Driving Change

Applying Behavioural Insights to Improve Air Quality on the UK’s Strategic Road Network

A report by The Behavioural Insights Team for Highways England

Report 1 of 2. January 2018

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Report 1 of 2 (This report)

- Project Introduction
- Part I – Drivers of Behaviour and Routes to Change: 6 Lessons in Behavioural Science
- Part II – A Review of the Literature on Behaviour-Change in Transport

Report 2 (separate publication) will include:

- Prioritisation of behavioural objectives
- Behavioural drivers & barriers and segmentation exercise
- Intervention longlist and recommendations
- Implementation and evaluation strategies
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Executive Summary

Introduction and purpose of the project

Poor air quality in the UK is estimated to cause 40,000 early deaths per year, with vehicle exhaust emissions and particulates from brakes and tyres being a major contributor to these adverse health effects. Highways England face the challenge of beginning to address this issue on the UK’s Strategic Road Network (SRN) through a range of infrastructure and policy solutions. This report focuses on the use of behavioural insights – findings from psychology, behavioural economics and the wider social sciences – to help inform those solutions. This includes:

- Ensuring that conventional policy tools, such as road pricing, speed compliance, and infrastructure changes, are ‘behaviourally informed’. By drawing upon behavioural insights, and designing policy to go with the grain of human nature, the chance of such policies having the desired impact on road-users’ behaviour increases;
- Exploring the use of more novel behavioural interventions, including nudges, to help support and encourage drivers, fleet operators and other stakeholders to pursue less polluting transport choices and behaviours; and
- Thinking about how public consent emerges and how communities can be best engaged to ensure interventions are publically and politically acceptable.

This report is the first of two publications. It provides:

Part I: Drivers of behaviour and routes to change – six lessons in behavioural science. A detailed overview of relevant behavioural insights concepts, drawing from psychology and economics and focussing predominantly on research relevant to pro-environmental and health behaviour-change initiatives; and

Part II: A review of the literature on behaviour-change in transport. A detailed review of the literature specific to transport behaviour to identify what works, what doesn’t, and why.

The logic behind this two-part approach is to equip readers with a detailed understanding not only of the existing literature in transport research, but also a more fundamental grasp of approaches to behaviour change and public engagement. This output will inform the second phase of the project to be published in a final report, which will identify a longlist of potential behavioural objectives, prioritise them (based on their potential impact and feasibility), and present a range of possible behavioural interventions with robust implementation and evaluation strategies.
Part I: Drivers of behaviour and routes to change – 6 lessons in behaviour science

A common and intuitive assumption is that our behaviour emerges from deliberate intentions, as we make logical choices based on our beliefs, values, attitudes and preferences. This understanding of behaviour emerges from ‘rational choice’ models found in economics and psychology, and is reflected in conventional awareness and information campaigns, training programmes and product labelling. These approaches imply that we change behaviour by first changing people’s awareness and beliefs, or by activating certain values or attitudes. Certainly, these methods can sometimes have an impact. However they often overlook or go against key aspects of human nature. A far wider and more effective behavioural toolkit is available to policy-makers and campaigners, and Part I of this report outlines 6 key lessons from behavioural science. It takes findings from the wider environmental and health behaviour research and draws parallels to the air quality agenda.

Lesson 1: Changing attitudes and beliefs is difficult, but behaviourally-informed messaging can help.

We tend to stick to our existing beliefs and worldviews, seek out that which confirms them and validates our actions, and ignore or downplay that which challenges them. This makes it difficult to change peoples’ attitudes or beliefs around car ownership through conventional campaigns and information, though behaviourally informed approaches can sometimes help. A narrative of blame on drivers, or messaging which invokes guilt, is likely to be rejected. Instead, we should harness social influence and identity, emotion, and a strong narrative which resonates with, rather than threatens, our existing assumption or preferences. There is also greater need to be sensitive to the mental models with which we think about air quality, with the emotion of disgust having particular potential (though remaining relatively unexplored).

Lesson 2: Changing attitudes and beliefs isn’t enough to change behaviour, but it is sometimes possible to ‘close the gap’.

There is often a large gap between our stated values, beliefs and attitudes, and what we actually do. If we expect attitudinal or information-based interventions to have an impact, we must bridge this gap, which exists for several reasons. These include:

- Conflicting motivations, such as for low cost, convenience, comfort and enjoyment, often prevail;
- We may care greatly but lack self-efficacy, feeling we cannot make a worthwhile difference;
• It is common for our actions, particularly those which require a small personal compromise for the public or common good, to be socially conditional: we only act if others are, but self-interest may prevail leading to a tragedy of the commons.

• Even with sincere intentions, we often fail to act due to practical barriers (such as hassle or lack of availability), and psychological barriers (such as procrastination, forgetfulness, inertia, and lack of know-how).

There are various ways to overcome each of these barriers. This includes harnessing existing positive motivators rather than attempting to elevate weaker ones (for example promoting electric vehicles on the low running costs and reliability), and ensuring the promoted choices are readily available and convenient. Where non-compliance is an issue, for example with speeding, the use of social norms and acts of reciprocity to promote cooperation and pro-social actions has good potential. Where intentions exist but actions are not following (for example, in following a personalised travel plan, or driving more fuel-efficiently), it is often beneficial to remove frictions from processes, identify timely moments at which change is more likely (for example when moving house, job, or buying a new car), and use prompts, feedback and commitment devices (such as a public promise or league table among fleet drivers).

**Lesson 3: Much of our behaviour is driven by automatic processes, we think with heuristics and are subject to bias.**

Counter to the ‘rational choice’ hypothesis, we tend to employ ‘fast and frugal’ cognitive processes, for example drawing on emotion, automating much of our behaviour into habit, and using heuristics (simple rules of thumb) to made decisions. These processes leave us highly susceptible to influence from our social and physical surroundings, as well as subject to a range of cognitive biases: predictable deviations from the optimal outcome. This provides opportunities to use the choice architecture (the way in which choices are framed within their context) to encourage certain choices. For example, defaulting new employees into certain travel benefits instead of free-parking; re-framing state subsidies on electric vehicles as discounts or cash-backs to make them more salient; boosting public transport use with loyalty stamps harnessing ‘endowed progress’, and many more subtle changes to our choice architecture may contribute modest but worthwhile improvements.

**Lesson 4: Incentives can be very powerful, but they should be behaviourally informed.**

Financial incentives often work, but our response to them is often complex. For example, incentivising an action signals that it may be undesirable and deserved payment, thus undermining intrinsic motivations – it is for this reason that positive incentives for compliance with speed limits, for example, would potentially backfire. Similarly a fine can
provide a moral licence to continue with the discouraged behaviour, undermining the social norm of complying. These ‘crowding-out’ effects must be considered in the design of incentives. There are also a number of ways to increase the strength of incentives by drawing upon behavioural biases. For example, lotteries can be more effective than fixed financial incentives because we tend to overestimate small probabilities. Including lotteries with low-cost purchases (such as bus tickets) can therefore be economical ways to incentivise behaviours. It may also be possible to re-frame state subsidies to make use of ‘proportional price evaluation’, for example ‘we’ll give you £2,500 on top of market price for your old car’ is likely to be more appealing than a hidden discount in the price of an electric vehicle.

Lesson 5: We are social creatures.

We have a tendency to mimic those we identify with, to conform to social norms, and to reciprocate acts done to us. Car ownership and driving style have clear social aspects, linked to status, identity and their signalling value, and these aspects of human nature should be reflected in policy design. For example, compliance with rules can be increased by telling non-compliers that they are in a minority of people deviating from the norm. Messengers whom people find credible, likeable, and identifiable have greater influence: Highways England may be credible, but may not be as effective as a peer of cultural icon when promoting safe (and fuel-efficient) driving styles to adolescents, for example.

Lesson 6: It’s not all about behaviour-change, sometimes we want to increase public consent.

Though increasing awareness and understanding is often an inefficient route to behaviour change, sometimes we may want to improve public awareness for its own sake, for example to increase engagement or consent for a policy intervention such as air quality barriers, speed limit changes or fuel duty increase. With this in mind, much can be learned from the world of planning, in which community engagement and objections are longstanding areas of research. Here the evidence shows that people value a sense of agency and influence, and so giving the community genuine say over decisions in a constructive manner can be beneficial (contrary to many planning systems where objecting is the only way to have a say). There may be particular merit in the idea of deliberative forums to consider air quality policy. Deliberative forums are jury-like public forums, formally engaged in the policy-making process and helping to generate a clear mandate and novel solutions to challenges that have complex trade-offs and aspects of contention.

Perceived fairness of procedure is also often as important as perceived fairness of outcomes. For example, though many drivers may resent paying higher fuel duty, hypothecating the revenue to improve roads, or tackle climate change, may help. Often
consent emerges after-the-fact, as our initial risk-aversion and uncertainty-aversion (which favour the status quo) fade after we have experienced the change.

**Part II: A review of the literature on behaviour change in transport.**

This part reviews the academic and policy literature on transport behaviour, which can be split into 4 broad topics:

1. Modal shift;
2. Purchasing decisions;
3. Driving style; and
4. Traffic management.

**Modal shift**

The UK is largely dominated by private car use, and this presents a number of challenges to mode shift: our infrastructure is broadly geared toward drivers, and though good alternatives exist in some parts of the country, often they cannot compete on the metrics which consumers care most about. This includes cost, ease and convenience, flexibility, and comfort. Though behavioural interventions such as personalised-travel-plans (PTPs) sometimes report modest impact, much of the research shows that there is rarely an easy or cheap approach to encouraging the uptake of alternative modes, unless the infrastructure is present and delivered to a high standard. Even road pricing, which can provide a strong disincentive to drive, tends not to be successful unless good, viable alternatives are present.

A number of psychological factors exacerbate these structural barriers to mode shift. For example we tend to be biased in our perception of costs, being quite poor at judging the total cost of driving (including depreciation, maintenance, fuel use, tax and insurance) compared to public transport where the full cost is simple and salient in the ticket price. This is especially true if we have a car already, where the sunk cost motivates us to use it on every journey, and it rapidly becomes the default choice.

Research shows that where viable alternatives to the car do exist, simple informational interventions may bring benefit if delivered at a timely moment, for example when people move home or start a new job. However, the evidence is mixed, with ample examples of where such interventions have had no impact, and generally quite weak methodological rigour across the discipline.

More substantive impact is often found with more structural interventions. For example, employers are in a relatively unique position of influence through the parking and other benefits they provide to employees. In the UK it is common to have (and expect) a free
parking space at work. However research shows that removing this benefit has a major impact on the rates of car use. Where employers not only stop providing free parking, but swap it for subsidised public transport, the impact can be profound. However this is context dependent: if other free parking exists nearby, or if alternative means are infeasible, this may not have the intended effect.

Behavioural interventions are therefore likely to be most effective to increase awareness and boost uptake of alternative means where the infrastructure is sufficient that public or active transport can compete with car use in cost, convenience, reliability and comfort.

**Purchasing decisions.**

There is strong evidence that structural barriers, including cost, infrastructure, and the capabilities of current technology, continue to be the dominant barriers to widespread uptake of electric vehicles. There are behavioural aspects to these, including some specific psychological details which may be well suited to the application of behavioural insights. For example, we are poor at considering the long-term running cost of vehicles, and as such the upfront cost is likely to be dominant in purchasing decisions compared to running and maintenance costs which make electric vehicles more competitive in the long-term. Moreover, concern over range limitations, charging infrastructure, long-term battery performance and resale value may be well founded, but are also likely to be exaggerated by our tendency for risk aversion and uncertainty aversion which bias us towards the familiar.

