	34

1. INTRODUCTION

Road traffic congestion has considerable negative impact on the economy, the environment, and society. The avoidable cost of congestion across Australian capital cities has been estimated to be around \$16.5 billion for the 2015 financial year (BITRE 2015). The total metropolitan congestion costs in Australia have been predicted to reach \$27.7-\$37.7 billion by 2030. Sydney's predicted congestion cost is expected to increase from \$6.1 billion to \$12.6 billion by 2030 (BITRE 2015). Melbourne's predicted congestion cost is expected to increase from \$4.6 billion to \$10.2 billion by 2030 (BITRE 2015). These costs are attributed mainly to vehicle delays (lost productivity), unreliability of transport services (eg, travel time variability), inefficient fuel consumption, and additional air pollution. As population and correspondingly vehicle ownership increase in extraordinary ways (BITRE 2015; Dargay et al. 2007), investigating ways to reduce the impact of road congestion is an increasingly important challenge. In this review, we focus on non-pricing (behavioural) interventions that might induce more efficient road usage and alleviate road congestion. We touch on safety, and equity, issues only in passing.

Transport authorities world-wide employ a variety of strategies focussing on managing both the demand and supply side of transport systems. Supply management strategies focus on building new roads, or investing otherwise in quality infrastructure; such strategies tend to be expensive. Demand management strategies focus on reducing the number of drive-alone (also called single-occupancy) trips, by encouraging off-peak travel, incentivising the use of public transport, promoting active transport modes (biking and pedestrianisation), and creating public awareness campaigns. These demand management strategies are collectively called transportation (or travel) demand management (TDM) measures.

Managing demand is widely considered a more cost-effective option than increasing supply. TDM measures hence have been widely employed in cities across the world over the last two to three decades. Historically, TDM programs have focused on daily commuter trips or broad-based awareness campaigns (eg, Cairns et al. 2004). However, personalised and social marketing campaigns have increasingly been applied to TDM at the household level and for all types of trips (Dill and Mohr 2010). As Behavioural Economics has moved into the mainstream (Committee for the Prize in Economic Sciences in Memory of Alfred Nobel 2017, The Royal Swedish Academy of Sciences 2017a, b, c), and some of its nudging strategies have proven promising in areas such as pension savings (The Royal Swedish Academy of Sciences 2017c, pp. 14 - 16; Benartzi and Thaler 2013), the possibility of employing "nudges" to improve transport systems has received new interest.

The purpose of this report is to provide

- an overview of current “nudge theory” and Behavioural Economics
- an explanation of the application of Behavioural Economics to TDM
- a critical review of non-pricing (behavioural) interventions implemented in Australia including publicly available program evaluation results
- a critical review of non-pricing (behavioural) interventions implemented internationally including publicly available program evaluation results
- advice on the quality of the evidence base (high/low), the size of the impact (high/low/inconclusive), the temporal stability of the impact (high/low/inconclusive), and the overall assessment (high/low/inconclusive)
- identification of constraints in the Melbourne context
- recommendations for further work, including pilots/trials

2. BEHAVIOURAL ECONOMICS AND NUDGES – AN OVERVIEW

Behavioural Economics deals with the effects of psychological, social, cognitive, and emotional factors on the economic decisions of individuals and institutions. It is concerned with “the three bounds” identified by Thaler (2015, p. 258): bounded rationality (or “cognitive limitations”), bounded willpower (“self-control problems”), and bounded self-interest (“social preferences”) which allegedly prompt numerous cognitive biases¹. Behavioural “choice architects²” have attempted to address these alleged departures from rational decision making through various behavioural interventions that were supposed to “nudge individuals in the right direction” (The Royal Swedish Academy of Sciences 2017c, p. 14).

The idea of nudging, as described by Thaler and Sunstein (2008), relies on designing the choice architecture without restricting the set of available choice options, or significantly changing the incentives. Essentially, “nudges” – a subset of the set of behavioural interventions -- need to be costless to implement and cheap to avoid:

“A nudge, as we will use the term, is any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not.” (Thaler and Sunstein 2008, p. 6)

¹ See Benson 2016 for an excellent primer.

² “Choice architecture” denotes the way in which a choice is presented to consumers, or citizens. “Choice architects” are those that design (and possibly implement) the “best” from the set of available choice options.

Nudges thus are an attempt to encourage people to make decisions that the policymaker believes to be in their, or their families', and/or society's interest.³ Importantly, nudges are meant to induce a voluntary behavioural change. People are not penalised if they do not follow suit, and opt, for example, out of a default that the policymaker has set to nudge individuals into some direction.

For example, Spain – like many other countries -- operates an opt-out system for organ donation, whereby all citizens are automatically registered for organ donation unless they choose to state otherwise (Johnson and Goldstein 2003; Matesanz et al. 2011; Whyte et al. 2012). The assumption is that most people want to be donors if they die in an accident and their organs could be used to save someone else's life, but for assorted reasons they never get around to registering; the opt-out system makes it easier for them to do what supposedly they really want to do.

The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel 2017 (The Royal Swedish Academy of Sciences 2017a, 2017b, 2017c) identified as another prominent example the *Save More Tomorrow* (*SMarT*) program explained in Thaler and Benartzi (2004) which has been implemented in the USA, and recently also in the UK. This program has increased the retirement savings of millions of people (Benartzi and Thaler 2013) by encouraging firms to implement automatic enrolment and automatic escalation in retirement savings plans.⁴

In a nutshell, behavioural interventions of the nudging kind are meant to facilitate decision-making, addressing both cognitive limitations and self-control problems which some brain scientists and cognitive psychologists have argued is due to our thinking being too fast for its own good.⁵

As also acknowledged by The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel (The Royal Swedish Academy of Sciences 2017b, p.6), behavioural interventions of

³ Whether the nudge is in the consumer's, or citizen's, or society's interest is an important question since it is not guaranteed that individuals' and society's interest are fully aligned.

⁴ Note that superannuation here in Australia as such is not a nudge although the current system is riddled with defaults such as *MySuper*, and similar default investment options that nudge people towards choices.

⁵ These researchers have argued that the brain functions as if it had two systems of decision making. See footnote 32 in The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel 2017c) for a historical note. One system is fast and automatic while the other one is slow and deliberative ("reflective"). Thaler and Sunstein (2008) suggested that through "choice architecture", and the incorporation of nudges (possibly in the form of defaults) into the choice environment, policymakers could devise interventions that help the automatic system make better decisions, thus absolving the reflective system of some of its functions. This view is not uncontroversial (eg, Ortman 2008).

the nudging kind have been criticised by libertarians as paternalistic; “but it is essential that joining the programme is completely voluntary and that participants are free to opt out of it at any time.” The concerns by libertarians, as well as the concerns of those who wonder about the long-run consequences of a world increasingly crowded by various sorts of nudges (eg, Ortmann 2015; Ubel 2016), was at the root of the rather diverse reactions to the Nobel Memorial Prize to Richard Thaler (eg, Berg and Davidson 2017). Still, as observed by The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel (The Royal Swedish Academy of Sciences 2017a, 2017b, 2017c), Behavioural Economics is now widely practised by numerous nudging units (“Behavioral Insights Teams”) in many countries. In Australia, such units exist on the Federal level (Behavioural Economics Team of Australia, or BETA; see Ball, Hiscox, and Oliver 2017) as well as the state level (e.g., in New South Wales and Victoria where the Behavioural Insights Units are embedded in the Departments of Premier and Cabinet). In addition, there is the Australian branch of the original London-based Behavioural Insights Team (<http://www.behaviouralinsights.co.uk/>) which was then embedded in the Cabinet Office and now operates six offices worldwide (London, Manchester, New York, Singapore, Sydney, and Wellington) in partnership with it.

While ideally nudges can help individuals overcome cognitive biases brought about by cognitive limitations and self-control problems, highlight better choices, and – without restricting choices –, promote behavioural change there is in our considered opinion no robust “nudge theory”. Rather, what goes under the label “nudge theory” is a collection of behavioural interventions that occasionally have, or seem to have, produced effects in certain contexts that typically cannot be robustly reproduced across different contexts. This state of affairs is due to a) cognitive biases not being robust to start with – a bone of contention in the academic literature since at least Gigerenzer (1996) and Kahneman and Tversky (1996) and b) – where they exist – their effects not being robust across place and time (eg, Carroll 2017 and references therein; Ortmann 2015 and references therein; Ubel 2016; Bolton and Newell 2017).



Figure 1: Piano Stairs in Stockholm (Source: Hansen 2010)

A case in point are the well-known, and often paraded, piano stairs⁶ (Figure 1) that have been implemented in cities such as Stockholm and Melbourne (Bates 2009). Ignoring for now the question whether indeed they qualify as a nudge (Hansen 2010), they manage to redirect pedestrian flows away from escalators to them initially (presumably doing their share to improve people’s health); we have not been able to find any robust evidence that this redirection of pedestrian flows is successful in the long run.

As mentioned, behavioural interventions of the nudging kind have been shown to be successful for retirements savings⁷ but convincing evidence from other areas is sorely missing.⁸

Regarding transportation and travel, interventions informed by Behavioural Economics have been used to address several practical problems, usually though without referring to them as nudges. For example, a long-established application in road design (predating the “nudge” label) is the use of gateways, sightlines, and coloured or textured road surfaces that affect perceived speed and safety rather than actual conditions (Avineri and Goodwin 2010). However, the application of other interventions informed by Behavioural Economics have not been systematically analysed, as we shall presently demonstrate through our literature search. Therefore, their effectiveness in transport and travel remains an open question.

⁶ Stairs leading out of a subway in Stockholm were transformed into a piano keyboard, which, when pressure was applied on a step, prompted a musical note. Study number 90 in the Appendix details these studies. Related nudges are visualizations at the feet of the escalator that suggest that walking up the stairs makes a person fitter than taking the escalator.

⁷ See, however, Dobrescu et al. (2017).

⁸ The insufficient evidence on the efficacy of nudges has been discussed, for example, by Priday et al. (2017), Kornet-van der Aa et al. (2017), Carroll (2017 and references therein), and Ortmann (2015 and references therein). Arnott et al. (2014) have concluded that there was no evidence for the efficacy of behavioral interventions, both of the nudging and/or non-nudging kind, for transport behaviour change.

3. TRANSPORTATION DEMAND MANAGEMENT AND BEHAVIOURAL ECONOMICS

The term Transportation Demand Management (TDM) originated in the US in the 1980s. Relatively low and stable oil prices, advanced cars, and increasing population led to increase in congestion, increase in pollution, and loss of productivity. Transportation authorities realised the need to manage transportation demand.

Figure 2 shows the increasing trend of the number of scientific publications on TDM⁹. There were around 750 studies on TDM in the last 25 years. Beginning in 2007, and as of October 2017, we find only 28 articles that mention Behavioural Economics measures¹⁰ in the area of transport (Source: Web of Science¹¹), of which only one talks about nudges. None of these articles reports case studies, and hence none of these articles will feature in our report below. Our finding demonstrates the relative infancy of the application of Behavioural Economics and nudges to TDM measures and the need to study them.