Beyond the electric vehicles, the remit of this project is also concerned with the purchase of also more efficient combustion vehicles and hybrids. Here some of the same issues emerge, particularly around cost, as new, more efficient vehicles upfront cost may not always be offset by significant savings in running costs. We are also quite poor at estimating these savings, and the non-linear nature of miles-per-gallons (as opposed to gallons per mile) further exacerbates this. It is also important to recognise that the majority of car purchases are through the second-hand market, and thus it takes several years for more efficient technologies to trickle-down into mainstream ownership.

As such, it can be concluded that there is a degree of inevitability to the transition to a cleaner fleet of vehicles, with conventional policy levers likely to be responsible for much of this change (such as the recently announced band on combustion vehicle sales in 2040). However there are areas which behavioural insights can contribute to in the more immediate term, including efforts to re-frame the cost benefits of more efficient vehicles, designing novel incentives, and addressing some of the uncertainty around range and longevity. Ultimately this will need to be supported by improvements to the supporting infrastructure.
Driving style

Differences in driving style have a significant impact on fuel use and emissions. This includes speed, harshness of acceleration and braking, lane-changing, and anticipation of traffic flow ahead. Changing our driving style is not easy, however, because it tends to be deeply ingrained in habit. Existing interventions have tended to use one of four approaches: informational and awareness interventions, training courses, in-vehicle feedback, and post-trip feedback.

Each of these approaches has certain advantages and disadvantages. To achieve habit change, information alone tends to be insufficient, though there are unexplored possibilities, for example harnessing particularly timely moments such as new births (when parents might be motivated to drive more safely, for instance). Training programmes appear to be somewhat effective when targeted at new drivers, since habits have not yet ingrained. Administratively, this also brings benefits of scale, whereas signup rates to post-test courses tend to be very low. If the goal is to target existing drivers, the recommendation would be to target fleets, since there appears to be greater scope to leverage stronger incentives (such as fleets operators’ higher fuel costs, or using social comparisons and league tables, shown to be effective elsewhere).

The use of in-vehicle feedback (telematics) holds a lot of potential, since habitual behaviours tend to require constant prompts to break, and the learning of new behaviours benefits from feedback against which to benchmark our improvements. Feedback in itself does not necessarily provide a motivation to change, and so telematics should not necessarily be seen as an intervention in their own right, but rather as the tool with which other motivators can be delivered (for example, using league tables, incentives or social comparisons among fleet drivers). Though post-trip feedback can achieve this, this depends on drivers’ knowing how to drive efficiently (either because they have an intuitive understanding of it, or because they have received training). Real-time, in-vehicle feedback can also be designed to teach by prompting specific actions.

Traffic management

Traffic management refers to a range of activities, including demand management, congestion reduction, and compliance with speed limits and other rules of the road. The link between congestion and air pollution is complex (for example, slow-moving traffic might produce less emissions than fact-moving traffic), though certainly the smoothness of traffic flow is beneficial. Sophisticated smart motorway systems are becoming increasingly common, using variable speed limits to smoothen traffic flow. Evidence suggests they tend to be effective, in some contexts, but only if road users comply. Increasing compliance is therefore
a key objective, and the same is true of static speed limits with pollution tending to rise significantly at speeds much over 70 mph. Social norms have been used to good effect to increase compliance with actions we are aware we should be doing anyway, but believe (often erroneously) that most people are not.

Other aspects of traffic management have received relatively little attention from an air quality perspective. Reducing overall demand (for example by promoting remote working), or smoothing the peak demand (for example by incentivising non-standard work hours) have great potential, with a small number of successful interventions showing that behaviourally-informed incentives can also be very effective.
1. Introduction

Poor air quality in the UK is estimated to cause 40,000 early deaths per year, with vehicle exhaust emissions and particulates from brakes and tyres being the major contributor to these adverse health effects. Meanwhile, road transport in the UK is one of the largest contributors to nitrogen–oxide emissions.¹

Clearly there is a need to rethink the way we travel, but as the UK transport network is largely designed around private car ownership there are no easy or quick solutions to these problems. UK policy is becoming more ambitious, for example with a recent announcement to ban the sale of new petrol and diesel cars by 2040.² Technological developments are also rapidly emerging with advances in battery design, and new models of mobility as a sustainable service, rather than as a practice of private ownership. However these developments are long-term, remain speculative and are likely to hit stumbling blocks in years to come – how do we avert shortages of rare materials used in battery tech, for example? And how will government respond to falling fuel-duty receipts, increased urbanisation, and the rise of autonomous vehicles (which might encourage us to drive further, not less)?

These are big questions, and often beneath them are questions about people and about behaviour. How can we encourage and support people to make more sustainable, less polluting transport decisions? Indeed, is this something people can simply choose to do? Why don’t we just stop driving to work and take the train? Or is this in fact a structural issue, in which case what can we do to shape our society, our infrastructure, and our policies in a way that takes us toward these goals?

Glossary

SRN – Strategic Road Network. The UK’s network of roads not under the direct jurisdiction of Local Authorities, including all motorways and most of the bigger A-roads. Covers 2% of roads by length, but 30% by vehicle miles, and 2/3rds of heavy goods vehicle mileage.

NOx – Nitrogen Oxides. A poisonous, highly reactive gas emitted when fuel is burned, particularly diesel.

PM2.5 – Atmospheric particulate matter less than 2.5 microns in diameter.

PM10 – Atmospheric particulate matter less than 10 microns in diameter.

VOCs – Volatile Organic Compounds, often irritable to the eyes and nose and a cause of headaches.

ICE – Internal combustion engine, used to refer to conventional petrol and diesel vehicles.

EV – Electric vehicle (entirely battery powered)

PHEV – Plug-in hybrid electric vehicle. A hybrid vehicle (battery and ICE) which can be charged by plugging it in, as opposed to drawing its charge from the ICE or regenerative braking only.

DfT – the UK Department for Transport

CO₂ – Carbon Dioxide. A greenhouse gas driving climate change.
1.1 Purpose of the project

Highways England have commissioned the Behavioural Insights Team (BIT) to begin to answer these behavioural questions, with a view to improving air quality in the UK. A lot of attention is often given to air quality within our towns and cities. However this project instead focuses on the Strategic Road Network (SRN), covering a small fraction of the UK’s roads but a much larger fraction of its vehicle miles. The SRN is mostly used for freight, commuting, business trips, holiday-makers and weekend trippers, as well as (though to a far lesser extent than on local roads) trips to the shops and school-runs. The report therefore focuses on both private vehicles and fleet vehicles, and a wide variety of driver types, journey types, potential motivations, barriers and opportunities.

The ultimate objective of the project is to provide implementation strategies for four well-evidenced behavioural interventions to improve air quality on the SRN. A number of steps are required to reach this goal, and will be delivered through two separate reports:

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<th>Objectives of this report</th>
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<td>• To provide a detailed overview of behavioural science in the context of pro-environmental and pro-health behaviour, in order to begin to understand what might be effective in promoting less polluting transport choices.</td>
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<td>• To provide a detailed literature review of the behaviour-change literature in the context of transport behaviour. This is split into four key themes: transport mode choice; vehicle purchasing decisions; driving style; and traffic management.</td>
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<td>• A thorough and non-systematic review of academic literature across the fields of psychology, behavioural economics, public health and sustainability.</td>
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<td>• An extensive review of academic, policy and commercial literature on transport behaviour.</td>
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<td>• 12 in-depth expert interviews with professionals working in transport policy, transport research and behaviour change. This includes representatives from UK and overseas government departments for transport, independent transport research organisations, leading academics in the fields of transport behaviour, mobilities, and sustainable behaviour, and other policy practitioners and behaviour-change specialists. The purpose of the interviews is to invite experts to share their knowledge about the extent to which different behaviours impact air quality and to get their views on what the most pertinent barriers to behaviour change are, and what motivations could be harnessed to encourage behaviour change.</td>
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Objectives of the second report

- To provide a systematic longlist/matrix of potential behaviour-change objectives that may be pursued to improve air quality on the SRN, alongside potential interventions, and metrics of impact, feasibility, and time-scale.
- To identify circa four priority behaviour-change objectives, and to undertake further in-depth exploration of each, identifying key barriers, opportunities, touch-points for intervention, and relevant consumer segments.
- To provide detailed intervention recommendations for each, and an outline strategy for the implementation and rigorous evaluation of the proposed interventions.

Methodology for the second report

- Further desk-based research to identify barriers, opportunities and potential touch points.
- Workshops and expert engagement to develop potential intervention ideas, drawing upon our EAST framework and the wider behavioural science literature (particularly that summarised in report 1)
- Development of a Theory of Change for each of the four behaviour change objectives.
- Development of a robust Trial Protocol for each, outlining the implementation and evaluation strategy.

1.2 What are behavioural insights and how can they help?

Behavioural Insights are research findings from psychology, behavioural economics, social anthropology and the wider behavioural sciences. They are insights into the way we behave, make decisions and choices, and are influenced by the world around us. The phrase ‘applying behavioural insights’ to a policy challenge, essentially means to apply a more sophisticated and realistic understand of human behaviour to the issue. Whether the policy area of interest is educational attainment, crime rates, pension savings rates, recycling, transport use or public health, most policy goals are ultimately about behaviour, and most public services are intended to be used by real people. It therefore stands to reason that policy outcomes can be improved by designing policies and services which go with the grain of human nature. The same can be said for explicit behaviour-change campaigns in public health and environmental issues, which can often also benefit from an injection of evidence-based behavioural science.

A common confusion is that ‘behavioural insights’ are ‘nudges’. The two are related but not the same: a nudge is a particular policy tool which aims to maintain freedom of choice whilst gently encouraging citizens to opt for the ‘good’ choice, for example by making pension enrolment the default, but keeping it easy to opt-out. Behavioural insights...
themselves however, are far broader, and can be applied to all manner of policy tools: regulation, incentives (such as taxation, subsidies, fines and grants), and information are all ‘behavioural’ tools, and can all be made more effective by embracing a better understanding of human behaviour.

1.3 TEST – Behavioural insights as a methodology

Behavioural insights is not just a collection of research findings and insights into human behaviour, but is as much a methodology; armed with this behavioural understanding, the objective is to understand the context, the reasons why people do what they do, the motivations, barriers and opportunities, and to develop solutions which are sensitive to these contextual factors. While this may lead to a novel ‘nudge’ solution, it may equally lead to the conclusion that benefits can be realised simply by removing hassle from a bureaucratic process, or that achieving change without stronger regulatory or fiscal intervention is unlikely.

In this spirit, BIT uses a four-stage project methodology, T.E.S.T. This project starts with a relatively high-level Target in mind: improving air quality on the SRN through a range of possible behaviours, including mode shift, purchasing of less polluting vehicles, improving driving styles, and better traffic management (including compliance with speed restrictions and reduction of peak demand). The second report further explores and prioritises these objectives. This report principally covers the ‘Explore’ section, providing insight into the drivers, barriers and motivations for these behaviours. This work is based on an extensive review of the existing literature, and on a number of expert interviews. The interviews were conducted with experts on transport behaviour and/or air quality from academia, research organisations, and government in the UK and overseas.

The second report will iterate on these early stages by refining the Target, choosing four much more specific behaviour-change objectives to focus on, and undertake further Explore work by identifying key barriers, drivers, and potential touch-points, and by conducting a customer segmentation exercise. The next phase will then progress to identify a range of Solutions, and subsequently design a series of Trials to evaluate the impact of those Solutions.
Part I: Drivers of behaviour, and routes to change – six lessons in behavioural science

2. Introduction

The transport literature is reviewed in Part II of this report, and though it reveals a lot about what does and doesn’t work under certain specific conditions, it is also quite limited: the quality of evidence is very mixed, and a relatively narrow range of interventions has been tested. It is therefore often difficult to ascertain why certain approaches sometimes work, and subsequently what could and should work under different conditions.

This section therefore aims to provide a more general understanding of behavioural insights, drawing upon psychological and behavioural-economic theory, as well as robust findings from public health and sustainability research. These areas were chosen because of the rich literature, and because the air quality agenda is something of a hybrid between the two. With
this deeper and more fundamental understanding in mind, we are better equipped to
generate novel intervention strategies or to tailor existing ones to new contexts.

In doing this, six key lessons are provided spanning a wide range of concepts, incentive
design, social influence, habit, emotion, cognitive biases and choice architecture. First,
however, the report starts with a critique of the most common understanding of behaviour:
rational choice. Though flawed, it provides a useful starting point and a good framework on
which to overlay more sophisticated ideas.

2.1 A flawed starting point: Rational choice, values, attitudes and beliefs.

There are many theoretical models of behaviour change, but perhaps the most intuitive is
that we can reason with someone to persuade them to change their actions: if we can only
inform people of the environmental or health impacts of their behaviour, we might convince
them to act differently. This is an information-deficit model of behaviour change, since it
implies that a lack of knowledge is the reason that some people don’t pursue the ‘best’
choices. A slight variation could replace ‘information’ with ‘motivation’ – that is, we should
aim to harness or promote certain motivations and attitudes with the expectation that we
can make people care more about their health or the planet, and thus act differently.

These approaches have long been the basis of most environmental and public health
campaigns, education, and awareness programmes. They are intuitive because we tend to
see ourselves as mostly cognisant and ‘rational’ agents, making choices which reflect our
attitudes and values. This approach also has a long history of psychological and economic
theory to back it up, including the seminal expectancy-value theory⁵, various iterations of the
Theory of Planned Behaviour⁶ (still one of the most commonly used models of behaviour),
the much-criticised but common Attitude–Behaviour–Choice (ABC) model⁷, and the Value–
Belief–Norm model of environmental behaviour⁸. Each of these brings additional insight, for
example adding in social norms and perceived control as contributing factors, but each of
them also has within it a common assumption that we reflect on our values, assess our
options and choose the action which is most likely to deliver on those values.

These ideas are even more pervasive in economic thinking, though the language used is often
different: we have preferences, and as self-interested agents we rationally trade-off our
options to deliver maximum utility in-line with those preferences. This process is assumed to
be agentic, autonomous and individual, such that behaviour is a product of our own choice.
2.2 Does rational choice theory hold up?

Our individual preferences clearly do inform our choices, for example whether we like driving and owning a car, or whether we like sitting on a train so we can relax and read a book. Moreover, we are often self-interested in our motives, perhaps more so than we acknowledge: our choices and actions reveal the dominance of enjoyment, convenience, and cost as motivators, often prevailing over our concern for the environment or for others’ wellbeing. It is also true that we have some capacity to reflect on our values, be persuaded by reason, and change our behaviour. For example, we may change our diets after deciding we want to get fit, or start to recycle after becoming aware of the environmental impact of plastic use. Furthermore, information provision is often a good starting point for behaviour change – for example, we can’t expect people stop driving and start taking the bus if they don’t know the bus routes – though clearly there are often more important barriers that information alone cannot solve, and information provision may in many cases be unnecessary.

So there is clearly much that the rational choice theory gets right. However, the model is also demonstrably wrong in a lot of its assumptions, and incomplete in its account of behaviour.

As outlined by Nobel Laureate Daniel Kahneman’s *Thinking Fast and Slow*, alongside our deliberative, quasi-rational side, we also have an automatic side to our behaviour and decision-making. This is based on emotion, instinct, social influence, habit and ‘fast and frugal’ decisions using simple heuristics (rules of thumb). These heuristics and biases are often based on cues from our social and physical environment, and often operate barely within or beyond our cognisant awareness. This leaves us highly susceptible to influence – from our social peers, from cultural norms, or even the way a menu is designed, for example. This means our preferences are highly context-dependent, and our choices in large part a product of the way the options are presented to us. Moreover, we are great effort- and cost-minimisers, tending to ‘go with the flow’ of that which is convenient, cheap, readily available and socially normative. This

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1 The predominance of self-interest is even greater if we accept the broadest definition of self-interest to include anything that brings us utility, which could include giving our life savings to charity, if that makes us happy. In the economic model, ‘self-interest’ refers to the act of seeking utility, but it does not mean we only find utility through conventionally ‘selfish’ acts.
allows us to process vast amounts of information and make quick decisions, but also means that we are constrained and influenced by society around us.

Social psychology further illuminates the fact that our deepest motivations are not always self-interested and individualistic, but rather we are connected members of a tribe who conform, mimic, seek status, and live in a web of cooperation and reciprocity. Our cultures embody meaning and we tap into group identities to construct narratives to make sense of the world.

All of these factors highlight the problem with trying to change behaviour by focussing narrowly on individual preferences and attitudes. To focus solely on these internal drivers of our behaviour (preferences, values, personality, cognitive processes etc.) overlooks the important external drivers of behaviours (such as the choice architecture, social influence, culture, the built environment, pricing, and the socio-technical context that surrounds us). The key point is that we are as much products of our society as society is a product of individuals’ choices and actions. A driving analogy would be to blame congestion on the actions of individual drivers without also looking at the design of the roads. Moreover, there are emergent complexities within traffic flow which cannot be explained through the actions of any individual driver. The same is true with the emergence of social practices such as the dominance of the car and the problem of air pollution: we need to consider both individual decisions and motivations, but we can’t separate chose choices from the structure of the world in which they are made.

As explained in one of the expert interviews:

“In workshops people get it – our behaviour is contributing to air quality issues. But please explain my choices to me? – What can I do about it? Don’t blame me when I’ve got little choice. This is even worse with diesel cars – we bought a diesel car because you told me to... So don’t set the world up in this way and then expect me to fix it – this is fundamental: it’s a systemic issue to most people, not an individual choice issue, and I’m sympathetic to that”

“If you want to promote eco driving, as well as telling them why that matters, it is better to also change the world around us – for example through variable speed limits – to ‘trick’ us into doing it anyway, not just because we’ve chosen to, though understanding why it’s important will make us more accepting of it.”
2.3 Constructing a better model

Figure 1 below is the reference point for the remainder of Part I of this report. It outlines a generic form of the rational choice model of behaviour (in blue) and six additions (in orange).

The rational choice model shows that beliefs and attitudes (or information and preferences) drive our decision-making process, which leads to intentions and thus to action. The implication of this is that to change behaviour we must first change beliefs and attitudes.

For example with a conventional cycling campaign illustrated on the left. The additions in orange include:

- Three ‘leaks’ reflecting three points of weakness in the model, illustrating that it is not necessarily wrong, but is highly inefficient and that certain gaps need to be plugged if we expect behaviour-change to follow from changes in beliefs and attitudes; and
- Three oversights representing important drivers of our behaviour which are overlooked by the rational choice model.

Combined, we have a much more complete account of behaviour. This is the basis of the remainder of Part 1 of this report, and we make frequent reference to these leaks and oversights.

![Diagram of the rational choice model with leaks and oversights](image)

**Figure 1:** In blue, the common but flawed ‘rational choice’ model, and in orange: three ‘leaks’ which must be plugged and three oversights which must be considered.
3. Lesson one: Changing attitudes is difficult, particularly around environmental and public health issues, but behaviourally-informed messaging can help.

**Lesson 1 key insights**

- Changing values and attitudes is often difficult. We are strongly wedded to existing beliefs, and have a tendency to distort the facts to justify them and our actions.
- If we do want to change hearts and minds, we should be wary of technical information, facts and figures which do not engage, and equally wary of campaigns which moralise and create guilt or blame – this creates defensiveness and denial in situations where behaviour change is not very easy.
- We should instead harness emotions, social influence, identity, and a coherent narrative, and be sensitive to the mental models through which we think about a complex subject like air quality.
- We should also ensure that a sense of agency and self-efficacy is maintained. If people come to care greatly about an issue like air quality, but feel unable to do anything about it, we may simply increase frustration and despair.

**Relevance to air quality on the SRN**

- We are attached to our cars, and conventional information and awareness campaigns are unlikely to create a widespread change of attitudes.
- In particular, messages which affront drivers’ behaviour, or imply guilt (e.g. through the narrative that air pollution is the fault of drivers) are unlikely to be successful.
- Creating an emotional response to air pollution may be powerful, and in particular the emotion of disgust has strong potential. Air pollution is often invisible, and so this is not instinctive, but is a natural response when we become aware of the composition of air pollution. However this approach brings risks: an emotional reaction to an issue which we can do nothing about may breed frustration and despair. It is therefore critical to maintain self-efficacy and ensure people know what to do about it.
- Social aspects of our transport behaviour also provide an appealing narrative, particularly with regards to the status of car ownership and driving style. This can be harnessed in messaging.
- There is a need to understand the narrative and mental models through which we perceive air pollution. Further research is needed, though a tentative starting point is to 1.) help people recognise the localised impacts of air pollution, 2.) overcome the ‘bubble’ effect of the car and impress upon people the health impacts to oneself (and one’s children) of driving, and 3.) avoid the narrative of blame, particularly with diesel vehicle ownership in light of historic pro-diesel policies.

Campaigns often fail at the first hurdle because they set out to change attitudes. This is a flawed objective because we tend to be strongly wedded to our existing worldview, and are psychologically well equipped to resist contrary information. For example confirmation bias and asymmetric updating refer to our tendency to focus on, interpret and recall information in a one-sided way which confirms our prior beliefs. Similarly, motivated reasoning leads us not to logical and balanced conclusions, but to conclusions which support our emotional stance on a matter and justify our actions.

These aspects of our psyche are barely visible to introspection, but deeply ingrained in us all. We make judgements intuitively, emotionally, associatively, and by drawing on existing
assumptions and stereotypes. Though we clearly do have capacity for critical reasoning, we can’t switch our intuition off, and this means the role of critical reason is often retrospective.\textsuperscript{11,12} Identifying a reasonable (and often flattering, to ourselves) explanation for the conclusion we have already arrived at or the action we have intuitively pursued.

This is also why the relationship between our beliefs/attitudes and our behaviour is two-way and often works in reverse to the intuitive model (oversight 3 in Figure 1). Through a process of self-perception\textsuperscript{13} we update our beliefs and attitudes to make sense of our own actions, often putting an ego-enhancing spin on them in the process.\textsuperscript{14} It is for this reason that changing behaviour can be a very powerful way to change attitudes, but the reverse is not always true or easy to achieve,\textsuperscript{11} illuminating one of the major problems that attitudinal and awareness campaigns face.