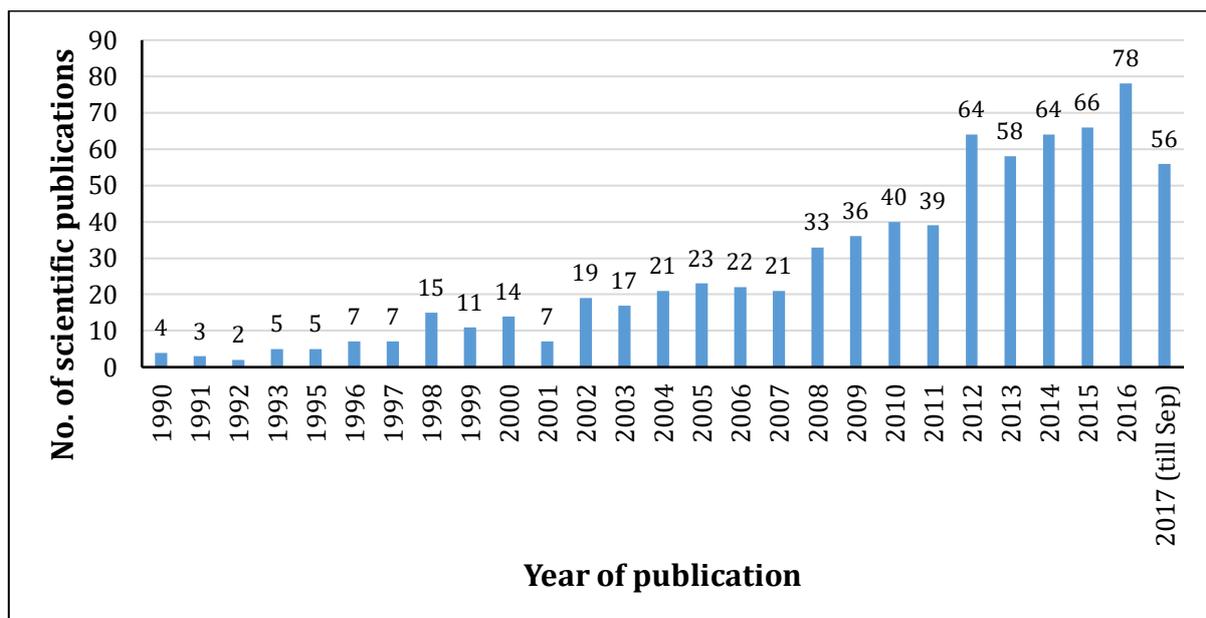


Figure 2: Number of scientific publications on TDM across years

(Source: Web of Science)

⁹ We used “transportation demand management” as the relevant search term. We included only studies that fall in the transportation domain.

¹⁰ We used “behavioural economics” as the relevant search term. We included only studies that fall in the transportation domain.

¹¹ Web of Science is a scientific citation indexing service that provides a comprehensive citation search. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialised sub-fields within an academic or scientific discipline. It was originally produced by the Institute of Scientific Index (ISI).

3.1 Pricing TDM Measures

Transport systems are susceptible to the *tragedy of commons*, i.e. individual users acting independently in line with their self-interest to the detriment of the common good in which they all share. In other words, the equilibrium that results from individuals choosing routes in line with their self-interest is likely to be inefficient compared to system-optimal traffic assignment. Internalising the externalities of congestion through pricing has been the strategy of choice of transportation economists (Arnott et al. 1993; Dixit et al. 2017). This program of congestion pricing was informed by the notion that pricing is the only lever to get individuals to internalise the cost they impose on the system. Pricing measures include strategies such as parking pricing, tolling, congestion pricing, carbon taxes, distance-based pricing, etc. These measures are meant to reduce the level of traffic congestion by discouraging (some) drivers through increased cost of travel (Givoni 2012), and they are widely considered to be the most cost-effective solution to congestion problems. They also generate a stream of revenues which could help in the implementation of pricing and other TDM measures (Saleh 2007). However, implementation of pricing strategies tends to be accompanied by concerns over equity and is politically difficult to implement (see Eliasson 2008 for a rare success story)¹².

3.2 Non-pricing TDM Measures

Non-pricing strategies focus on improving access to public transport, pedestrianisation, promotion of biking, promotion of shared vehicles, park & ride, awareness campaigns about pollution, etc. Non-pricing strategies seem fairer, less prone to criticism, and hence politically more easily and quickly implementable than pricing measures. In European countries, traffic reduction by planning or engineering methods, of which pedestrianisation and promotion of biking have been key components, have a long history, and have shown more success in reducing congestion than road pricing (Goodwin 2004). Interestingly, cultural factors can massively influence the take-up of biking (Grize et al. 2010).

Below we review the existing literature on different non-pricing TDM measures, and their effectiveness in reducing congestion through case studies from around the world. When we talk about TDM measures below, the reference is always to non-pricing TDM measures unless noted otherwise. We focus on those TDM measures informed broadly by Behavioural Economics and “current nudge theory”. We re-iterate that in our considered opinion the latter is little more than

¹² Equity and its perceptions can have implications on acceptability of these policies. More importantly, not considering this could lead to certain sections benefitting from it substantially more than others.

a collection of behavioural interventions and the effects that have been reported stand on shaky empirical ground (eg, Ortmann 2015).

4. METHODOLOGY AND ASSESSMENT

To gather relevant case studies, we searched in Web of Science and Google. As in our Web-of-Science search of scientific publications on the topic of TDM, we used the strings of words such as “transportation demand management”. We also used “behavioural economics and transportation”, and “nudges and transportation”. We included only studies that fell in the transportation domain. In addition, we only included studies that reported case studies which were predominantly published by state and Federal governments.

We identified a total of 102 case studies as relevant. Case studies had to be TDM implementations, or proposed trials in the *field*. The spreadsheet in the Appendix enumerates all the TDM case studies that we found and reviewed. Several of the TDM strategies that were reviewed involved large-scale transportation investments, with some behavioural interventions. However, only 46 out of the 102 studies¹³ could be categorized as having elements of non-pricing strategies of relevance in the present context.

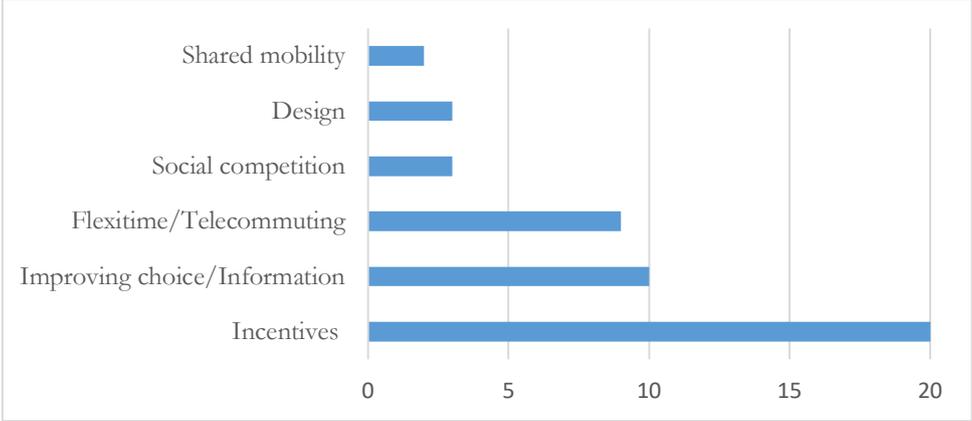


Figure 3: Reviewed case studies, classified into categories

We classified these 46 non-pricing TDM strategies into six categories which, in ascending order of number of studies included, are (see Figure 3): (a) Shared mobility (b) Design (c) Social competition (d) Flexitime/Telecommuting (e) Improving choice/Information, and (f) Incentives (eg. gamification). We do not consider congestion pricing. Figure 3 shows how many out of the 46 identified studies belonged to each of the six categories.

¹³ As of November 1, 2017.

Table 1 (below) summarizes the findings from all 102 studies. It summarizes the congestion and accessibility impacts, behavioural changes (and their stability), community acceptability, equity impacts, and the benefits and costs of implementing these classes of strategies. It should be noted that strategies involving: design, social competition and improving choice/information have low numbers of studies and broadly fit under strategies that can be referred to as “nudges”. Table 1 discusses these three together under “Nudges”. We also discuss Flexiwork and Telecommuting separately in Table 1, due to their differences. The Appendix enumerates all 102 case studies. A brief description of each of the case studies, including their mechanism, expected vs. actual impacts, issues raised from the implementation, are also presented there. The following are noteworthy conclusions:

- (1) In only two¹⁴ of the 102 studies, we find the authors reporting failure. These numbers suggest a publication bias¹⁵ which would be in line with a well-established phenomenon in the social sciences (e.g., Munafo et al. 2017).
- (2) Almost all strategies that used nudges were part of other interventions. Therefore, when evaluating the effectiveness of a “nudge” intervention multiple hypotheses could explain the impact. It was therefore impossible to isolate the marginal effect of the “nudge”.
- (3) Behavioural interventions of the nudging kind were typically not trialled with sufficient experimental control (availability of relevant data or period of trial) to be able to evaluate robustly their impact and effectiveness.
- (4) Our review suggests two key insights on stability of behaviour: (a) A well-designed nudge can encourage individuals to experience an alternative; for a lasting switch to occur the alternative it has to provide tangible benefits though¹⁶, and (b) If an individual is indifferent to available options, a well-designed default can result in a stable shift.¹⁷

The effectiveness of interventions was identified based on our professional judgement which draws on evidence from the behavioural literature (eg, Dixit et al. 2017) and the evidence found in our review, which repeatedly showed the effectiveness of incentives and individuals’ willingness to engage and explore new designs (eg. Piano Stairs¹⁸)

¹⁴ Study 17 and 90 in the Appendix.

¹⁵ Publishing only results that show a significant positive finding. An important correlate is that many unpublished findings that show no effect, or are negative, never make it in the public domain, thereby significantly biasing the evidence base.

¹⁶ The framing of Singapore LTA’s travel early “for a leisurely breakfast”. Travelling early provided benefits in cost and travel time savings to individuals.

¹⁷ Wiryakusuma et al. (2017) used defaults in calendars to nudge travel towards off-peak periods.

¹⁸ They typically do not continue their use since it does not provide consistent contribution to individual utility.

Table 1 Summary of Performance Measures

Strategy	Congestion and accessibility impact	Behavioural change and stability	Community acceptability	Equity	Benefits and Costs
Flexitime, compressed work week (a flexible hours schedule that allows workers to alter workday start and finish times)	Reduce total traffic, reduce peak period congestion.	Shift trip time, shift peak to the off-peak period.	High support from employees and supervisors, increase employee satisfaction and flexibility.	+ : Benefit disadvantaged groups, improve affordability. - : Not applicable to some types of jobs.	+ : Reduce travel costs - : Increase administrative and management responsibilities, difficulty in measuring productivity.
Telework (a work arrangement in which employees do not commute to work place, instead use mobile telecommunications technology)	Reduce total traffic, reduce congestion, improved access.	Shift trip time, reduce vehicle trips	Highly accepted by employees and supervisors, increase employee satisfaction and flexibility.	+ : Benefit disadvantaged groups, improve affordability, improved productivity. - : Not applicable to some types of jobs	+ : Reduce travel costs - : Increase administrative and management responsibilities, increase the difficulty of measuring productivity.
Shared mobility services (transportation services that are shared among users, including PT; bikesharing; carsharing; carpooling; ridesourcing)	Reduce total traffic, reduce congestion, improved access.	Shift travel mode, reduce vehicle trips, reduction in vehicle ownership.	Highly accepted by community, the number of users keeps increasing.	+ : Improve affordability, benefit non-drivers, improve basic mobility.	+ : Reduce travel costs, reduce vehicle ownership and therefore reduce transportation costs.
Incentives	Has stable positive impacts on behaviour	Shift travel mode, reduce vehicle trips	Acceptable	+Improved accessibility -Marginal benefits to different economic groups need to be considered from an inequity aversion perspective	+Improved transportation outcomes
Nudges (Social competition, Design of choice architecture, Information)	Improved active transport and reduce congestion	Incentives, design, bundling choices, reducing risk, positive messaging, social competition. Evidence mixed	Acceptable	Has no equity impacts	+Improved choices -Costs associated with design and implementation -Evidence inconclusive

5. CRITICAL REVIEW OF NUDGE INTERVENTIONS IN TRANSPORTATION

In the following sub-sections, we discuss how biases resulting from *limited rationality and limited self-control* might play out and how nudges might help to counteract them. As you will recall, these are two of the three bounds identified by Thaler as being the cause for departures from rational decision-making. We also briefly discuss how *limited self-interest* or *social preferences* might play out in this context.