This is not to suggest that values, beliefs, and attitudes are unimportant. By feeding into our identity they reinforce behaviours, and this can also become a virtuous loop, for example pro-environmental behaviour in one domain strengthening our values and thus encouraging pro-environmental behaviours in other domains.\textsuperscript{15} One of our expert interviewees recognises the problems with rational choice models, but also the problems with discarding them entirely:

\begin{quote}
[The behaviour-change discipline] has overcome the ridiculous ABC [attitude, behaviour, choice] models of behaviour and suggestions that attitude changes lead to behaviour change... But we’re at risk of going too far the other way and suggesting behaviour is entirely mindless and contextual. It’s not, it’s a complex relationship between the two.”
\end{quote}

Research shows that pro-environmental attitudes and beliefs to predict (i.e. correlate with) pro-environmental and pro-health behaviour,\textsuperscript{16} however the correlations are weak and dominated by other factors such as wealth. Moreover it is often impossible to determine the direction of causality with such findings (do environmentally-friendly people become cyclists? Or are people who cycle for all manner of reasons more likely to adopt pro-environmental values?). Moreover, just because strong attitudes might drive behaviours in

\begin{footnotesize}
\textsuperscript{11} Though initially counter-intuitive, the logic is as follows: if we are undertaking an action such as recycling or eating healthy food (perhaps for banal reasons such as because it is very easy, we are incentivised to do so, or the food happens to be delicious or was the default given to us) we can readily adopt the pro-environmental or pro-health values which ‘explain’ our actions in an appealing light. This bring benefits to our ego, and there are no psychological barriers since our actions are compatible with the story. The opposite – trying to persuade someone to adopt attitudes which their behaviour is incongruous with – is more difficult to achieve, since to do so invites feelings of guilt, cognitive dissonance, inadequacy and hypocrisy. For example, studies have shown that paying people to volunteer causes their subsequent attitudes to be more favourable: \textit{the doing primes us for the believing} (Xiao & Houser, 2014). This is analogous to classic cognitive dissonance studies in which coerced behaviours (e.g. poorly paid work which ends up being highly tedious) are often justified by fabricated beliefs (we tell ourselves the work was interesting, as that’s a more appealing explanation than being duped).
\end{footnotesize}
some individuals, this does not imply that an efficient route to behaviour change is to try to replicate those attitudes in other people. As highlighted by another of our interviewees, these tendencies can be difficult to change:

“[Driving style and transport choice] are strongly correlated to 5-factor personality traits. This suggests it’s quite difficult to get people to voluntarily change, as we’re up against quite strong and deep motivations”

Four reasons we are psychologically ill-equipped to address environmental and health crises

**Evolutionary mismatch.** We are innately biased towards the present over the long-term, and poor at noticing slow, gradual change. We also tend to ignore that which we can’t feel, hear, see or touch, conserving our finite worry for more immediate threats. Moreover many contemporary environmental and health problems either did not exist through our evolutionary history (e.g. air pollution); we did not live long enough to suffer them (e.g. cancer), or arise today because the evolutionary trait was beneficial historically, but not now (e.g. fondness for sugary and fatty foods causing obesity and heart disease today, proclivity for over-consumption to signal status, etc.)

**Anxiety-avoidance.** Anxiety is a powerful motivator, but when we can do little to solve the cause of concern, we are motivated to avoid the source of anxiety. This includes disengagement with environmental or health issues. Participants of a lab experiment for instance, were presented with a choice where they could pay to delay being tested for a medical condition. The more serious the illness, the more patients were willing to pay to not know about it. Self-efficacy and empowerment are clearly vital if we want people to act, rather than to disengage.

**Conflicting motivations.** Matters of health and the environment frequently bring conflicting motivations: we want to fly, drive, eat fatty foods and smoke because they are easy, enjoyable, cheap or convenient, but we also don’t want to damage the planet or our health. This conflict invites cognitive dissonance, closely linked to guilt. We could resolve this conflict by changing our behaviours to conform to our values (and some people do), but this often requires compromising other self-interests (enjoyment, cost, convenience etc.), and so instead we resolve the conflict by fudging our values and beliefs to justify, or at least avoid threat to, our behaviour: We ignore, downplay, deny or cherry-pick the information presented to us, make excuses, and get irritated at those who challenge us (one of the reasons why campaigns that evoke morality can often fail – we don’t want to be made aware of our deficiencies or our hypocrisies.)

**Ambiguity.** Not only are we motivated to ignore or downplay ‘inconvenient truths’, it is also incredibly easy to do so because environmental and health messages are frequently complex, highly uncertain, and involve trade-offs which are ripe for being distorted, ignored or heeded selectively. For example, plastic packaging is bad, but reduces food waste; Diesel cars are bad, but EVs burn oil at the power station and use scarce materials in their batteries; Diet coke has less sugar, but aspartame is bad for you; Alcohol is bad, but red wine is good for the heart; Eat less fat, or eat more good fat? Cycling is healthier, but won’t I be exposed to more traffic fumes? Plastic bags are bad, but cotton bags are worse because they use so much water to produce? Very few people have the expertise or inclination to make these trade-offs or resolve these apparent contradictions. Faced with this kind of information we ignore the bits which challenge our beliefs or undermine our behaviours, and adopt the bits which justify them. It is for this reason that organised ‘climate deniers’ do not need sophisticated, scientific counter-arguments: It is sufficient to manufacture a little doubt, and our psychology does the rest.

3.1 Behaviourally-informed messaging

The focus of BIT’S work typically deals with behaviour change we, rather than attitude change, and the pitfalls listed over the previous several pages highlight just how difficult it is to promote behaviour change solely with an information, awareness or value-based campaign. Generally, interventions which target contextual factors and automatic drivers of behaviour should also be considered.

However, there are things that can be done to increase the impact of messaging. Principally, the focus lies on aspects of our psychology which truly drive our behaviour, including
emotions, social influence, identity, status, narrative, and self-interest. When dealing with complex issues such as air quality the aim is also to understand and reflect the mental model with which people think about an issue.

Techniques which rely on rational deliberation (facts and figures or complex information) are to be considered with caution. Techniques which induce guilt or which conflict with more powerful motivation should also be abstained from as this tends to lead to avoidance (for example, the pushing of values which we aren’t living up to, and which demand unrealistic compromise from us). An important aspect of this is self-efficacy: getting people to care more about an issue may simply breed frustration or despair if it is not easy and appealing to adopt the behaviour they are asked to adopt.

Social influence, identity and status are particularly important and are explored in further detail in lesson 5. Here the focus is on mental models and narrative, and emotion.

3.1.1 Mental models and narrative
We have a naive understanding of air quality, health and the environment, which is currently not well understood, but needs to be reflected in any successful campaign. As expressed during the expert interviews:

“Do people understand the relationship between air and health? People have a naive theory about this. Messaging has to work with existing models and sense-making ways people have - whether that's messaging to change behaviour (which is unlikely because messaging is not very good at that), but more likely, messaging to build support and consent for policy change. So it’s important to understand how road users view these things and the connections between their actions and their impacts.”

“There are in-built assumptions among technical people working in these technical topics that we need to use communications well to explain the technical issue to people to help them understand it - but rather than changing people to understand the issue better, we should change the fundamental narrative of the topic to fit people better.”

The World Bank’s 2015 World Development Report80, ‘Mind, Society and Behaviour’ was right to highlight ‘mental models’ as one of the three core aspects of decision making (alongside automatic thinking, and social thinking). The key insight is that we draw on concepts, categories, identities, stereotypes and existing narratives which deeply influence how we perceive and interpret the world around us. These mental models are deeply ingrained in an individual’s culture, which “influences individual decision making because it serves as a set of interrelated schemes of meaning that people use when they act and make choices.”81
By way of example, one of the expert interviewees suggests the defunct ‘miasma’ mental model of health might be a useful starting point to understand air quality as a health issue, particularly as it still maintains an intuitive appeal. The miasma model is an obsolete medical theory that disease emerges from ‘bad air’, for example around rotting food and faeces. In the late 19th Century it was replaced by the germ theory of disease:

“We don't really have a robust set of understandings about people’s mindsets regarding “stuff that we put into the air that’s bad” – CO₂, NOx, particulates etc. Surveys often test basic ‘awareness’ but that doesn't really dig into how people understand and think about this. The understanding between what you breathe, and health, is complex – There are 3 common mental models. One is the ‘infection model’, that we can be infected by germs in the air, which is not particularly relevant to air pollution. Another is the ‘clogging’ model – it’s physical, we feel it building in our throat. This is one of the issues with particulates [when pollution is extreme], though it’s not the ones that get stuck in your throat that matter so much, it’s the smaller one that go down further. Most interesting is the 19th century miasma model which we’ve spent centuries trying to overcome, but now we need to bring back. It's a model we still intuitively have, and it's often about smells…”

The point here is not that the ‘miasma’ model of bad air is a correct or necessarily useful framing for air quality issues. Rather, the point is that if we are to shift attitudes to air pollution, it is necessary to understand the mental model or framing which people find most intuitive, and to reflect this in campaign materials – the miasma model is one such ‘mental framing’ which may offer a useful starting point. More research is necessary to ascertain whether or not it is the best one.

A closely related concept to mental model is that of narrative, or ways of understanding. When we consider whether something ‘makes sense’, this is not a careful judgement of accuracy, but of its narrative fidelity, that is, our ability to merge this with our existing worldview: does it ‘feel right’ and does it provide a story coherent with our own? Does it offer us explanations that are easy to agree with, perhaps because they offer palatable explanations for our situation or have emotional resonance?

For example, a narrative of air pollution being the fault of consumers not buying the right cars and driving too much is not compatible with the narrative of someone who bought a diesel car because the government encouraged them to, who lives in a world largely designed around private car ownership, or of someone who obtains a lot of status and enjoyment from their car. Capturing the hearts and minds of such people needs a different narrative than one of blaming drivers, even if the ultimate goal is to get them out of their cars.
3.1.2 Emotion

It has long been known that emotion is the basis of much of our decision-making and attitude-formation, and there are many examples of campaigns which draw on emotions, such as cigarette packets with graphic images designed to evoke disgust\textsuperscript{32}; poverty-relief and pet adoption campaigns designed to evoke sympathy\textsuperscript{33}; fear-based health campaigns,\textsuperscript{34} and environmental campaigns designed to evoke guilt, fear or empathy\textsuperscript{35}. There is also evidence to suggest that campaigns based on fear or disgust are more likely to be shared on social media, and thus more likely to go viral.\textsuperscript{36}

However, not all examples are necessarily effective, and many can be quite counterproductive. As discussed in lesson 1, guilt often causes us to close up, rather than take action. Evoking an emotional response to a behaviour we want to encourage or discourage (such as the use of disgusting images on cigarette packs) is not the same as evoking disgust at something we can’t easily control (such as air pollution). Emotions should therefore be targeted carefully to ensure they are able to motivate action, not frustration, as summarised by one of the expert interviewees:

“...in my previous work] the thing that really seemed to bring an emotional response (which is dangerous but maybe useful – you need to link it to something you can do about it) – was not around the statistics of deaths, though shocking – it was the constitution of particulates. If you describe to people what we are breathing in, it is disgusting, and disgust is powerful. But that should only be used if we can do something useful with it.”
4. Lesson two: Changing attitudes isn’t enough to change behaviour, though it is sometimes possible to bridge the gap

Lesson 2 key insights

- Even if attitudes, beliefs and values are changed successfully, this won’t necessarily lead to behaviour change. There is a value-action gap, caused by several factors:
  - First, sincere values or attitudes will not necessarily lead to sincere intentions to act, because:
    - We have competing motives, and even though we tend to exaggerate the importance of pro-social values, our concern for cost, enjoyment and convenience often prevail.
    - We may care greatly, but lack self-efficacy.
    - We may be disinclined to act if others are not. In other words it is common to have a degree of conditional cooperation to our actions, but a tragedy of the commons often emerges and undermines collective action.
  - It is sometimes possible to overcome these barriers by harnessing the prevailing motivators to promote sustainable and healthy choices (e.g. ‘selling’ the choice on cost, enjoyment or convenience, rather than using sustainability or health messaging). Good behaviours should also be made easy, leading by example, and by harnessing reciprocity and social norms to motivate collective action.
  - Second, however, even when sincere intentions exist behaviour may not follow. This is due to a number of practical barriers (hassle, availability) and psychological barriers (procrastination, inertia, forgetfulness, lack of know-how).
  - Each of these barriers must also be overcome, for example by removing frictions, providing prompts and reminders, harnessing timely moments to overcome inertia, and adopting implementation intentions and commitment devices to help convert intentions into action.