This critical review of non-pricing (behavioural) interventions implemented in Australia and elsewhere includes publicly available program evaluation results and our assessment of the evidence base, the size of the impact, and its temporal stability. Unfortunately, the studies that we reviewed provide few robust data of marginal effects of non-pricing (behavioural) interventions. Since the number of Australian case studies was limited, we have discussed them together with the international studies.

5.1 Limited Rationality

Limited rationality deals with cognitive biases associated with perceptions, aversion to losses, and individuals excessively relying on defaults (“default bias”). These biases have been found to influence transportation choice and its impact on congestion and safety (Dixit et al. 2017). Framing choices based on this understanding, could help influence behaviour.

5.1.1 Perceptions

Perceptions of the world significantly influence our choices. These perceptions are shaped by how our senses and brain receive and process signals (Ware 2008). It is widely accepted that optical illusions tend to be a robust phenomenon while the reality of cognitive illusions, as mentioned earlier, has been in dispute for decades. Kahneman and Tversky (1979), for a hypothetical setting, demonstrated optimism bias where individuals’ overweight low probabilities and pessimism bias where individuals tend to underweight high-probability events. Dixit, Jian, and Hassan (2017), studying taxi drivers in Dhaka, found that individuals systematically underestimated the travel time risks. These (mis)perceived travel time distributions could have a significant impact on route choices and hence designing interventions that could influence perceptions to be more realistic might be useful. In the case of taxi drivers, to the extent that they typically do not have to internalize the costs of the externalities that they impose, incentives might have to be changed first. But similar misperceptions might exist for ordinary drivers, so designing interventions that could influence their perceptions might be useful.

Traffic safety researchers have long designed environments to help reduce speeding or make drivers more aware. Such interventions could well be labelled nudges. Typical designs have relied on utilising visual perception mechanisms to give a better sense of speed or to catch attention. For example, life-sized replicas of police officers (Preston in the UK and Bangalore in India), painting the surface of the road (in Chicago, Vancouver and various parts of India including Ahmedabad), and 3-d speed breakers (Ahmedabad city in India) have been used to get drivers' attention (Olewitz 2016); see Figure 4 below. Ahmedabad highway officials have reported that accidents have been eliminated in the areas after road paintings.



Figure 4: Road paintings to gain attention

Similarly, in Chicago horizontal lines were painted on a stretch of road to influence the perception of speeding (Moskvitch 2014); see Figure 5 below. This design was found to reduce speeding behaviour and a 36% reduction in crashes were observed.



Figure 5: Reducing speeding through spaced lines

Another way to affect perceptions are travel choice information systems which are intended to shift travellers' trip time and travel mode, and to shorten trips by providing travellers with comprehensive information on trip planning, route finding, travel options to particular destinations, real-time arrival and delay information, and travel time and cost estimation. The most common strategies under this category include multimodal navigation websites and smartphone applications (Google Maps, Apple Maps), public transit navigation systems,

information provided through shared-mobility smartphone applications (Uber, Lyft, Didi Chuxing), and monitors providing real-time information of buses, trains and trams.

However, information campaigns need to be carefully designed to avoid unintended consequences. The study by Wijayaratna et al. (2017) demonstrated, through laboratory experiments, an information paradox. The paradox suggests that provision of real-time information on certain routes makes congestion worse for everyone. This might happen if individuals, provided with real-time information, take routes in anticipation of reduced expected travel cost, bringing about an increase in the expected total system cost. Hence, placement and type of information need to be carefully planned and monitored.

The presentation of public transport information as a schedule, rather than based on presenting the frequency is another interesting case in point on perceptions. Avineri (2004) found in a laboratory experiment¹⁹ that people underestimated waiting times when public transport information was presented as frequency which in turn led to larger than expected waits for the bus. This is also referred to as the “waiting time paradox”. Therefore, presenting public transport schedules is the appropriate strategy.

While there may be considerable fixed costs involved in installing information systems²⁰, the marginal costs approach almost always zero, so information campaigns – even though technically not a nudge – seem worth considering. Once again, most of these strategies have relied on pushing information out. However, there is typically no clear description of the methodology used to determine the information strategy that was selected.

5.1.2 Improving choice architecture by addressing loss and risk aversion

People behave differently depending on whether information is framed in terms of gains or losses. Individuals seem often more sensitive to losses than to gains, a phenomenon called loss aversion. This has led “choice architects” to frame messages as losses to get people to actively opt-out of a choice or sometimes as gains to make an alternative more appealing.

¹⁹ The mean age of the participants was 40 years. However, the location of the experiment was not reported. We conjecture that it was conducted at Ben-Gurion University in Israel.

²⁰ The costs of implementing these strategies include the development of information systems as well as the production and installation costs of devices. It is important to note that private sector information providers (eg. Google Maps, Waze) not only rely on information generated from the usage of their devices, but the public infrastructure set up by the government to collect information (eg. Loop detectors and Public transport GPS data). Therefore, the government would have an important role to ensure that reliable and correct information is accessible to the public.



Figure 6: Framing in gains

The Singapore LTA, for example, rolled out a travel-free-morning program to nudge commuters to travel earlier for free rides to reduce congestion during the morning peak (Land Transport Authority of Singapore 2015b). (Again, strictly speaking, this is not a nudge as it contains financial incentives, i.e. free trip.) The slogan used to promote this program was “travel free and have a leisurely breakfast” (Figure 6), which were all framed in the gain domain, i.e. gain of a “leisurely breakfast” (Design Incubation Centre 2015). Though shifts in departure time were observed, they were accompanied with free travel. This program is a good example of the mix of non-pricing and pricing strategies where the effectiveness of the non-pricing framing intervention is difficult to disentangle from the effects of the pricing intervention.

Preferences and perception over risk play an important role in individuals’ choices over travel modes, departure time, and routes (Dixit et al. 2017). These are usually captured as the value of reliability. However, little work has been done on communicating clear reliability metrics to individuals to influence their choices or provide guaranteed transportation services (e.g. emergency ride home in San Luis Obispo, i.e. study number 19 in the Appendix). The service in San Luis Obispo offers free, or low-cost, door-to-door rides home in cases of emergency for employees who commute through carpooling, public transit, bicycling, or walking.

Traditionally, it has been assumed that providing more choice options improves individuals’ ability to make more rational choices. However, some evidence has suggested that due to cognitive constraints, many choice options could result in inefficient choices (famously, Iyengar and Lepper 2000). That evidence is, however, not uncontested (Scheibehenne et al. 2010, 2011; Chernev et al. 2010, 2015, 2016). In our opinion, the debate is ongoing and there is no

conclusive evidence that individuals' ability to make rational choices is compromised by many choice options.

Working on the assumption that choice overload can be a problem (although in our considered opinion there is no clear field evidence for it in the present context), suggests that only those attributes be presented that individuals would care for. This could be done by bundling choices; integrated fare systems for public transit such as Opal card in Greater Sydney and Myki in Victoria are prominent examples. This allows individuals to think of public transport as one mode of transportation, and might make it easier for individuals to make the trade-off between the use of private and public transportation choices. There are also start-ups such as Skedgo that offer personalised trip planning by bundling payment options for various travel modes and also parking. Design of maps can also help improve accessibility of information about public transport, with the best example being that of the London tube map (See Figure 7). This template has since been adopted in Victoria.

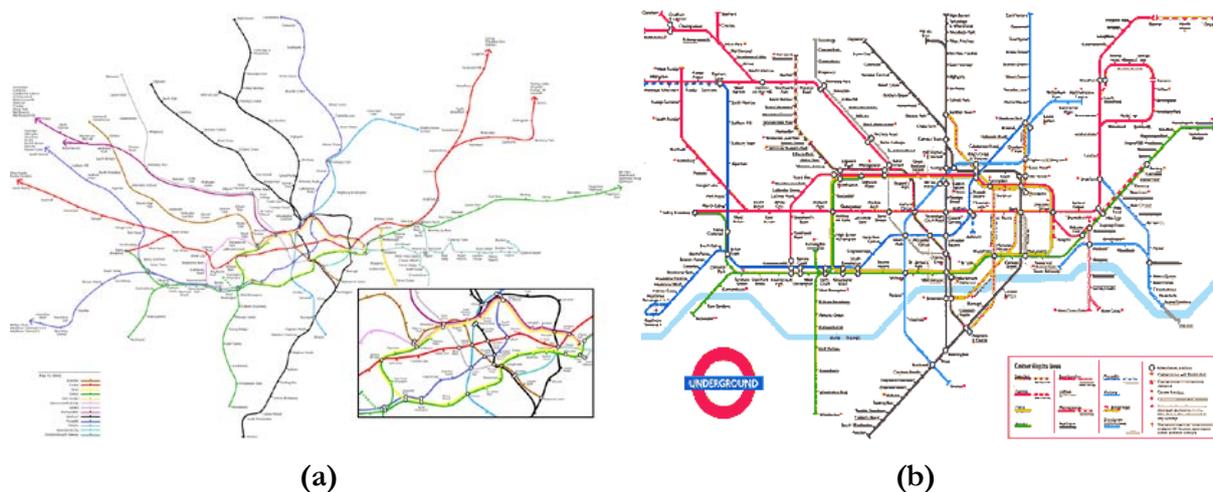


Figure 7: Map of London underground (a) Actual map (b) Displayed map

Designers play an important role in structuring the choice context. Designers used the idea that travellers like to set themselves up in front of information screens, to intelligently use space and designed seating to provide an unrestricted view to the information screens. This nudged travellers to more efficient traffic flow from waiting area to the boarding queue in the Copenhagen airport (Olewitz 2015). Similarly, the City of Port Phillip in Victoria used designers to design urban space and re-time traffic signals to make it safer to walk and ultimately improve walking trips (study number 92 in the Appendix). The modified signal reduced the hassle of multi-stage crossings for more people and removed barrier for those unable to cross within allocated time by increasing pedestrian signal phasing and reducing waiting times.

5.1.3 Defaults

Evidence abounds that individuals tend to choose default options, i.e. options choice architects set prominently. Default biases have been attributed to cognitive limitations, biased perceptions, or high levels of uncertainty on alternative options. As mentioned, default biases have motivated automatic enrolments and enrolment escalation²¹ (Smith et al. 2013; see also Thaler and Benartzi 2004, Benartzi and Thaler 2013) as well as organ donation opt-out schemes in Spain and other countries (Johnson and Goldstein 2003); however, in the transportation context defaults are difficult to engineer.

Nevertheless, multi-modal trip planning applications such as TripGo²² provide emissions information (in addition to the route navigation capabilities) for each suggested travel plan. Such applications can create or increase environmental consciousness among drivers and shift them from their usual default option of the car to more sustainable ways such as walking or riding a bicycle. Similarly, City Mapper²³ provides information on calorie usage and awareness on the positive physical impacts could shift individuals to walk more.

Individuals' reliance on defaults and habits are a source of stickiness in travel patterns. However, periods of transportation disruption are an opportunity to correct it. A recent study by Larcom et al. (2017) found that disruption in the underground tube in London led commuters to explore more efficient routes, which they adopted even after services returned to normal.

Wiryakusuma et al. (2017), building on three interventions (changing default settings in Microsoft Outlook calendars and condensing the default available times; prompting managers to discuss and model flexible working; using a competition to disrupt habits) suggest a complementary measure that involves the targeted involvement of large organizations in particularly afflicted CBD areas. The authors report a 3 percentage-point increase in the number of off-peak arrivals and departures based on the first two nudging interventions alone; when they added the third they report to have found a 7 percentage-point increase in the number of off-peak arrivals and departures even two months after the competition had finished. While these are encouraging results, they are – in the authors' words – from a “quasi-experiment”, so it is not clear how stable and lasting the effects of these interventions (“the treatment”) are and, for that matter, how real they are. It would have been clearly desirable to have as baseline a comparable organization without treatment during the same time frame.