Relevance to air quality on the SRN

- Cost, convenience, comfort, and perceived reliability generally dominate our transport behaviour. Behaviour-change initiatives should aim to harness these rather than to elevate less dominate motives like sustainability.
- Health is a stronger motivator than sustainability, and better harnesses self-interest, though may still be weak compared to cost, comfort and convenience unless the health detriments are made very obvious. Moreover, this will depend on the population segment – for example, new parents may be interested in safety, whilst teenagers may be more motivated by status and risk-seeking.
- There is therefore a fundamental need to ensure the ‘good’ transport behaviours deliver on these metrics, and/or are framed as such. For example, promoting electric vehicles on the basis of running costs and reliability is more likely to gain traction.
- Compliance (for example with speed limits) is partly a problem of conditional cooperation. The norm to comply exists, but many don’t emboldened by assumptions that many others do not. Using messaging harnessing social norms and reciprocity, or alluding to surveillance, may therefore be effective.
- Good intentions may exist with a range of transport behaviours, for example better vehicle maintenance, uptake of schemes, driving more fuel-efficiently, cycling to work more, or following a personalised travel plan. Removing frictions to processes, or using public commitments (e.g. among employers or local authorities) may therefore be impactful. There may also be great potential in identifying timely moments to prompt certain behaviours. For example, when moving home (timely moment to prompt mode shift), when starting a new job (timely moment to prompt mode shift or uptake of a personalised travel plan), when having a new baby (timely moment to prompt safe driving materials), or completion of the DVLA registration (timely moment to prompt booking of a free electric car test drive).
Introduction

Changing attitudes and beliefs is difficult, but campaigns which successfully do so will not necessarily change behaviour, and in fact our actions are often very poorly predicted by our attitudes. We illustrated this point as 2 leaks in the behaviour model on page 21. First, raised awareness or concern for an issue will not necessarily translate to a sincere intention. This is partly because we often care about issues and want to do something to help, but not in the moment when it requires personal sacrifice. In other words other motivations such as cost, enjoyment or convenience often still prevail, and these may be in conflict with the ‘virtuous’ behaviour. Moreover, a lack of self-efficacy can stop attitudes turning into sincere efforts to change, or we may be conditional in our willingness to act, dependent on everyone else doing their bit too. Second, if we do overcome these issues and form sincere intentions to change our behaviour, we are still often not successful. This is due to various psychological barriers (such as procrastination, finite willpower, lack of know-how) and practical barriers (such as hassle or lack of options). These issues are considered in turn below.

4.1 Other motivations may still prevail

It is an often overlooked fact that raising someone’s concern for air quality, the environment or their health will not change their choices if other conflicting motivations still dominate. This is quite a likely outcome: surveys show that concern for social issues is often ‘high’, but not relative to factors like cost, enjoyment, and convenience. This is despite the tendency to exaggerate prosocial values in surveys, with the dominance of self-interest being even more apparent in our revealed behaviours. Some individuals act more virtuously than others, of course, but for most of us our values play a modest role in our behaviour, but are major factors in identity formation, self-enhancement and virtue-signalling. For example wealth is highly correlated with pro-environmental values, but also highly correlated with individuals’ ecological footprint (leading to the perverse outcome that pro-environmental values are predictive of environmentally damaging behaviour, because both are driven by wealth). We would therefore be naïve to believe that the majority will willingly compromise their comfort, enjoyment, convenience or wallets, in the name of weaker motivators such as sustainability (or to a large extent, even our own health). There is ample evidence, for example, showing that selling food on a healthy message is ineffective compared to selling it on a message of enjoyment, taste and decadence.

It is therefore necessary to identify the motivations which are truly driving a decision, and where possible harnessing them. This might involve making changes to the product or service itself (so that it cheaper, more convenient and more appealing to consumers), or, where that
is not possible, ‘framing’ the benefits as such (for example, selling electric vehicles on the fact that they are cheaper in the long-run, rather than on their environmental credentials).  

Electric cars, impossible burgers, and twisted carrots

It is often unrealistic to expect consumers to compromise enjoyment, convenience and cost in the name of sustainability, or even for their own health. Many manufacturers recognise this, and so market products on these primary motivators, with healthy or eco-friendly credentials being just one more reason to purchase – sufficient if no other compromise is necessary.

For example, increasing public awareness and concern for the environmental impact of beef is leading to a number of ventures to replace the common beef burger. Impossible Burger, a meat-free burger sold on its hyper-real meat texture and superior taste, complete with ‘blood’, has been designed with the recognition that most consumers of beef burgers would be unwilling to give up the experience of eating meat. Vegetarian campaigns will not have the necessary impact, and a way should be found to deliver the same enjoyment at a lesser environmental and animal-welfare impact.

Tesla have similarly recognised that electric vehicles cannot be sold to mainstream buyers solely on their pro-environmental credentials. It was therefore Elon Musk’s ambition to create a supercar, and subsequently more affordable family cars, which outperformed their competition on conventional metrics – driving experience, reliability, speed, lifetime cost, status and desirability – and which happened to be environmentally friendly too. Certainly, owners can feel positive about their sustainable purchase, but rarely would this be a sufficient motivator if the car failed to deliver on these other counts.

Sometimes it’s not about making the product fundamentally more enjoyable, but using careful framing to market it as such. For example, food marketed as healthily consistently under-sells compared to the same food marketed as delicious. One recent study found that ‘twisted citrus-glazed carrots’ significantly outsold ‘carrots with sugar-free citrus dressing’. 48 BIT’s work with the World Resource Institute similarly finds more indulgent language to increase sales of sustainable (vegetarian) food, while language like ‘meat-free’ (which merely highlights what the meal is missing) is very unpopular. These results highlight the importance of framing pro-environmental and healthy options through a message of enjoyment, not self-sacrifice.

4.2 Self-efficacy and empowerment

People will generally not act if they do not feel empowered or able to make a difference. As explained in our expert interviews, the issue is not just about people understanding the issue of air pollution and being motivated to do something, but what people are able to do with that understanding and motivation:

“The way that the topic has hit the public consciousness has contributed to widespread defeatism and defensiveness – we’ve learnt about [air pollution] as a terrifying thing, but we’re powerless to do much about it. One choice we have is to get out of our cars, but the world has been set up in a way which has caused this problem, and now you’re going to blame me and tell me to get out of my car, when there are not many choices about this. This leaves people on the defensive, justifying their car use and angry at government. We really need to maintain a sense of self-efficacy rather than lapsing into defeatism.”

The importance of self-efficacy and empowerment is a common thread throughout the UK Department of Environment, Food and Rural Affairs’ (Defra’s) ‘4Es’ framework for behaviour change: Enable (making it easier, ensuring the support and availability for change is there), Encourage (motivate, incentivise, ensuring the change brings genuine personal benefit), Engage (build community buy-in, understand and reflect the needs of their lifestyles), and
Exemplify (government and local authority leading by example).49 In other words, people should not be merely pushed to make choices which are greener and healthier, but aspirations they already have should be nurtured by ensuring good options are available, easily accessible, relevant to people, and by leading the way with exemplary changes across government and the corporate world – many individuals feel helpless if these ‘big players’ are not doing their bit.

4.3 Conditional cooperation, reciprocity, and the tragedy of the commons.

The air quality issue can in many ways be seen as a hybrid of environmental and public health issues. One key factor in which environmental and public health issues differ, however, is the role of the individual versus society. Environmental behaviour is mostly about individual decisions and actions, the effects of which are highly dispersed, impacting society at large. In contrast, health issues are normally about individual decisions and actions which impact our own personal health (though the effects of obesity, smoking, infectious disease, and drug use also bear costs on society).

This leaves environmental issues uniquely susceptible to a tragedy of the commons, where the individual incentive is misaligned with the societal incentive. For example, purchasing an electric vehicle for the benefit of the environment poses a significant personal cost, but since the benefit is dispersed across the planet, the environmental benefit to the individual are tiny. Therefore, though we may all be better off if everyone stopped driving, it rarely makes sense for any self-interested individual to do so. The traditional economic solutions to such situations is to privatisate the public resource being spoiled (i.e. the environment) or adopt strict regulation (either putting limits and licenses on use of the resource, or correcting for externalities through taxation).

However there are also aspects of our psychology which can help address this problem. We have an innate tendency for conditional cooperation50, reciprocity,51 and correspondingly, a disdain for freeloaders and unfairness52. This means we are much more likely to contribute to a public good if everyone else is, and reciprocity, the ‘web of indebtedness’, is the glue that holds it together: if others do something for us, we feel obliged to do something in return. The power of reciprocity is commonly used in marketing (as with free samples encouraging sales, for example), but can also be used to overcome social and environmental problems.
Harnessing reciprocity and social norms where self-interest might otherwise prevail

As explained by Nobel Laureate Elinor Ostrom:

"The idea that rational, self-interested individuals will not act to achieve their common or group interests... became known as the 'zero contribution thesis.' The zero contribution thesis underpins the presumption... that individuals cannot overcome collective action problems and need to have externally enforced rules to achieve their own long-term self-interest."

She goes on to explain, however, that the zero contribution thesis is contradicted by everyday life in which people generally do not cheat on their taxes, and many contribute to voluntary organisations. Thus,

"...a core question is how potential cooperators signal one another and design institutions that reinforce rather than destroy conditional cooperation."

She further explains the role of social norms and reciprocity as a social enforcement of collective good – i.e. peer pressure to conform and cooperate, and social exclusion for freeloaders. The urge we feel to reciprocate a kind favour, and the pain we feel at humiliation or social exclusion, is the proximal psychological motive (in evolutionary terms) reflecting the ultimate evolved motive of collective action which improves our odds of surviving and flourishing.

One can harness the force of reciprocity, and reinforce positive social norms. BIT has done this in a number of situations where selfishness or a tragedy of the commons might otherwise prevail.

Charitable donations. As part of a “donate 1 day’s salary” campaign at an investment bank, BIT tested a range of messages and found that giving a packet of sweets (costing £0.50) before asking (unconditionally) more than doubled the number of donations from 6% to 11% of bankers (with donations typically valued at a few hundred pounds).

Organ donations. BIT used a reciprocity-based message to add hundreds of thousands of people to the organ donor register in one year. Using prompts on the DVLA website after completing a vehicle tax renewal, of several different messages the most successful was “If you needed an organ would you take one? If so, please help others... implying the fact that many others are helping and contributing to the common good, which you may benefit from, and are currently freeloaders off.”

UK Farmers’ conditional cooperation. Our proclivity for fairness and conditional cooperation often manifests as surprising support for top-down policies and regulations which restrict or impose a cost on our own behaviour. For example, many UK farmers want stricter regulations on animal welfare and provenance because it would force all farmers to comply, despite individually being reluctant to take the steps which they are asking to be enforced, as it would make their business uncompetitive relative to others who do not take such steps. The lack of regulation therefore promotes a race-to-the-bottom and lowering of standards in the name of competition, necessary to maintain a price advantage but not an outcome many individual farmers actually want.