²¹ Enrolment escalation refers to automatically increasing contributions during automatic enrolment.

²² Study number 89 in the Appendix

²³ Study number 101 in the Appendix

Furthermore, nudges using novelty techniques (e.g. gamification, piano-stairs), or taking advantage of disruptions, could help individuals explore more beneficial alternatives. For the impact to be lasting the alternative must provide tangible value to individuals, as compared to their prior defaults.

5.2 Limited Self-Control

Individuals have been found to discount outcomes that present themselves in the future; an example of this is the implication of improvements in transport infrastructure. For example, Dixit et al. (2010) found that individuals are more likely to vote for funding infrastructure through bonds than sales tax, essentially transferring costs to the future. However, there is evidence that allowing individuals to experience future states through virtual reality (Dixit et al. 2017) or by anchoring the future outcomes (Shu 2008) can overcome biases associated with discounting future consequences. In the case of incentives, discounting future consequences implies that individuals care more about receiving incentives now rather than a higher incentive later.

Under uncertain choice conditions, individuals have been found to procrastinate to explore more options and gather information. However, imposing time constraints can get individuals to evaluate their choices quickly and appropriately in conjunction with incentives. Limited time offers can be successful in reducing procrastination and nudging towards efficient choices (Johnson et al. 2012).

5.3 Limited Self-Interest or Social Preferences

A few programs (studies 4 and 94 in the Appendix) have relied on using social preferences and status to nudge towards better behaviour in transportation systems. This involves referencing individuals' behaviour in relation to the community and the community impacts. For example, the Singapore Land Transport Authority launched a campaign to nudge thoughtfulness in public transport commuters. The campaign involved using messaging that focussed on social consequences of being thoughtful (Land Transport Authority of Singapore 2015a). To the extent that better behavior in public transportation makes it more attractive, it is possible that on the margin such campaigns might help to induce more efficient road usage and alleviate road congestion. Except for the evidence in chapter 2 of Cairns et al. (2004, specifically Tables 2.2. and 2.3.), we are not aware of robust recent evidence that could speak to the issue.

Similarly, companies like IAG through the Safer Journeys app, and AAMI through its safe driving app, are focussing on drivers being able to rate themselves to their peers on safety in the

hope of improving safety among its users. Though the exact effectiveness is unclear, the city of Boston implemented a similar application that gives weekly prizes to the safest drivers. Through the Boston safe driving app, over 3 million miles were travelled in the first three months, with a 47% reduction in phone use and 35% reduction in speeding (City of Boston 2017). They found sustained long-term reductions in phone distraction, harsh braking, and speeding. Accidents are a major contributor to congestion (Terrill 2017), and nudges to improve safety do provide congestion benefits.

Such schemes have also been employed to influence active transport. For instance, the city of Geelong's (in Victoria, Australia) intervention involving community members referring the program to each other, coaching provided by the community on best ways to be active, and competition, resulted in increased numbers of individuals choosing to walk and an increase in their walking time (study number 94 in the Appendix). Seven Geelong workplaces participated in the six-week workplace team challenge that used a wireless physical activity device to record steps and other activities. An intuitive website was designed to encourage interaction between team mates and a range of motivating challenges to maintain engagement at work and at home (City of Greater Geelong 2017).

5.4 Incentives

Incentives refer to the strategies that provide travellers incentives or discounts to encourage them to use alternatives to private cars such as public transport, cycling, and walking. The most common strategies include reducing public transit fares, offering discounts such as lower rates for off-peak travel times and frequent users, and providing convenient payment systems such as Opal Card System in Sydney and Myki Fare Card System in Melbourne.

Though incentive schemes do not fall under nudge interventions as defined by Thaler and Sunstein (2008, p.6), they can be low-cost or even revenue-neutral, where the revenue allocated for incentives driving behaviour change and the operational expenses are recovered through cost savings from operational improvements or advertising sponsorships. Cost savings from an operational perspective from fuel and fleet savings can be achieved for example by needing to operate fewer buses during peak travel because people have shifted travel to non-peak hours due to incentives (eg, Rey et al. 2016).

Start-ups such as Metropia (based in USA) have begun to provide incentives in the form of reward points and discounts for more sustainable transportation choices (study number 87 in the Appendix); they rely on revenue from advertising based on travel patterns which they use to

disburse incentives. Clearways, an Australian start-up company that was a finalist for the 2017 Wolfson Economic Prize²⁴, proposed incentives on fuel tax to manage traveller behaviour (study number 88 in the Appendix). Their underlying philosophy was that behaviour such as off-peak travel would be rewarded with discounts on fuel excise. The mechanism is similar to the Oregon trial where individuals pay for kilometres travelled but receive credits on their fuel tax²⁵, however the Oregon trial did not propose any incentives on congestion avoidance behaviour.

Incentive strategies have been found to have the most robust and stable impact in relation to change in travellers' departure time, travel mode, reduction in vehicle trips, and reduction in vehicle ownership. These changes in individual behaviour have been found to have system impacts that include reduction in congestion.²⁶ Since travellers receive benefits, these strategies are usually widely accepted by the community. In terms of equity impacts, incentivising people to use public transit and non-motorised modes can benefit non-drivers, improve affordability and improved basic mobility. The modal shift arising from this may reduce demand for car use and reduce congestion for automobile users, therefore benefiting from the subsidies as well.

5.5 Gamification-Oriented Incentives

Gamification-oriented incentive policies refer to the TDM measures which nudge travellers to choices that are socially beneficial. People widely accept these policies which are effective due to the combined effect of incentives and embedded game designs on behaviour. The behavioural changes can include shifting trip time and mode. An example is the Singapore smart commuting program. In this program, participants are encouraged to shift their transit trip schedules to off-peak periods. The more they participate in the program, the higher their chance to win rewards (Land Transport Authority of Singapore 2015b). Other successful cases include the Infosys-Stanford Traffic project (study number 96 in the Appendix). In the Infosys-Stanford project individuals received points for travelling during non-peak periods that determined their likelihood to win a large incentive at the end of every week. These strategies have been found to be effective to reduce congestion during peak hours. The equity impacts are similar to incentive based policies, and tend to benefit the entire system.

²⁴ <https://policyexchange.org.uk/news/finalists-for-wolfson-economics-prize-unveiled/>

²⁵ <http://www.myorego.org/about/>

²⁶ This is based on assessment of the case studies and the in-depth review in Dixit et al. (2017).

6. SUMMARY OF BEHAVIOURAL INTERVENTION STRATEGIES

Based on our review, we identify the main behavioural interventions undertaken which are shown in Table 2. These behavioural interventions are specific and elaborate on the interventions shown in Table 1. We also assess the quality of the evidence base. As discussed earlier, behavioural interventions of the nudging kind were typically undertaken with other changes in the system, which made it hard to isolate the impact of nudge components.

Table 2: Summary of Behavioural Intervention Strategies

Behavioural interventions	Characteristics of intervention	Cognitive process	Behavioural impact	Cost involved	Evidence
Incentives	economic	Rationality	Economically induced behaviour	Limited cost unless revenue neutral, behavioural and transport economist	HIGH
Transport Disruptions	degraded default choice	Defaults	Explore	Improving alternatives, behavioural and transport economist	HIGH
Information/ Education	information	Perception	Inform perception	Technology, behavioural and transport economist	HIGH
Gamification	novelty	Defaults	Explore	Design, behavioural and transport economist	MEDIUM
Perception-Visual and ergonomic design	information	Perception	Easy access to information to inform perception	Human factor experts and designers, behavioural and transport economist	LOW
Changing default setting in calendar	Changing defaults	Defaults	Changing social norms, change perceptions	Designer, behavioural and transport economist	LOW
Limited time offers	time pressure	Limited self-control	limit procrastination	Design and cost of offer, behavioural economist	LOW*
Reference social norms	competition/ embarrassment	Limited self-interest	Adherence to social norms	Design and marketing	LOW*
Framing as gains	loss aversion	Loss aversion	Increase likelihood to accept	Design and marketing	LOW*

*LOW implies that the evidence base isn't sufficient to make a conclusive judgement

It is found that behavioural interventions relying on incentives, taking advantage of disruptions as well as information/education provision have a sufficient evidence base to suggest that they do indeed affect behaviour change. Gamification acts as a catalyst for individuals to explore alternative options, however, it only results in a stable behavioural change if the alternative provides tangible benefits. The other strategies are usually carried out for a limited period of time, or bundled with other regulatory/infrastructure developments. Therefore, it is not possible to evaluate their true impact or their temporal stability. However, for the nudge to induce a stable behavioural change, the alternative being nudged to should have at least the same, and preferably higher, utility for individuals.

7. VICTORIAN CONTEXT

Victoria is one of Australia's most densely populated states. Melbourne, its capital, has for the past seven years been ranked as one of the most liveable cities in the world (The Economist Intelligence Unit 2017). Yet, Melbourne is the second most-congested city in Australia and 58th in the world among the cities assessed by (TomTom 2017). Melbournian commuters spend 33% extra time travelling on congested roads relative to the time they would spend in free-flow conditions. Congestion is likely to spread to outer suburbs of Melbourne in the coming years (Infrastructure Victoria 2016). An important moderator of Melbournians' willingness to spend extra time traveling on congested roads is the likely advent soon of autonomous vehicles which might reduce the opportunity cost of travel time and willingness to pay for travel time savings (Wong et al. 2017).

Melbournians have low public transportation usage (BITRE 2015), about half of what Sydneysiders have. This low usage has been attributed to public transport services being inadequate to displace car usage. There seems considerable potential here to increase the take-up of public transportation (eg, Eliasson 2008). Of relevance seems what we understand to be the high utilisation of train station carparks and bus park and ride facilities on weekdays indicating that demand for car parking outstrips supply, although there is a confound here in that parking options are free. Obviously constructing additional parking options would come at considerable cost.

Some of these facts seem to suggest some straightforward TDM pricing interventions, especially in conjunction with travel choice information systems interventions. However, concerns regarding acceptance of pricing strategies has led agencies to explore behavioural interventions, which also include incentive mechanisms that are revenue neutral (or do not require substantial investments).

The best-known non-pricing TDM strategies in Melbourne have been delivered through the "Next 5" initiative of the Public Transport Victoria. The program provides users with information, real-time updates, and the ability to plan journeys. It is meant to improve reliability, public transport patronage, and a possible mode shift in travel. Currently, real-time information is available for 218 metropolitan train stations across 17 lines, all tram routes, and all metropolitan bus routes.

Incentives are also provided for off-peak travel. Journey is free on the metro train network if commuters touch on and off before 7.15am on a weekday. Furthermore, trams are free in the CBD throughout the day.

With congestion being perceived as having worsened in the past five years, and extraordinary growth predicted in the population and workforce (BITRE 2015), there can be little doubt that – notwithstanding an impressive slew of infrastructure projects (Pittman et al. 2017) – to the extent that behavioural interventions might have predictable marginal effects, they are worth looking into. We suspect strongly though, since there is no magic nudge bullet that can do the trick by itself, that the available and documented nudges will have to be part and parcel of attractive transport alternatives that can provide travellers tangible value in cost, comfort, reliability, or travel time savings. We repeat that nudges can only result in stable behavioural change if the offerings they nudge to are at least similar, if not better, than the current offering.

8. CONCLUSION AND RECOMMENDATIONS

We recalled the purpose of this report at the end of our introduction. We have given an overview of Behavioural Economics and “current nudge theory” which in our considered opinion is but a collection of possible effects of various behavioural interventions. We have tried to identify (documented) applications of such interventions, and their consequences, to TDM in Australia and elsewhere from publicly available program evaluation results.

Specifically, we have reviewed available TDM case studies to identify, and critically assess, the applicability of interventions informed by Behavioural Economics, focussing on non-pricing (behavioural) interventions often known as nudges. As discussed, unfortunately, many of these studies provide limited information on the way the programs were implemented. There was limited evidence for negative impacts (only two). However, many pilots were conducted for which no reports were available. This suggests a publication bias towards reporting positive findings which needs to be taken into account when evaluating the impact of interventions of the nudging kind.

We have not been able to identify effective behavioural interventions that deserve to be labelled “nudges”, i.e. behavioural interventions that are costless to implement and cheap to avoid if so desired. Our conclusion is in line with a growing sense among many experts that Behavioural Economics and “nudges” have been oversold (eg, Carroll 2017 and references therein; Ortmann 2015 and references therein; Ubel 2016, Bolton and Newell 2017).

Current TDM case studies typically implement behavioural interventions of the nudging kind in conjunction with other regulations or service enhancements, which makes it hard to discern a trustworthy evidence base due to multiple alternative hypotheses associated with several interventions being carried out at the same time, (lack of) temporal stability of a reported effect, or the trials being carried out for too a short period. However, all interventions involving incentives were found to be effective.

Dixit et al. (2017) have provided substantial evidence that showed that the alternatives that provide clear benefits to individuals are the ones that are stable. However, due to biases in perception or cognition these alternatives might not have been explored or used. Behavioural economics might be able to help nudge people to move to these personally and socially beneficial alternatives (eg, Wiryakusuma et al. 2017). However, if the alternatives in themselves do not provide value to an individual, there would be a need for clear incentives to be introduced.

Finally, we found that the design of behavioural intervention strategies was often not clearly documented, with most of them having been trials that existed for only a limited period of time. In addition, the evaluation for many lacked satisfactory before-after information.

In sum, we found that behavioural interventions relying on incentives and/or information have a sufficient evidence base to suggest that they can change behaviour (prominently Eliasson 2008). Further, there is evidence that shows that gamification can support these interventions by acting as a catalyst for individuals to explore the incentives and information interventions. However, people will only sustain a change in their travel behaviours if they feel that they are better or no worse off than previously. This is very much in line with standard economic theory.

Evidence also shows people will experiment with new travel behaviours due to disruptions caused by major infrastructure projects. These will be opportune times to conduct travel behaviour change interventions based on incentives and information which incorporate gamification.

The experimental design of the 46 transport behaviour change interventions documented as part of this paper were not scientifically robust. This was due to lack of clear documentation, trial periods that were too short, and poor evaluation due to absence of before and/or after observations.

We recommend that Infrastructure Victoria develop relatively small-scale trials for transport behaviour change interventions. While randomized control trials (RCTs) are generally considered the gold standard of what constitutes a trustworthy evidence base, they are unlikely to be implementable in the transportation context and are in our view not the optimal strategy in this context. A key requirement of RCTs is that participants are randomly assigned to either a treatment or a baseline (“control”) condition. Some such assignment seems impossible in the transportation context, or implementable only under very specific conditions such as two essentially identical organizations in the same neighborhood. We note that even then the only inference that could be drawn would be based on a very specific treatment when in fact many possible treatments can be thought of in any specific situation.

In line with the arguments of Hausmann (2016), we hence advocate relatively small-scale trials, possibly informed by standard economics, that are based on trying things out and that allow to explore several promising avenues. The recent study by Wiryakusuma et al. (2017), while questionable from a scientific point of view, might well be a practical strategy, last but not least given its comparatively low design and implementation cost which we estimate to be in the four digits at most. We do not know what the corresponding benefits are in shifting one out of twelve commuters to off-peak times for arrival and departure but are confident that it must be worth the expense. Small-scale experiments of this kind would provide clarity on the effectiveness of transport behaviour change interventions in Melbourne, which could inform future decisions on larger-scale programs.

As to recommendations for further work, it would be important to conduct carefully designed pilots/trials to be able to measure impacts of non-pricing TDM measures through before-after studies or other field experiment evaluation methods. We also recommend they be built on, and expand, current infrastructure (eg. integrated smart cards and parking), current public transport incentives, change in context (such as disruptions in transport services) and real-time information systems (Next5). Accompanying measures could be similar to those explored by the LTA in Singapore, with staggered price discounts that expand on the current breaks Melbourne commuters already receive. Another area of interest could be trialling them for parking, with park-and-ride services, or incentivising early arrival. This can be undertaken in collaboration with large business centres. We highlight this strategy, and describe some of the other potential strategies that can be explored, in Table 3.

Table 3: Potential Trials of Non-pricing Strategies

Opportunity	Strategy	Targeted Cognitive Process	Modes	Stakeholders	Confidence
Shift travel to off-peak periods	Information/Education	Perception	All modes	Government, Businesses	MEDIUM*
	Framing as gains	Loss aversion	All modes	Government, Businesses	LOW*
	Revenue neutral incentives where the cost incurred from incentives can be recovered through advertising promotions for shopping, coffee, as well as cost savings from PT operations	economic rationality	PT	PT operator, Businesses	HIGH*
	Gamification to find best time to travel	Novelty and social status	PT	PT operator	MEDIUM*
	Change defaults on calendars	Influence social norms	All modes	Businesses	LOW*
Disruptions	Information/Education	Perception	All modes	Government, Businesses	HIGH*
	Limited time offers for substantial PT discounts	Limited self-control and economic rationality	PT	Government	HIGH*
	Gamification to find best time and/or mode to travel	Novelty and social status	PT	PT operator	MEDIUM*
Journey to school	Revenue neutral incentives for parents not using cars (eg. walking, carpooling PT) for pick-ups. The cost recovery would come from less personnel needed for traffic management and congestion costs and or advertising. The incentives could vary from actual cash-back to free fruits/ice cream etc.	economic rationality	All modes	PT operator, Schools	MEDIUM*
	Gamification and competition based on active modes	Social status	Active modes	Government, Schools	LOW*
	Framing as gain with quality active time	Loss aversion	All modes	Government, Schools	LOW*
Leverage existing parking facility to promote PT usage	The biggest friction point with PT involves connectivity and flexibility of travel for users. With most park-and-ride services over-subscribed, we suggest providing incentives with subsidized or free parking for PT users in adjacent commercial/council parking lots. The cost of this mechanism can potentially be recovered through revenue generated from additional users and/or advertising from product endorsements for breakfast/coffee. Eg. Free coffee on the way to PT.	economic rationality	PT	Government, Parking providers	HIGH*

*Need to ensure that the alternative being nudged to has equal or greater utility for individual than the current choice

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APPENDIX														
No.	Case Study	TDM Strategy	Mechanism	Nudging Mechanism	Description	Intended Changes to Travel Behaviour	Expected Impacts	Actual Impacts	Issues during implementation	Change	Quality of evidence	Size of impact	Temporal stability of the impact	Final
1	TransAmerica Financial Corporation, Flexible working hours	Flexible working hours: employees start any time between 7 and 9 AM, and depart between 3:15 and 5:45 PM.	Improved transit choice		Started the flextime program from 1974. Over 90% of those 3700 eligible employees make use of it. Employees are allowed to start at any time between 7:00 and 9:00 a.m., and depart between 3:15 and 5:45 p.m.	Shift trip time	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel.	1) Over two-thirds of the employees arrive before 7:30 AM to avoid congestion. 2) Aid recruitment and retention. 3) The company also benefits from higher morale and longer hours of operation.		+	High	Low	High	Medium
2	Southern California Association of Governments, compressed workweek and flextime	Compressed workweek: employees work 9 hours a day and get every other Friday off.	Improved transit choice	Changing defaults and providing incentives	Started flextime and a compressed workweek program from 1980. All 125 employees are eligible for compressed workweeks, and 95% take advantage of the option. Employees work 9-hour a day and get every other Friday off.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.	1) Reduce number of commuting trips. 2) Increase employees' satisfaction.	1) Time recording methods have been revised several times. 2) Difficult to arrange meetings on Friday.	+	High	Low	High	Medium
3	The University of Pennsylvania, flexible Work Option	Flexible working hours.	Improved transit choice	incentives	Offer employees flextime, flexplace, compressed work schedule, part-time work and job sharing.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.				Low	Inconclusive	Inconclusive	Inconclusive
4	Commuter Challenge Program (https://commuterchallenge.ca/)	Week-long event during Canadian Environment Week, which encourages Canadians to use active transport options and telecommuting during the week.	Improved transit choice	social competition	A competition between Canadian cities and workplaces. Encourages Canadians to leave their cars at home.	Shift trip time, shift mode, reduce vehicle trips	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	834272 employees and 1671 workplaces participated nationally in 2017, contributing 260808 kg CO2 reduction and 1621640 driving kilometer reduction.		+	High	High	Low	Medium
5	Automobiles-en-Libre-Service in Paris, carsharing	Carsharing: Provide 2000 electric carsharing vehicles.	Improved transport choice		Complement the bikesharing system Velib. Provide 2000 electric cars, which will cost a few euros per hour to use, depending on mileage.	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	By July 2016, 3980 bluecars have been registered for this service, attracting 126900 subscribers. From the survey in 2014, 15% decrease in the number of motorised two-wheelers was reported from Autolib users.		+	Low	High	High	High

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6	Arlington, carsharing	Carsharing: partnered with Flexcar and Zipcar. Added 15 cars in 2005 and 16 cars in 2006.	Improved transport choice	.	Analysis of carshare activity in Arlington, Virginia (a suburb of Washington DC)	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	1) 37% increase in carsharing members from 2005 to 2006. 2) 27% increase in carsharing trips from 2005 to 2006. 3) Members stated that carsharing has allowed them to reduce their vehicle ownership rates and overall vehicle-miles traveled while increasing transit use and walking. Members also have generally been able to postpone buying a vehicle.	.	+	High	High	High	High
7	New York, carsharing	Carsharing: Allow employees to use 25000 unused government cars for carsharing.	Improved transport choice	.	The system allows employees to reserve 25000 unused government cars by utilizing the same software as Zipcar, the popular car-sharing service.	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	1) Reduce the number of service garages from 47 to 37. 2) Reduce 20% total fleet vehicles.	.	+	High	High	Medium	High
8	Boston's Silver Line	Bus Rapid Transit	Improved transport choice	.	Reduce the travel time from 20-40 min to a reliable 15 min.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Doubled ridership during the first year of operation.	.	+				
9	Vancouver's B-Line routes	Bus Rapid Transit	Improved transport choice	.	.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Ridership increased 20 to 25%.	.	+				
10	Los Angeles express arterial bus service	Bus Rapid Transit	Improved transport choice	.	Reduce the travel time by 29%.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Ridership increased nearly 40%.	.	+				

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11	Adelaide O-Bahn	Guided buses	Improved transport choice		Part of the Adelaide Metro in South Australia, shuttling over seven million passengers back and forth a year. It takes roughly 20 minutes to travel the length of the busway.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
12	Seoul Bus Rapid Transit	Bus Rapid Transit	Improved transport choice		Over 76 kilometers of median busways were constructed in 2004. Over 5,000 buses have installed GPS tracking technology to ensure improved customer service, and 815 buses have been converted to operate on natural gas. A smart card system is utilized to allow free transfers to different transit services. Travel times along the BRT corridors have been reduced by 5 times.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	This led to an 11% increase in public transport use and a 27% reduction in traffic accidents during its first year of operation.		+				
13	Los Angeles Orange Line	Bus Rapid Transit	Improved transport choice		The Orange Line is an exclusive busway, with one lane in each direction and signal priority to give them green lights at intersections serving primarily suburban, middle-class areas.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Expected to increase the ridership from 5000 weekday boarding to 22000 by from 2005 to 2020, but achieved the 2020 goal after operating for 7 months.		+				
14	Mexico City's MetroBus	Bus Rapid Transit	Improved transport choice		The system had replaced 350 older minibuses with 97 brand new articulated diesel buses that have eliminated over 35,000 tons of greenhouse gases and reduced passenger exposure to tailpipe emissions by 23-59%. Offer flat fare.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	1) Reduced travel time by an average of 33%. Reduced accidents by 30%. 2) High customer satisfaction (an average approval rating of 8.2 out of 10, and 6% of passengers reported having switched from using cars since MetroBus was opened.)		+				