Tax compliance. BIT has used social norms to boost tax payments in many countries, using some variation of the phrase ‘9 out of 10 people pay their tax on time’. One particularly interesting result was the positive impact of the phrase “64.5% of Guatemalans declared their income tax for the year 2015 on time. You are part of the minority of Guatemalans who are yet to declare for this tax”. Here the norm is very weak – a mere 64.5% - however, it is effective because it is far higher than most Guatemalans presumed. Clearly the risk of punishment is low with 35% of the population, but this message harnesses the idea of conditional contribution to the public good, by overcoming the misconception that nobody else is contributing.

4.3.1 Harnessing self-interest: localised and personal impacts of air quality

As noted above, where an action is in society’s interests, but not in our own interest, a tragedy of the commons can occur. This is frequently a problem for environmental causes. However, we should not forget that air pollution also has a personal cost – driving can be bad for our own health, and for the health of our immediate communities. This provides a stronger link between our actions and our own self-interest, which may be harnessed by framing driving as damaging to one’s own health, rather than merely as damaging to society.

However, two challenges exist. The first, already discussed, is that if drivers feel unable to do anything about it, the likely outcome is despair and frustration, not behaviour change. The second, is that it may prove difficult to get people to appreciate the localised and self-harming impacts of their own transport behaviour. Though general awareness has increased due to significant media coverage, the invisibility of the issues makes it less salient day-to-day. We also lack an intuitive understanding of pollution’s localised impact, and in particular the exposure we have to pollution whilst driving: despite sitting behind another car’s exhaust, a car can feel like a pollution-free ‘bubble’. This is rarely the case except in the newest cars with modern air-intake filters. As discussed during our expert interviews:

“With CO₂ we have global effects from a local activity. With air pollution however, we have mostly local effects of local activity. One of the key things we need to help people
understand to develop engagement is the localisation of air pollution. This is probably easiest to do with particulates [as opposed to gaseous emissions] as it makes more sense. E.g. When leaves fall off the ground, they land where they fall. This is harder to get your head around with gases."

“[Transport] behaviour and choices have consequences for other people but also for you. For example, with mode choice, choosing between cycling and taking the car, we will immediately think “I’m making the world better for everyone else [by cycling] but aren’t I breathing in more of this stuff myself?” This is the bubble effect of the car. There is evidence that shows this often isn't true – sitting in a car behind someone else’s exhaust is the worst place to be unless your car has very modern filters, but as soon as you enter that technical argument you’ve lost, as the emotional and intuitive understanding is that being in the car is better for you”.

Clearly, framing the issue as local and in one’s own best interests may bring benefits if the dominant belief is that we are all individually better off driving a car, and unwilling to compromise this for benefit of others.

4.4 The intention-behaviour gap

The above discussion on competing motivations, self-efficacy, conditional cooperation and self-interest explains why seemingly sincere attitudes towards a cause may not lead to sincere intentions to do anything. The next ‘leak’ in the model in Figure 1 explains why sincere intentions may still fail to translate to action: the intention-behaviour gap. These barriers against action are both physical (lack of options, hassle, etc.) and psychological (procrastination, willpower, forgetfulness, lack of know-how, etc.). The major causes are briefly discussed below, though the brevity of the discussion does not reflect a lack of importance: simply removing small frictions from a process, for example, can often have a disproportionate impact on our tendency to act, while procrastination and lack of willpower can be very potent obstacles.
Procrastination can lead us to indefinitely put off an action we have good intentions to pursue. For example, there are strong economic incentives to switch energy supplier, but we often never get around to it. This is largely driven by our bias towards the present (discussed in lesson 3), meaning we put off things we don’t want to do, and succumb to the immediate pleasure of doing something else. It is also greatly exacerbated by hassle and friction costs, discussed below.

A lack of willpower is also related to our present-bias, as our immediate ‘doer’ tends to overrule our long-term ‘planner’, meaning we give in to short-term temptations and struggle to delay gratification. This leads to many suboptimal health decisions such as smoking and eating sugary and fatty foods against our better judgement.

Forgetfulness can be a major factor, particularly where ingrained habit promotes existing behaviours, and where there is a lack of urgency for change and a lack of clear decision-points to prompt change.

Lack of know-how is often not addressed with simple awareness campaigns. For example we may become aware that plastic waste is bad for the environment but lack of knowledge on which types can be recycled, or we may know that processed ready-meals are often bad for our health, but lack cooking knowledge or access to easy recipes for healthy food.

Hassle factors and friction costs are seemingly trivial points of effort which disproportionately stop us from completing an intended behaviour. The power of friction costs is well known to marketers who aim to make it as simple as possible to sign up to a product or subscription service, but slightly more difficult to cancel (for example requiring written notice), often leading us to continue paying for services we’ve long since intended to cancel.

4.5 Closing the gap: make things easy

There are many potential solutions to the above barriers, and a vast literature on the subject. One of the most powerful things to do, reflecting the significance of hassle and friction costs, is to make the desired behaviour easier. This is a strategy BIT has used with success in much of our work, for example expediting the collection of tens of millions in tax revenue by removing a single ‘mouse click’ from the form process (sending recipients of a notification directly to the form, rather than to the webpage with the form on it). Similarly, householders are more likely to install loft insulation if a loft clearance service is bundled (even at significant extra cost to the customer), and recycling contamination can be reduced by putting bespoke lids (shaped for bottles, paper etc.) on bins.
Perhaps the most powerful way to make something easy is to default it. For example, changes in UK pension legislation making private pensions opt-out instead of opt-in have led to a significant increase in the number of savers, whilst in Germany, despite energy customers saying they would opt for a green tariff if offered it, only 1% did make this choice. When it was offered, 69% ended up with it when defaulted, compared to 7% who were not defaulted.\textsuperscript{59} Technology also has great potential to make things easier through automation: the Nest learning thermostat automatically saves energy by changing heating schedules in response to household occupancy and weather patterns,\textsuperscript{60} smart appliances promise to deliver vast savings across the grid as they automatically use energy when it is most available, while driverless cars may eventually render congestion and inefficient driving styles a thing of the past if they manage to automatically optimise traffic flow.

Just as behaviours can be encouraged by removing frictions, they can discouraged by introducing them. For example, a number of studies have found that food waste can be significantly reduced at canteens by removing the trays, requiring people to return to the canteen for seconds and discouraging them from taking too many items on first pass.\textsuperscript{61}

\subsection*{4.6 Closing the gap: timely moments, prompts and reminders}

One of the most widely applicable strategies in promoting behaviour change is to identify (or create) key timely moments and decision points.\textsuperscript{62,63} When a behaviour is automatic and habitual, or indeed when it is perfectly conscious but subject to procrastination or a lack of strong motivation to change, we often benefit from a clear decision-point to nudge us into action. For example, moving house or office location are timely moments to promote changes to commuting habits, and existing patterns of behaviour are broken and we must make an active decision on what to do next. We discuss some examples from the transport literature in the later section on mode shift.

Removing decision points is also a powerful way to encourage an existing behaviour to continue: many social media websites use this trick to keep users browsing for longer
(continuous scrolling with no need to click onto the next page so that there is never a natural point to stop). Experimentally this has been shown with an ingenious bottomless soup bowl (self-refilling, unbeknownst to the eaters), leading participants to eat far more than from a regular bowl with unlimited top-ups\(^6\). The same is true when serving popcorn in one large tub versus two smaller tubs (a ‘partitioning effect’\(^7\)). These results can feel abstract, but have real consequences to our health behaviours. For example, making the ‘last 2’ pills a different colour has been suggested as a way to completion of a course of antibiotics, portion sizing and partitioning has a major bearing on obesity.

Much research also shows that simple **prompts, reminders and calls to action** can effectively help overcome forgetfulness, help cement new habits, and elicit immediate action rather than continued procrastination. These can take many forms, and have been used to good effect in much of our own work, for example using SMS text prompts to increase court fine payments and reduce missed hospital appointments\(^8\) and increase educational attainment by sending reminders to parents about upcoming tests, and providing suggested discussion points.\(^9\)

**4.7 Closing the gap: feedback, commitments and plans**

Ongoing feedback can be helpful in achieving complex and longer-term goals. It can be encouraging, help break-down ambitious goals into more achievable steps, and is particularly important where there is a learning element: without knowledge of progress it is very difficult to understand what actions are leading to success. For example, weight-loss programmes make strong use of feedback (regular weigh-ins, often with a social element too – see ‘commitments’ below), and one of the key justifications of the £11bn smart meter roll-out in the UK is to be able to provide real-time feedback to energy users to help them become more energy efficient.

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**Designing home energy feedback.**

There is a large body of ongoing research on the use and design of in-home displays (IHDs) to give householders real-time and aggregate information on their energy use.\(^1\)

Research in this technology reveals a number of interesting insights about how we engage with feedback. For example, in order to maximise benefit the feedback must be extremely easy to use, with simple red/amber/green traffic lights, indicating bad/OK/good energy consumption, seemingly effective. More complex displays tend to garner less attention from the users (though this clearly depends on their level of interest and motivation to engage). However, a key insight is that this needs to be well calibrated to maintain motivation: many users complained that it never changed from red despite turning most appliances off, and this undermines their sense of self-efficacy as well as the ability for the feedback to tell them anything useful. As such, feedback should be individually tailored to the household, and constantly updated to maintain motivation.

Also important is the finding that feedback serves at least two discrete purposes: for some people, it is used as a short-term learning device. For example after receiving an IHD, residents often go around the house, turn appliances on and off, and identify which use most energy. This may be a one-off process for the householder, and provides some benefit by educating the user on energy-intensive appliance. This information will be retained to a varying extent, and the motivation to do anything with this information may wane. For other people, feedback was more effective when used as an ongoing ‘monitoring’ device, using the IHD to continuously set goals and limits, for example to budget and track their energy bills, or simply to try and make improvements month on month.

There are clear lessons here in the design of in-car feedback for the teaching of, and continued improvement of, fuel-efficient driving techniques.
Commitment devices are self-imposed restrictions to help us stick to our intentions. We are often aware of our own weakness to temptation or tendency to procrastinate, so engineer consequences to our misdemeanours, or restrict our own freedoms, to motivate us to stay on track. Commitment devices may take the form of novel subscription services (such as gym memberships) through which you forfeit money if you don’t meet your target attendance, or an app which limits the amount of time spent on social media. The general principle is that we are far more likely to achieve something if not doing so incurs some cost. For example, simply making a public promise or social agreement can be very powerful, reflecting our strong aversion to breaking social contracts and promises.

We often fail to achieve our goals because unexpected obstacles can get in the way which we have failed to plan for, leading us to fall back into habitual patterns of behaviour as we deal with the interruption. One helpful intervention in these cases is to encourage people to develop implementation intentions.\textsuperscript{49} This is a simple ‘if, then’ plan through which we are encouraged to identify possible setbacks and plan strategies to deal with them before they arise, minimising the disruption they have to our goals when they do occur. They can also be helpful in overcoming frequently-occurring barriers to ingrained habits (for example to aid smoking cessation, “if my colleague invites me to join their cigarette break, I will make myself a coffee instead”).

BIT has used implementation intentions alongside commitment devices to good effect in helping jobseekers find work quicker\textsuperscript{50}, where they are well suited because the daily activities required (job searching, attending interviews, writing CVs) can often be thwarted by unexpected interruptions such as a sick child, a late train or temptation to do something more enjoyable than writing a CV. They have also been used to good effect in a variety of health goals\textsuperscript{71} (such as losing weight, reduced snacking, exercising more and quitting smoking), and can be an effective component of personal travel plans to promote sustainable transport (discussed later in Part II), though the evidence here is less robust.