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15	Portland Streamline Program	Bus priority, bus system improvement	Improved transport choice		Installed transit signal priority at 275 intersections and signal priority emitters on buses; installed curb extensions; consolidated bus stops; removed bus pull-outs; and improved service quality	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Ridership increased 16.3% from 1999 to 2005. The number of vehicle-hours to non-frequent service routes decreased 2.4% and ridership on these routes decreased 0.7%. Gained 12000 additional weekday bus riders, contributing \$1.7 million more revenue.		+				
16	Bus Rapid Transit in Johannesburg, South Africa	Bus Rapid Transit	Improved transport choice		Encouraged by the city's successful bid to host the 2010 Soccer World Cup, South Africa. 78 stations and a total length of 120 km. As of May 2010 there were 143 buses operating. These are new buses that comply with the latest environmental and comfort standards.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
17	Santiago, Chile Transantiago	Bus system improvement	Improved transport choice		It was introduced on February 2007, replacing the previous transit system that had thousands of independent bus operators with hundreds of new, large-capacity buses operating on bus-lanes with comfortable shelters at stops.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Poor customer satisfaction during the first few months of operation, irregular headways, long queues outside bus stops, crowding during peak hours.	Poor planning. Poor services during the first few months of operation. Inadequate service to peripheral neighborhoods that previously had direct bus services.	-				
18	Waterloo, Canada iXpress	Bus system improvement	Improved transport choice		33 kilometres of high quality bus routes that connect four downtowns, major university facilities, office complexes, major hospitals and regional shopping centres. Reduce transit travel times in the corridor about 25%.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Ridership increased 12% on the Northern Corridor and 62% on the Southern Corridor.		+				

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19	Ride-On Central California	Guaranteed Ride Home	Improved transport choice		Transportation Management Association for San Luis Obispo County in Central California, offers door-to-door Guaranteed Ride Home service anywhere in the area on weekdays between 8 am and 7 pm.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	The GRH Program has proven to be a significant benefit for employees.		+				
20	City of Albuquerque GRH Program	Guaranteed Ride Home	Improved transport choice		The program is offered to commuters that use any form of alternate transportation at least three times a week. Monthly bus pass purchasers are automatically registered for GRH. This service can be used up to five times a year for personal illness, family illness, unscheduled overtime or any other emergency that requires commuters to leave work or school.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
21	The Pennsylvania State University TDM Program	Guaranteed Ride Home	Improved transport choice		In case of an emergency (medical, disaster, or work related emergencies) for a rider or driver, GRH provides free transportation home via a rental car or taxi.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
22	Hughes Aircraft Back-Up Vanpool Program, Tucson, Arizona	Guaranteed Ride Home	Improved transport choice		Provides an emergency van only for vanpoolers during the day and after work. For after work service, employees must call the Hughes rideshare office before 4 p.m.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
23	Golden Gate Bridge District Flex-Pool Program, San Francisco, California	Guaranteed Ride Home	Improved transport choice		provides vanpool services for all commuters using District transit, vanpools, carpools or club buses in downtown San Francisco. Vans are owned by the District and driven by volunteer commuters in exchange for unlimited use of the van. Reservations must be made by 3:30 p.m.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							

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24	Montgomery County Government Subsidized Taxi Program, Montgomery County, Maryland	Guaranteed Ride Home	Improved transport choice		Provides county employees who use transit and carpool with reimbursement for taxi or transit use in emergencies.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
25	Denver Regional Council of Governments, Denver, Colorado	Guaranteed Ride Home	Improved transport choice		16,500 registered car-poolers who rideshare at least twice per week are eligible for two free taxi rides for emergencies over a 6-month test period.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
26	Xerox Company Fleet Car Program, Palo Alto, California	Guaranteed Ride Home	Improved transport choice		Rideshare patrons may use company cars in emergencies. Use is limited to two hours, though cars can be brought home and returned the next day.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
27	City of Bellevue Subsidized Taxi Service, Bellevue, Washington	Guaranteed Ride Home	Improved transport choice		Carpool, vanpool and transit patrons are eligible for the program. Applicants are given taxi vouchers good for limited mileage for one year. Users must pay for the cab themselves, then send in the voucher to the regional transit agency (Metro) and request reimbursement. Metro refunds the taxi fare less a \$1.00 co-payment.	Shift mode, reduce vehicle ownership	Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
28	Chattanooga's Downtown Electric Shuttle	Shuttle Services	Improved transport choice		Shuttle service is free. The Electric Shuttle provides the transportation link identified as one of the top goals for community development.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Partly lead Chattanooga to be one of America's most liveable cities.		+				
29	Urban Jitney Services	Shuttle Services	Improved transport choice		Private companies provide "jitney" shuttle van services in several major U.S. cities. Some jitney services are approved by regulators, others are technically illegal but ignored by local officials because they provide useful services.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							

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30	Shuttles to Suburban Centers between Metrorail stations and nearby suburban retail/office/residential centers (Tyson's II and Fair Lakes)	Shuttle Services	Improved transport choice		Twenty-five passenger buses carry residents to the station, and employees from the station to the malls.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
31	Hop and Skip Shuttles in Boulder, Colorado	Shuttle Services	Improved transport choice		The "Hop" bus is a circulator Shuttle that makes a loop through central Boulder. The "Skip" bus makes regular runs on a major north/south arterial.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
32	Microsoft CTR and Connector Bus System	Shuttle Services, rideshare, telework, bike encouragement, technology	Improved transport choice, Travel choice information	incentives	Provide employees incentives to use efficient travel options since 1995 including: Flex Pass, rideshare matching and preferred carpool parking (2,100 stalls), vanpools (more than 1,150), telework, bike parking (1800 stalls), commute website, "Real Time" ride matching, active parking management, and free connector bus services from 2007.	Shift trip time, shift mode, reduce vehicle trips	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	94% on time performance, gained average 3650 riders per day, ridership increased significantly during 2008 due to fuel price increase, over 60% riders had not previously commuted by public transit.		+	High	Medium	High	High
33	Fred Meyer Vanpools: One-Stop Commuting	Shuttle Services	Improved transport choice		When the I-5 bridge over the Columbia River closed for repair in 1997, the Fred Meyers corporation established a vanpool program to help their employees get to work in Portland.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	High customer satisfaction.		+				
34	San Francisco bike-transit integration program	Bike/Transit Integration	Improved transport choice		BART provides 4313 bike parking spaces. Caltrain's 32 suburban rail stations offer 400 bike racks and 1100 bike lockers. 5 bike stations with 659 bike parking spaces at BART and Caltrain stations.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	The percentage of public transport trips combine with cycling tripled since 1990.	Difficult for cyclists to get across some areas in the city during particular time periods because of the road use regulation. Caltrain denies boarding to cyclists sometimes.	+				

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35	Portland bike-transit integration program	Bike/Transit Integration	Improved transport choice		All buses have bike racks, all TriMet LRT stops and transit hubs provide 670 bike parking spaces, 15 downtown locations provide bike lockers which are close to light rail or bus stops.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		Bike parking spaces are lack of good quality and quantity, poor design of access to stations by bike, LRT denies boarding to cyclists during peak.					
36	Vancouver bike-transit integration program	Bike/Transit Integration	Improved transport choice		All buses have bike racks, 660 bike parking stations in bike racks, 400 secure bike lockers at most Sky train and all West Coast Express stations.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		Bike parking spaces are lack of good quality and quantity, need more capacity on SkyTrain to accommodate cyclists.					
37	Minneapolis bike-transit integration program	Bike/Transit Integration	Improved transport choice		All buses have bike racks, 271 bike parking spaces and 226 bike lockers next to Metro Transit stops. Bike station is 1/10 of a mile from the Chicago and Lake Street transit hub.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		Bike racks are needed at four more LRT stations, lack of bike paths and lanes leading to train and bus stops.					
38	Chicago bike-transit integration program	Bike/Transit Integration	Improved transport choice		All CTA and PACE buses have bike racks, bike parking spaces at most CTA and METRA suburban rail stations, provide largest bike station in USA with indoor parking for 300 bikes right above two rail stations.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		CTS subway is old with limited ADA facilities, flights of stairs make it difficult to bring bikes on board.					
39	Toronto bike-transit integration program	Bike/Transit Integration	Improved transport choice		All TTC buses and GO Transit buses have bike racks, 1771 short-term bike parking spaces and 114 bike lockers at TTC and GO Transit stations, new bike station at Union Station with secure, sheltered parking for 200 bikes.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		No bikes allowed on rail transit during peak hours, lack of elevations in many stations, lack of bike parking and secure lockers at stations, no coordination of bike routes with transit stops.					

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40	Washington, DC bike-transit integration program	Bike/Transit Integration	Improved transport choice		All WMATA buses have bike racks, 1800 bike racks and 1300 bike lockers at Metro stations, bike station for 150 bikes opened at Union Station.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.		Restricted bike access to Metro during certain hours, bikes restricted on VRE and MARC suburban rail.					
41	Seattle Metro bike-transit integration program	Bike/Transit Integration	Improved transport choice		All buses have bike racks.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	More than 40000 cyclists use racks each month.						
42	British Columbia bike-transit integration program	Bike/Transit Integration	Improved transport choice		Provide bike storage lockers at many transit stations and park-and-ride stops, increase the number of bike racks on buses.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.							
43	Los Angeles MTA bike-transit integration program	Bike/Transit Integration	Improved transport choice		All buses have bike racks. Work with bicycle committee to determine the most appropriate bus routes.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.							
44	Denver's New Light Rail	Light Rail	Improved transport choice		Opened a new southwest light-rail line in 2000.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	Ridership is 32% more than the expected first-year ridership.		+				

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45	Seattle, Way-To-Go Household Car Reduction Program	Incentivizing individual to take actions for efficient transport	Positive pricing	incentives	Seattle's Strategic Planning Office paid the participating families \$85 per week for keeping a daily diary of their transportation activities and expenses during the six weeks that they did not use their extra cars.	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Enhances physical, mental, and emotional health.	1) The 23 families in the pilot program made nearly 200 fewer car weekly trips totaling 1,260 miles of travel avoided. 2) At least four families decided to sell the car.		+	High	Low	High	Medium
46	Ottawa-Carleton Region, TravelWise Website	Website to provide multiple travel choice information	Travel choice information		Provide a one-stop, on-line source for complete information about multiple modes such as walking, cycling, carpooling, public transit.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use.				Low	Inconclusive	Inconclusive	Low
47	Australia, TravelSmart programs	Encourage people to use alternatives to their private cars.	Travel choice information, positive pricing		National travel behaviour change project.	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Enhances physical, mental, and emotional health.	1) The pilot project in South Perth in 1997, resulted in a 14% reduction in car travel, a 16% increase in walking, a 21% increase in public transit use, and a 91% increase in cycling. 2) These changes in travel behavior were found to continue when measured one and two years later.		+	High	High	High	High
48	Toronto, Pollution Probe's annual Clean Air Commute challenge	Encourage employees to use alternatives to their private cars.	Positive pricing	incentives	VIA Rail upgrades, free passes, and other valuable coupons were distributed to all Clean Air Commute participants. A draw was held for over 100 prizes related to resource-efficient commuting, such as bikes and accessories, transit passes and in-line skates. Companies sometimes supplied their own giveaways for employees as well.	Shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Enhances physical, mental, and emotional health.	The pilot study participants were significantly more likely to have taken public transit (four times as often), bicycled (five times as often), walked or ran to work (seven times as often),		+	High	High	Medium	Medium

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49	America, National Bike to Work Month	Cycling promotion: sponsor cycling activities during the month and produce organizer's kit to help promotion.	Positive pricing, improved transport choices	Support and engagement	The League of American Bicyclists has declared May to be National Bike Month since 1956. The League also promotes Bike to Work Week and Bike-to-Work Day. They invite communities, corporations, clubs, and individuals to join in sponsoring bicycling activities during the month of May. The League produces a National Bike Month Event Organizer's Kit to help individuals and organizations that promote these events.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	According to a study by Piatkowski et al. (2014), among the 1000 survey respondents, the bike ridership has experienced a modest increase after the event. But the long-term impact on behaviour is inconclusive.		+	Low	High	Inconclusive	Low
50	Vienna, Munich, and Zurich car-free pedestrian zones	Walking promotion: car-free pedestrian zones	Improved transport choices			Shift mode, reduce vehicle trips, reduce vehicle ownership	Environmental protection. Enhances physical, mental, and emotional health.							
51	Munich, Berlin, Hamburg, Vienna, and Zurich bike route networks	Cycling promotion: expand bikeway networks, on-road bike lanes, bicycle priority streets	Improved transport choices			Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.							
52	Hamburg and Berlin, bikesharing	Bikesharing	Improved transport choices		Hamburg and Berlin have 129 and 130 docking stations for bikes	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium

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53	Munich, bikesharing	Bikesharing	Improved transport choices		Free-floating system without docking stations, where bikes can be returned to any major intersection in the middle ring of the city	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium
54	Zurich, bikesharing	Bikesharing	Improved transport choices		Free of charge, and offers a variety of 300 bicycles, including e-bikes, cargo bikes, and bicycles with children's seat	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium
55	Vienna's, CityBike system	Bikesharing	Improved transport choices		Offers 1200 bikes at 96 docking stations.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium
56	Paris Vélib, bikesharing	Bikesharing	Improved transport choices		Initially had 10,000 bicycles with 750 automated rental stations. Within two years this had grown to 20,000 bicycles and 1,450 stations, about 1 station every 300 m throughout the city centre. As of July 2014, Paris's Vélib had the greatest market penetration with 1 bike for every 93 habitants.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium
57	Hangzhou, Public Bicycle	Bikesharing	Improved transport choices		Launched in 2008. Initially, the network consisted of 2,800 bikes with 30 fixed stations and 30 mobile stations. Now the Hangzhou network has exploded to 66,500 bikes and 2,700 stations.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium

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58	America, Capital Bikeshare	Bikesharing	Improved transport choices		The second largest bikesharing program in America. Beginning as SmartBike DC in 2008, the network now features over 300 stations and 2500 bikes.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	1) 4 in 10 respondents made a trip that they would not have made without bikeshare. 2) Each member saved \$800 in transportation costs on average. 3) 50% of members report driving a car less often. 4) 5% of members report selling a car since joining Capital bike share and 80% of this cohort claims joining bike share was a factor in their decision to sell.5) The annual average reduction in vehicle miles traveled is 198 miles per member.	+		High	High	High	High
59	California, Employee Bicycle Travel Reimbursement Program	Cycling promotion: employers offer employee travel reimbursement for cycling	Positive pricing, improved transport choices	incentives		Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Low	Low	Low
60	Nottingham, Cycle-Friendly Employers' Project	Cycling promotion: improvements and incentives to encourage bicycle commuting	Positive pricing, improved transport choices	incentives, engagement and support	Implemented in 1996 including a number of improvements and incentives to encourage bicycle commuting, such as cycle mileage allowances for short journeys (15 pence per mile), company pool bikes, public information, promotion, and a Bicycle Users Group to provide feedback from participants.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	Employers reported an increase in cycle commuting. More employees cycle more often. The program is credited with increasing cycle commuting in the region by 19.5%, during which areas without such programs had a small decrease in bicycle travel.		+	High	High	High	High

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61	Copenhagen, Free Bike Program	Bikesharing: Free City-Bike Program	Improved transport choices		1000 specially designed free City-Bikes were stationed at 120 stands around the city. For a deposit of only 20 Dkr. (US\$3), anyone can take a bike and cycle wherever they want, within downtown (restricted area). There are now more than 2,000 bikes in the program.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.				Low	Inconclusive	High	Medium
62	Buena Park, California, Employer-Funded Commuter Bikes	Cycling promotion: give new bikes to employees who commute to work 3 out 5 days for 6 months. Commuters who use their own bikes are given \$300.	Improved transport choices, positive pricing	incentives	Apple Computer provides free use of mountain bikes for employees at its Cupertino, CA, facility. The chemical company Ciba-Geigy was able to avoid building a new garage at a facility in Switzerland by encouraging its employees to ride to work. Any worker willing to give up his or her parking space was given a new bicycle, an option 230 employees chose.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity. Enhances physical, mental, and emotional health.	10% of the plant's 480 workers now commute regularly by bicycle, helping Nabisco satisfy the Los Angeles area's anti-pollution rules.		+	High	Medium	Medium	Medium
63	Swiss, Transit Ridership	Public transit encouragement: provide suitable incentives	Positive pricing		Provide high quality service and suitable incentives (high fuel prices and limiting downtown parking supply), and Transit-Oriented Development	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Switzerland maintains high per capita public transit ridership and low automobile mileage		+	High	High	High	High
64	The Greater Manchester, Journey Planner	Journey planning website	Travel choice information		An automated website that provides comprehensive regional transport information. Users input their origin, destination, travel time and preferred mode, and immediately receive a recommended itinerary, complete with transit schedule.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Medium

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65	Châteauroux, France, Free transit	Public transit encouragement: free public transport	Positive pricing	incentives	Eliminated local public transport fares and expanded service in 2001.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Total transit ridership approximately tripled from 21 to 61 annual trips per capita.		+	High	High	High	High
66	New York City, Fare Discounts and Smart Cards	Public transit encouragement: provide suitable incentives and discounts	Positive pricing	incentives	In 1997 the New York City transit system shifted from a token system to a smart card system called MetroCard, introduced free transfers between various transit modes and companies, a 10% bonus for purchases of \$15 or more, and other discounted payment options.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	In the following years, transit ridership increased about 30%		+	High	High	High	High
67	The Hague, Real Time Information	Installation of monitors providing real-time information on tram arrival stops	Travel choice information			Shift trip time, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	The perceived wait time decreased by 20%, and that this likely to increase transit ridership.		+	Low	High	High	Medium
68	New York City, Trip Planner	Public transit navigation system	Travel choice information		A public transit navigation system that provides information on routes, schedules and fares, aerial and three-dimensional views of the city, and walking directions from a subway stop to a destination, in a format that can be viewed by computers and mobile telephones, and produce printed maps.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Medium

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69	California, Youth Transit Pass	Public transit encouragement: provide suitable discounts to young people	Positive pricing	incentives	Purchase of the pass gives people under 17 unlimited access to buses (as well as light rail in 1999) throughout San Mateo County in California and along an 80-mile corridor in Utah from June through August.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Passholders use their pass an average of 30 times per summer. The pass provides highly valued independence for teens, while at the same time reassuring parents as it gives teens access to a wide range of activities during the day when parents are generally unavailable to provide transportation.		+	High	Medium	Inconclusive	Medium	
70	Connected Bus	Connected bus	Travel choice information		The Connected Bus incorporates the following technologies and services: A mobile router network that integrates various on-board electronic systems, such as engine monitoring, payment, security, GPS, driver communications, etc. Integrated transit priority with traffic signal networks, improving transit service speeds. Real-time arrival information and passenger counts to help fleet managers ensure adequate capacity; addresses loading conditions and bus-to-bus transfers. On-board personal computers with touchscreen monitors, allowing transit riders to obtain transit service information and contact friends. Electronic payment systems, making transit travel more convenient and reducing dwell time. Prominent display of on-bus, real-time information, including status of connections at key transfer points. Allows riders to reach their destinations more reliably. "Green" programs, which increase the reward for new riders who have switched from driving by offering data counts of environmental benefits per rider. Helps the SFMTA comply with Federal Transit Administration (FTA) standards regarding regional and national interoperability.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.								

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71	Melbourne, Myki Fare Card System	Public transit encouragement: provide suitable discounts, convenience and high-quality service	Positive pricing	incentives	Myki is an integrated smart card ticketing system in the Melbourne, Australia region. It is designed to make public transport use easier and more convenient. It integrates information, ticketing and services. Offer discounted off-peak fares, free Sunday travel for Seniors, a Sunday Saver ticket, and a weekend pass	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	High	Medium
72	San Francisco, Commuter Check	Public transit encouragement: provide suitable incentives	Positive pricing	incentives	Commuter Checks are purchased by employers as either a company-paid benefit or by using pre-tax employee paid contributions.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	1) The program was expanding by approximately 35% a year, and since the pre-tax employee-paid option became available in June 1998, the rate of growth has exceeded 100%. 2) Surveys indicate significant user appreciation of this service, and that it increases transit use.		+	High	High	High	High
73	NextBus	Public transit navigation system	Travel choice information		NextBus combines GPS data with predictive software to give public transit passengers accurate arrival time predictions for the next few vehicles, accessible through the Internet (including mobile telephone screens) and bus stop signs.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Overcome unnecessary waiting in public transit use. Allows users to decide whether to rush to a bus stop, wait, or choose another route or mode.		+	Low	Inconclusive	Inconclusive	Low
74	RideScout	Multi-modal navigation smartphone application	Travel choice information		Aggregates multimodal travel options into a single interface. Users can identify which mode is best suited for their given circumstance. The app also features real-time information, journey planning tools and a notification service that sends users a ping when it's time to leave for to catch the bus or train.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Low

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75	Portland, Trimet Trip Planner	Multi-modal trip planner	Travel choice information		In 2011, it was the first US transit agency to produce a trip planner that combined walking, cycling and transit direction into sequential journey. The planner also features an elevation chart, to accommodate a user's cycling preferences and carshare locations.	Shift trip time, shorter trips, shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Low
76	Rideshare Online	Ridesharing	Improved transport choices		The first self-serve, regional public Internet ridematching service in the nation. Instantly matches commuters with carpool or vanpool partners with a similar daily commute in nine Puget Sound area counties, including King, Pierce, Snohomish, Kitsap, Thurston, Island, Mason, Skagit and Whatcom counties.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Low
77	RideQuest	Ridesharing	Improved transport choices		A ridematching Internet site provided by the Greater Redmond Transportation Management Association. Users enter a street address or intersection, and the software produces a map showing that location. If the location is correct, it is entered into the database along with information on the users travel needs and preferences. They can send an automatic email to other registered commuters who may be able to rideshare.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Low

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78	Dynamic Ridematching, e.g. Los Angeles SmartTraveler, Bellevue Smart Traveler, Seattle Smart Traveler	Ridesharing	Improved transport choices		Rideshare programs that match riders for individual trips, rather than a series of regularly scheduled trips, and provides information quickly and conveniently to help drivers and riders connect.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	Inconclusive	Inconclusive	Low
79	Puget Sound Telecommuting Demonstration Project	Telecommuting	Flextime/Telcommuting		Initiated in 1990 by the Washington State Energy Office (WSEO). It included 25 public agencies and private firms in the Seattle area. These groups signed a memorandum of understanding that outlined the projects policies and procedures. WSEO staff provided assistance to employers in establishing telecommuting programs.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.	1) Most participants telecommute an average of one day a week.2) Benefits by teleworkers included increased job satisfaction, enhanced performance, and greater flexibility.3) An average of 26 fewer annual commute trips were recorded.	1) Job security. 2) Less visible in the office. 3) Lack of adequate equipment.	+	High	Low	High	Medium
80	First Interstate Bank, telecommuting	Telecommuting	Flextime/Telcommuting	incentives	Most telecommuters work from home, but a few work at telework centers. Some equipment is provided by the bank, and business-related telephone calls are reimbursed.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.	1) Supervisors report increased productivity and less time off. 2) Telecommuters report fewer distractions and greater flexibility in balancing home and family responsibilities.		+	High	Low	High	Medium
81	TRW, telecommuting program	Telecommuting	Flextime/Telcommuting	Competition	More than 1,000 employees in Orange County, California participated. Governed by guidelines that identify the responsibilities of all groups and establishes ground rules for participating in the program.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.	Reduced stress, increased productivity and reduced vehicle travel.	Information access and security for telecommuters	+	High	Low	High	Medium