4.8 Conclusion to lesson two

Lesson two highlights the many reasons why changed attitudes may not lead to changed behaviour. A lot of BIT’s work fits within this space: designing markets and incentives to ensure that pro-social values align with stronger motivators like cost and convenience; using social norms and reciprocity as levers for cooperative and prosocial behaviour; or overcoming the intention–behaviour gap by making behaviours easier, harnessing timely moments, or using prompts, commitment devices and implementation intentions. These techniques alone can often address the major barriers to a behaviour and create significant change.
5. Lesson three: Our behaviour is often automatic, we think with heuristics, and we’re susceptible to bias

Lesson 3 key insights

- Our behaviour is dominated by automatic processes, including habit and emotion.
- Our decision-making processes tend to draw upon heuristics (rules of thumb, mental short-cuts), often drawing upon cues from our environment.
- We *satisfice*, rather than *optimise*, trading-off effort with accuracy in decisions.
- These processes are highly efficient, but leave us susceptible to influence and cognitive biases – predictable deviations from the logically optimum decision.
- *Choice architects* (those in control of the environment in which decisions are being made) can therefore gently ‘nudge’ us toward certain behaviours without precluding the freedom to choose, or resorting to regulatory or fiscal interventions.
- Particular attention should also be paid to how we overcome ingrained habit, with substitution (e.g., cigarettes for e-cigarettes) being one good strategy.

Relevance to air quality on the SRN

- The use of defaults is a powerful way to influence behaviour without removing choice. For example, switching the default for new starters at work such that they get public transport benefits but not a parking space is likely to have major impact.
- Scarcity bias (our tendency to want that which is scarce) could be harnessed with artificial deadlines of government subsidies for electric vehicles.
- Various nudges could be used to boost public transport use, for example loyalty stamps (10th journey for free), harnessing endowed progress (our tendency to pursue that which we’ve made progress with), by pre-filling the first 3 stamps.
- Decoy and choice-set effects could be used to promote the sale of certain fuel types or other peripheral purchases.
- We get ‘transactional utility’ from a sense of having a good deal. Subsidies on electric vehicles should therefore be made more salient, frames as a discount, or cash-back.
- Illusory superiority (our belief we are better than average, e.g. at driving) suggests that safety campaigns highlighting the danger of other bad drivers would be more effective than those focusing on our own driving style.
Introduction

The concept of automatic behaviour was already introduced in section 1.2: we draw heavily on habit and emotion, and think with heuristics (rules of thumb). These cognitive processes exist for efficiency: they are ‘fast and frugal’, and so we tend to *satisfice* rather than *optimise*, seeking a good-enough solution without expending unnecessary brainpower. We do this by using simple rules and mental short-cuts, and by moving regularly recurring actions onto auto-pilot. Anyone who has learnt to drive knows the benefit of this, as we simply don’t have capacity to consciously think about our driving technique, focus on the road, and hold a conversation simultaneously – it is only once our driving has become habituated that we can manage to allocate attention to other tasks.

However this efficiency brings a trade-off on accuracy, and thus we are susceptible to bias: systematic deviations from the optimum outcome\textsuperscript{ii}. Moreover, the fact that these processes often draw on cues from our social and physical environment leaves us profoundly susceptible to influence, often in ways which escape our attention. For example one prevalent heuristic is likely to be “if something is working OK and there’s no obvious reason to change, stick with it rather than needlessly exploring unfamiliar alternatives”. This has obvious evolutionary benefit – reducing unnecessary risk and saving wasted energy – but in the modern world it might stop us from exploring alternative commutes or from saving hundreds of pounds by switching our energy provider.\textsuperscript{73} We might therefore observe this behaviour and infer we are suffering from cognitive biases such as risk aversion, uncertainty aversion and inertia.

5.1 Nudging with choice architecture

The use of choice architecture gives us a way to harness, or overcome, these cognitive biases and heuristics. For example, the way a form is designed, the order of items on a menu, or the framing of investment options in a pension fund will all influence our decisions because they tap into certain psychological tendencies. It is rarely possible to have an entirely neutral choice architecture (influence is inevitable) and so by designing it appropriately we can make the healthier, more sustainable or otherwise ‘good’ option more likely, without precluding the freedom to choose something different. We have included a

\textsuperscript{ii} ‘Optimal outcome’ as defined by economic rationality, which of course is not always a good benchmark for ‘optimal’, as it assumes self-interested utility maximisation is the goal. For a robust criticism of the ‘biases and heuristics’ literature, see Gigerenzer (1999) Simple Heuristics That Make Us Smart, and Gigerenzer (2015) Simply Rational. Gigerenzer rightly rejects the derogatory term ‘irrational’ which reveals the classical economic assumptions not only that people *are* rational and self-interested, but that they *should* be. Rather, argues Gigerenzer, heuristics often have a lot of ‘ecological rationality’ when viewed in context and with a better understanding of their psychological purpose. Regardless of their value, they do exist, and lead to predictable outcomes which we should recognise.
catalogue of relevant biases and heuristics, and examples of where they may be relevant in the health, environment and transport context, in Appendix C.

5.2 Habit

Habits tend to be automatic (with little deliberative reflection); tend to perpetuate the status quo; and they are often insensitive to gradual change (it takes a sudden change to jolt us out of them). These facts makes habits difficult to change, and conventional interventions which aim to influence our beliefs or intentions are usually ill-suited to the task (unless there is very strong motivation for change, and a concerted effort to bring the issue back into conscious awareness). That said, attempting to change habits is a worthwhile aim: their pervasiveness means small changes can have major impacts. For example, it has been estimated that obesity could be ‘solved’ in the majority of the population if they ate just a few less bites per meal, and it only takes the erratic driving style of a few drivers to send ripples of congestion through following traffic. Moreover, habits are clearly highly relevant to our driving style, as well as to our commuting decisions.

A lot of the literature on habits focusses on helping us overcome destructive habits such as smoking, on the assumption that there is a very strong motivation to do so. This is commonly framed around ‘the three Rs of habit change’: Reminder (identifying the key triggers or contexts in which we succumb, and using it as a conscious reminder to overcome the automatic response); Routine (replacing the habitual response with a new response, and routinising it), and Reward (to reinforce the new habit until it becomes automatic). As noted in Lesson 2, implementation intentions can be useful in creating and sticking to these intentions by forming plans in response to regularly occurring triggers. However, the aim is not always to equip people with the tools to change their own habits. Policy-makers are also interested in the influence they can have on the public’s habits, particularly where their motivation to change is relatively weak or indifferent (driving style being a perfect example).

The academic literature on habits often makes a distinction between downstream interventions (focussing on the individual, often with information, education, or motivational campaigns) and upstream interventions (looking to change the nature of the environment that encourages the bad habits). For example in health, the former might aim to increase awareness among students of unhealthy foods, while the latter might aim to restrict the availability of unhealthy foods near a school. The main insight is that downstream interventions may work for people whose habits are not yet strongly formed, but tend not to be effective for those whose habits are already ingrained. As such, educating young drivers how to drive efficiently before they have developed their own driving style may be effective, but training courses for those who have been driving for years is are unlikely to be effective,
unless there is a very strong motivation among the drivers to break their old habits (which is possible, if, for example, they are receiving rewards for efficient driving). Some success has found with ‘downstream-plus’ interventions, aiming to pair information and education with changes in context. For example, eco-driving training might be delivered on arrival of a new child (which might bring with it a motivation to start driving very safely), or when purchasing a new car (which may feel different to drive and thus elicit a slight change in driving style).

However, on average upstream interventions which change the context appear to be most effective at breaking old habits, since they fundamentally change the triggers and contextual cues on which our habitual responses are based. For example this may entail changes in the technologies we use, the physical or social environment around us, or the pricing of products we buy.76

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**E-cigarettes and artificial sweeteners**

Breaking an old habit often requires effort, but there is another way: through substitution we can maintain the habit whilst making it less damaging. Habits tend to be based on a three-part process of trigger > behavioural response > psychological reward. It is therefore an effective intervention to substitute the behaviour for something less damaging, in response to the same trigger and same reward.

For many years the NHS was averse to e-cigarettes, since smoking them is worse for one’s health than not smoking at all. However, they are 95% less harmful,77 and are an easy substitute for conventional cigarettes. As such, they are a very powerful quitting tool, and the numbers of people switching from cigarettes to e-cigarettes far outweighs those adopting e-cigarettes who would otherwise not have started smoking. Policy is now starting to reflect this, and provides a good example of where pragmatism can bring social good even if it goes against conventional wisdom or ideology.

Other examples of substitution include the use of artificial sweeteners in tea and coffee, a switch from full-sugar to diet carbonated drinks, or from beef burgers to chicken burgers, bringing substantial environmental benefits without requiring consumers to give up meat.
6. Lesson four: Incentives often work, but should be ‘behaviourally informed’

Lesson 4 key insights

- Incentives often work, but there are many ways they can backfire, and many aspects of our psychology which can be used to strengthen them.
- Incentives send signals. For example payment for a behaviour may signal that it is undesirable, or deserves payment. This may lead to ‘crowding out’ of any intrinsic motivation, and as such incentives, if paid at all, should be big enough to overcome this.
- Payment of a fine (or foregoing of a subsidy) can be seen as a ‘license’ to continue with the behaviour being discouraged.
- There are many cognitive biases relevant to incentives, and these can be addressed or harnessed to help ‘power’ financial incentives. For example, lotteries can be effective because we focus more on the size of the prize and over-estimate small probabilities. Our tendency to discount the future relative to the present means upfront incentives or delayed cost can be most effective.

Relevance to air quality on the SRN

- We discount future costs relative to the present. We therefore focus on the upfront cost of the car more than the long-term running costs, which disadvantages the sale of electric vehicles and new, cleaner combustion vehicles. Front-loading the savings, for example in a ‘pay-as-you-save’ scheme (spreading the vehicle costs over the long-term based on the petrol costs you would have paid) may therefore effective. A light-touch alternative is to make long-term costs more salient at the point of purchase.
- Similarly, we are poor at considering cumulative costs, perceiving car use to be cheaper as we consider petrol costs (often quite inaccurately), but overlook depreciation, maintenance, tax and insurance. Public transport, however, has the full cost salient in the ticket price. Making total running costs salient at the point of purchase (e.g. through labelling mandates) may be effective.
- Novel incentives such as community bulk-buys of electric vehicle combine incentives and social influence, or lottery tickets on the back of public transport tickets could be a cost-effective incentive.
- Other novel, behaviourally-informed incentives include a ‘use it or lose it’ clause on free bus passes (harnessing loss aversion), or harnessing proportional price evaluation in government subsidy design: framing a government subsidy as “we’ll pay £2,500 on top of market value for your old banger” would both be more salient, and proportionally perceived at greater, than a hidden subsidy at a modest fraction of the car’s cost.

Introduction

A large literature in economics is dedicated to studying the relationship between monetary incentives and behaviour, mostly because the classical economic model suggests that monetary costs and rewards are a principal driver of our behaviour. This is broadly true, and in the case of transport behaviours, prices, subsidies, taxes, fines and rewards can all be manipulated to encourage or discourage certain choices.

However, the mechanisms are not always straightforward. Incentives don’t only shift the economic costs and rewards, but bring about additional psychological and behavioural consequences. In this section we take it as a given that incentives do often work in their
intuitive and predictable way: all else being equal, cheaper products and services sell more, payments to do something encourage people to do it and fines and taxes discourage actions. However it is worth focusing on some important exceptions and complications to this account, and ways we can ensure incentives are ‘behaviourally informed’.