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82	State of Arizona, telecommuting Program	Telecommuting	Flextime/Tel ecommuting	Information	Allowed telecommuting since a pilot project was established in 1989. The program includes policies and information materials to promote telecommuting within all state agencies. The program has expanded, and has a goal that 15% of state agency personnel participate in some type of telecommuting.	Shift trip time, reduce vehicle trips	Reduces peak period traffic. Shifts peak to off-peak periods. Improves access, reduces the need for travel. Reduces total traffic.	Positive feedback from telecommuters and supervisors.		+	High	Low	High	Medium
83	Alameda County, Congestion Management Program	Public transit encouragement: provide suitable incentives to employees	Positive pricing	incentives	Four employers provide financial incentives to encourage reduced driving.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	Reduce automobile commute trips by 16-20%, and significantly more if combined with other TDM strategies.		+	High	Low	High	Medium
84	UK, Tax Policy Supports Commute Trip Reduction Programs	Public transit encouragement: provide exempt from UK income tax and employment insurance	Positive pricing	incentives	Since 1999, the following are exempt from UK income tax and employment insurance: Buses of 9 or more seats used mainly to bring employees to and from work. Subsidies to public bus (but not rail) services used substantially for commuting. Bicycles and cycling safety equipment. Workplace parking for bicycles and motorcycles. Alternative transport for car sharers to get home in exceptional circumstances. A cycling business mileage allowance of up to 12p per mile.	Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.				Low	High	High	Medium
85	Intel Corporation, incentives	Public transit encouragement: provide free transit passes to employees	Positive pricing	incentives		Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.	The company receives a significant discount on transit pass prices, plus state and federal tax credits.		+	High	Low	High	Medium

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86	HOV facilities in U.S. cities	HOV Priority	Improved transport choices			Shift mode, reduce vehicle trips, reduce vehicle ownership	Congestion reduction. Road and parking savings. Consumer savings. Environmental protection. Efficient land use. Improve equity.							
87	U.S. cities (Austin, El Paso, Tucson, New York City), Metropia	Incentivising car driver to take actions for congestion and emission reduction	Positive pricing	incentives	A mobile phone-based navigation app. Find the optimal time to leave origin and arrive at destination in as little time as possible. It gives reward points (redeemable at local stores) for drivers who plan trips in advance. Drivers get more reward points by carpooling. After the end of each trip, the app shows the amount of emissions as well.	Shift trip time and make drivers environment conscious	Congestion reduction. Environmental protection. Improve equity. Could potentially reduce peak period traffic.	Not available yet, as the app is more like a start-up, which took off recently. One more concern is the lack of clear explanation of how the reward points work. If a driver drives his/her car for longer distances than usual in order to get more reward points, is he/she serving the cause of the app?	The reach of the app is low although it was launched in 2014. People have concerns regarding reward points (not being consistent), road closures (not updating frequently in the app), suggesting longer routes, etc.					
88	Australia, Clearways (an Australian startup based in Sydney)	Incentivising drivers to change driving habits	Positive pricing	incentives	Clearways is a transport technology startup in Sydney. Clearways is going to launch a platform for smart mobility – empowering people to make the smartest possible choice for their transport needs. The objective of Clearways is to reward people for changing their driving habits.	Change in driving habits	Change in driving habits	Not available	Not yet implemented					
89	Skedgo and its subsidiary TripGo (Australian startup based in Sydney)	Personalised trip planning and mobility	Information provision and improved choice	Bundling, Defaults	Skedgo focusses on personalised trip planning by bundling payment options for various modes. Uber Australia partnered with Skedgo to complement its ridesharing trips with public transport routes. Skedgo has plans of rewarding PT users with some x amount of free parking. The app also shows the amount of emissions by taking each option.	Look for more travel mode options and make drivers environment conscious	Environmental awareness. Less hassles for payment.	Not available	While the real-word issues are not known yet, the app has been criticised for being buggy. However, the overall avg. rating on Google playstore is 4.2					

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90	Piano stairs, Stockholm and Melbourne examples	Encouraging walking	Improved choice	Design	This novel approach has been trialled in a number of locations. In Stockholm, Metro station stairs covered in 'piano keys' that played as people walked up the stairs to encourage people to walk instead of using the escalator. (This was only a one-day intervention and unlikely to result in sustained changes in behaviour). A similar project was implemented for a week on stairs at Southern Cross Station in Melbourne.	Prompts and fun make stairs the preferred choice but no measure of how long this would last. Could be incorporated as one component of a follow-on campaign.	Promotion of walking	66% more people used the stairs on the day the piano stairs were installed. No extended intervention or evaluation of ongoing changes in behaviour. No evaluation or impact study has been published.						
91	Love Living Local, City of Darebin	Pedestrianisation	Footpath stencils (prompts), pedestrian wayfinding (prompts and timely information, also building social norms), newsletters for residents, kits for new tenants, a 'Transport Café' stall (relevant and timely information). Strategies for making walking easier included an incentive-based home delivery service for groceries so that people didn't need to drive to the local market.	Design	Project focused on reducing car use for local trips to neighbourhood centres. Had a wide audience and was well received within the community. Utilised a broad range of behaviour change interventions focusing on shopping trips. Delivered over three years.	Mode shift from driving to walking	More walking trips	Process evaluation, no outcome evaluation data available. Unable to determine whether there were measurable increases in walking.						

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92	Greenlight Project, City of Port Phillip	Pedestrianisation	Nudge approach in adjusting the local context to make it easier to walk. Reduced hassle of multi-stage crossings for more people. Removed barrier for those unable to cross within allocated time. Automatic phasing of pedestrian green light reduces 'friction cost' of walking.	Design	Increasing pedestrian signal phasing and reducing waiting times to improve safety. Aimed to reduce unsafe crossings on red lights and provide additional crossing time, benefitting people at a slower walking pace (important for children, people with disabilities and older people). Sub-goal to increase walking trips by making local walking easier	Mode shift from driving to walking	More walking trips	Project evaluation showed safety improvements. Supported related behaviour change projects of walking school bus.						
93	Try Walking, City of Boroondara	Using technology	Prompted self-monitoring and goal setting by recording walking information. Received timely feedback on walking distances and times. Wayfinding and capital works reduced 'friction costs' of walking by making it more direct, informative and pleasant.	Support, engagement and social gaming	Focusing on the Camberwell activity centre, residents were encouraged to replace short driving trips with walking. Residents logged their walking journeys on a smartphone app. The app measured changes in walking activity following infrastructure upgrades in key locations.	Mode shift from driving to walking	More walking trips	140 people participated; 88% walked more often and 64% drove less. Significant increases in walking on upgraded streets.						

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94	Geelong Active City, Healthy Together Geelong, City of Greater Geelong	Walking promotion	High participation rates by using opt-out (every employee invited to participate). Coaching and goal setting to get people started and to set specific actions; identified intrinsic motivation. Used social networks as support	Support, engagement and social gaming	1,200 employees and 1,000 residents engaged to become more physically active, including use of active travel. Large-scale intervention delivered over 12 months. Phone-based coaching intervention supported by referrals to local services and facilities.	Mode shift from driving to walking	More activity and walking trips	Evaluation against a control group: 8.6 minute increase in average daily activity (20% increase in activity). 40% of people choosing more walking (for exercise).						
95	Liverpool Hospital workplace travel plan, NSW South West Primary Health Care Service		Positive pricing	Incentives	Workplace travel plan for 3,000 staff aimed to reduce private car trips to work. Multiple interventions undertaken, with a focus on personalised journey planning, end of trip facilities, subsidised public transport tickets. Events and active travel campaigns. Delivered over three years.			Evaluated outcomes (statistically significant) using travel survey data: 5% reduction in car trips and associated increase in walking and cycling trips.						
96	Infosys Technologies, Bangalore, India	Incentivisation to shift to earlier arrival times	Positive pricing	Incentives	Each participating commuter received credits for swiping in at work either before 8 a.m. (1.5 credits) or between 8 and 8:30 a.m. (1 credit). At the end of each week participants with at least 3 credits participated in a draw to select winners who received cash.	Shift trip time	Reduction in congestion; punctuality among employees; more productivity because of early morning work	Over the six months of the experiment the number of bus commuters who arrived before 9 a.m. increased by almost 30%. This field experiment provides a high degree of external validity.						

No.	Case Study	TDM Strategy	Mechanism	Nudging Mechanism	Description	Intended Changes to Travel Behaviour	Expected Impacts	Actual Impacts	Issues during implementation	Change	Quality of evidence	Size of impact	Temporal stability of the impact	Final
97	Field experiment in Singapore (INSINC)	Incentivisation to shift PT users from onpeak to off-peak	Positive pricing	Incentives	The incentives used are based on earning credits for each trip taken during weekdays for both on-peak and off-peak travel, but the off-peak trips earn 3 times the credits of on-peak trips.	Shift trip time	Reduction in peak hour congestion	The authors report a 10% shift from on-peak to off-peak travel.						
98	Forced experimentation of alternate routes in London because of underground tube strike		Improved transport choices (but just by chance)	Explore	A strike on the underground forced many commuters to experiment with new routes, brought lasting changes in behaviour. This effect is stronger for commuters who live in areas where the underground map is more distorted, which points to the importance of informational imperfections.	Consider other choices		About 5% of commuters found a better route to work thanks to the strike. T						
99	Santander cycles (formerly Barclays cycle) hire scheme in London	Bikesharing	Improved transport choices		Having previously relied on unsubtle messages telling people that cycling to work was good for them and the environment, TfL changed its plan. Instead of spending millions on messaging, it invested in creating a bicycle hire scheme that enabled behavioural change rather than telling people to alter their habits.	Shift mode, particularly for short trips		A study showed cyclists using the scheme are three times less likely to be injured per trip than cyclists in London as a whole, possibly due to motorists giving cycle hire users more road space than they do other cyclists. Moreover, recent customer research showed that 49 per cent of Cycle Hire members say that the scheme has prompted them to start cycling in London.						

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100	Bike to work in Dublin	Cycling promotion: sponsor cycling activities to work	Positive pricing; improved transport choices	Incentives	Government initiative offering tax free bikes for cycling to work. Using the Bike to Work scheme, the employer helps to obtain a brand new bike and safety equipment worth up to €1,000. It saves up to 51% of the cost of a bike and accessories									
101	City Mapper	Personalised trip planning and mobility	Information provision and improved choice	Bundling, Defaults	Citymapper is a journey planning service integrating data for all urban modes of transport, from walking and cycling to driving, with an emphasis on public transport. It is currently operated in several cities around the world, including Sydney and Melbourne	Look for more travel mode options		Not available	The App has more than 50,000 downloads on Playstore and the avg. rating is 4.5					
102	Sydney trail (behavioural insights team of NSW and TfNSW collaboration)	Flexitime	Improved transit choice	Social competition and changing defaults	Changing default settings in Microsoft Outlook calendars. Prompting managers to discuss and model flexible working. Using a competition to disrupt habits.	Shift trip time			Organizational culture is often resistant to change. Employees report that they are worried about being negatively judged by their managers if they ask for flexible hours, despite most managers saying they would view it positively.		High	Medium	High	High