6.1 Incentives send signals

Incentives impart meaning: they imply information on the desirability of the behaviour, the person providing the incentive, and the motivations of others engaged in the behaviour. For example, when Swiss residents were asked if they would support the construction of a nearby nuclear power plant, those told that they would receive significant compensation were less likely to support the project. Here the incentive implied risk, and so acceptance of the power plant deserved compensation. Similarly, medical studies which offer higher compensation can receive fewer volunteers even when controlling for actual risk level. This effect emerges in more banal situations too: for example offering workers a bonus for completing a task implies that there is low expectation that the task would/should be completed, and so may undermine productivity.

This is one way in which explicit incentives can ‘crowd-out’ intrinsic motivations. Similar effects can occur if receipt of an incentive dilutes the intrinsic ‘signalling value’ of a behaviour: being paid to be sustainable, for example, can negate the virtue that the action previously embodied. This is not just about vanity either – we care deeply about how we perceive ourselves, too. Extrinsic incentives can also simply displace intrinsic ones over time, such that when a reward is removed (for example, a limited free bus pass), we’ve become accustomed to the incentive, and thus its removal leads the behaviour to drop below the level it would have been at if no incentive were ever introduced. Parents may find, for example, that children are less willing to help around the house for free if they’ve become accustomed to receiving pocket money for doing chores. This is not inevitable, of course. It is possible that short-term incentives help people start a new habit, overcome learning barriers, or lead to the adoption of new values which continue to drive behaviour into the long-term.
Moral licencing can also undermine intrinsic motivations when payments or fines are introduced. For example, when turning up late to collect their children for childcare, parents who were subsequently fined starting turning up later – the fine becomes a price, and by ‘paying for it’ (which equated to cheap childcare), the social stigma was gone.\textsuperscript{83}

Where there is significant risk of crowding out, common advice is to ‘pay enough, or don’t pay at all’\textsuperscript{84}. In other words the extrinsic incentive or disincentive should be strong enough to more than compensate any loss of intrinsic motivation that may have existed, otherwise we risk doing more harm than good.

There is some evidence of motivational crowding in, where a small reward or penalty strengthens the intrinsic motivation. There is less evidence on this and the mechanisms are less understood. It is possible that the incentive is enough to just about ‘tip’ the behaviour into being ‘worth pursuing’, or alternatively that the small incentive sends a signal that reminds us of what we should be doing. The plastic bag charge in the UK is a possible example of this. Whether an incentive undermines or strengthens an intrinsic motivator may not be easy to predict. Context is clearly important, as is understanding existing beliefs and motivations. For example, many people affected by the emissions scandal are wary of having their car’s software upgraded to reduce emissions because of news stories of reduced performance and problems arising. Paying car owners to adopt the software might feed into this narrative (it ‘deserves compensation’) and thus backfire. However carefully framing it as a discount (limited time only, free of charge, normally £X) may have a more positive effect, implying it is normally something ‘worth paying for’.

**Cognitive bias in incentives**

Cognitive bias has been discussed in lesson 3, and a catalogue of some of the most prevalent is included in Appendix A. Some biases in particular have a bearing on the design of incentives.

**Mental accounting** describes our tendency to compartmentalise funds into separate categories, violating the standard economic assumption of fungibility (that all money is interchangeable).\textsuperscript{85} For example, money for petrol, for vehicle tax, for insurance, for maintenance and for the car’s upfront cost may all be ascribed different ‘envelopes’, whereas as the cost of train travel may all be lumped into a single ‘envelope’ captured in entirety by the ticket price. This will skew our perception of the costs of commuting by car versus train in a manner which leads us to under-estimate the true cost of driving.

The **Sunk cost fallacy** leads us to be influenced by past costs which are not retrievable and which should have no bearing on future decisions, but which do so. For example, having purchased an expensive car, I may be motivated to drive even on a trip where the marginal cost (petrol) is more than the train ticket, in order to get value out of the car purchase.

**Proportional price evaluation** states that we perceive prices in proportional, not absolute terms: £10 off a £100 price tag feels more than £10 off a £50 price tag. This has implications on the perception of discounts and the ‘transactional utility’ (i.e. the value of the ‘deal’), and this can be manipulated by changing the framing. For example, reducing the cost of a £22,000 vehicle by £800 may be of greater objective value, but perceived to be less appealing, than reducing the interest rate of the credit used to buy it from 4.9% to 1.5%.\textsuperscript{86}

**Hyperbolic future discounting** describes our tendency to be biased towards up-front costs and rewards relative to those in the future. The immediate present is particularly salient.\textsuperscript{87} When purchasing products this leads us to focus too strongly on the price tag and ignore the long-term running costs. BIT’s work has found this to be true with white goods (where purchases were successfully nudged towards more efficient products by highlighting the running costs at the point of purchase).\textsuperscript{88} This is of clear relevance to electric cars which have very high upfront costs and very low running costs, and there is merit in policy tools which make the long-term financial benefits highly salient, or which front-load the savings and delay the costs (for example, free credit, or pay-as-you-save schemes).
6.2 ‘Powering’ financial incentives.

There are various ways we can ‘power’ financial incentives, harnessing their psychological aspects to make them more effective, per pound spent.

For example, symbolic rewards can be as, or even more, effective as monetary rewards. Where monetary rewards may crowd out intrinsic motivation, symbolic rewards are likely to strengthen it, particularly if they have a strong virtue-signalling value. In this way their use allows us to tap into the strong motivator of personal pride, social approval, kudos etc. and as such they should be public. For example, studies have found better volunteer retention with symbolic rewards than with financial rewards\(^9\), and better results within community safe-sex campaigns (with hairdressers giving out condoms in sub-Saharan Africa).\(^10\) Public recognition can also be made salient through published league tables, which also embody a strong social norming effect since people are compared to their peers. For example, ranking UK government departments on their energy use led to significant reductions among most departments (the biggest reduction was an impressive 22% in one month).\(^11\) There are clear applications for promoting eco-driving among fleet drivers, or for encouraging uptake of sustainable transport measures among employers.

Another way to overcome the risk of crowding out is to offer pro-social incentives, which the recipient passes on to another person or cause of their choosing. This has an added virtue-signalling effect, and winning £100 for your charity of choice may therefore be more motivating than winning £100 for yourself.

Where the aim is to encourage collective action, collective incentives can be useful. For example, a Local Authority may provide a bulk installation of multiple charging stations once a certain number of electric vehicles are bought within a community. We have also used conditional, collective incentives to encourage attendance and take-up of adult learning classes: attendees are paired up, and both receive a reward if both attend, but neither receive a reward if one of them doesn’t show up. This social contract adds weight to the implications of not attending. Again, there may be applications here with driving style among fleet drivers, or to encourage uptake of eco-driving classes or other employer schemes.

Lotteries and prize draws can be effective because we tend to over-estimate very small probabilities, and we focus on the size of the prize more than the long odds of winning. This means, for £1000 spent, giving 1000 people a 1-in-1000 chance of winning the whole pot may be more effective than giving a guaranteed £1 each. This said, the trade-off does depend on the values. This result tends to hold when the foregone payment is negligible (£1), and the potential winning is attention-grabbing (£1000). Otherwise loss-aversion would suggest the
opposite result, with the definite payment being more appealing; for example, £50 would be more appealing than a 50% chance of winning £100.92

Regret lotteries offer an alternative format: everyone is entered, even if they haven’t complied with the behaviour being encouraged. Only those who did comply are eligible to win, but others are alerted that they would have won if they had complied. This can be effective where we have repeated opportunities to encourage the behaviour, and thus the regretful winners can comply next time, and it also benefits from having lots of ‘would-be’ winners, not just one.

Gamification refers to the inclusion of competitive, chance, motivational, reward, or other ‘fun’ elements to provide a psychological hook to the activity being promoted. These may be attached to a financial reward, or the ‘game’ may itself be the sole motivator. Its effectiveness depends heavily on the specifics of the design, though on balance the literature suggests it is an effective tool and sometimes quite dramatically so.93 It has commonly been used in education, turning learning material into games to aid motivation and retention,94 and in public health,95 96 for example with technologies such as the Fitbit encouraging physical activity to earn rewards such as discounts on health insurance premiums and free cinema tickets.

Behaviourally-informed incentives: sugar, tax-avoidance, plastic bags and teachers’ pay

There are many ways policy-makers can draw upon behavioural insights to increase the power of incentives.

UK sugar tax. Information and awareness campaigns to encourage healthy eating and drinking tend to have limited impact, particularly outside the minority who are self-motivated to use this information. Similarly, applying a small tax to sugary drinks is unlikely to be enough – their price elasticity is not particularly high, meaning a marginal reduction in consumption may occur but most consumers will simply pay slightly more for their drink.

A key insight is that our health behaviours are hugely constrained and influenced by our environment. Therefore, making the environment less obesogenic, for example by reducing the availability of high-sugar drinks, has a far greater impact on our health. As such, the sugar tax was designed to target manufacturers, not consumers. Different tax thresholds were set at magnitudes of sugar content, designed to make it possible to avoid the tax with ambitious but achievable reformulation. So far, this has proven to be effective, with evaluations showing that reformulation is having a far greater effect on what consumers consume, than the mere price-effect does on what they choose.97

The Chinese and Taiwanese authorities use a novel lottery-based incentive to reduce tax avoidance. Many retailers were avoiding paying sales tax by not registering the sale of goods. In response, the authorities mandated lottery tickets on receipts (using tamper-proof equipment). Their face value was extremely low due to the very long odds of winning, but because we tend to focus on the prize and over-estimate small probabilities, shoppers now ask for a receipt, making tax avoidance much harder. The key insight is that if the receipt had the same face value as rebate (a fraction of a penny), the effect would not be as strong, and thus the lottery policy is highly cost effective.98

The UK plastic bag charge of 5p has led to a reduction in bag use of over 80%. This is a nice example of ‘crowding in’, whereby extrinsic incentives strengthen intrinsic motivations: 5p is generally not considered enough of an economic incentive to leverage such dramatic change, but it is a highly effective reminder whenever we purchase something that we should not be using plastic bags. This is aided by the fact that we are accustomed to bags being free, so 5p is highly salient, proportionally larger than it would be if added to a product we already pay for, and therefore acts as an ‘annoyance’ tax.

Harnessing loss aversion, studies have found that performance-related pay can be more effective if you pay it upfront, and then take it back if the performance standard is not met, rather than simply paying it out if the performance standard is met. For example this has been shown to be effective with teachers’ performance-related pay (where teacher performance is gauged by student performance).99
7. Lesson five: We’re social creatures

Lesson 5 key insights

- Our beliefs, attitudes and actions are profoundly influenced by our social environment, our culture and our social identity.
- Social influence can be normative (peer pressure – complying with norms to fit in), or informational (social proof – internalising the beliefs of others).
- Social identity is a powerful mediator of influence – we are more influenced by people we perceive to be like us.
- Also important are whether or not we are being observed (which increased peer pressure), and the perceived credibility of the influencer (which increases social proof).
- It is possible to nudge certain behaviours using simple social-norm messages (telling people what most people like them do), or by choosing the right messenger.

Relevance to air quality on the SRN

- Campaigns need to be delivered by the right messenger. Highways England may be perceived as credible and legitimate, but may have less influence than, say, a peer or cultural icon when promoting safety driving, for example.
- Status is a major barrier with unsafe driving (which also tends to be un-economic). There may therefore be potential to directly undermine the status associated with speeding or aggressive driving though soft penalties.
- Social norms are often used to promote behaviours which are the majority norm. There is almost no research, but good potential, in using relative norms, for example “more and more people are buying electric vehicles”. This also harnesses aspects of status and identity for those who want to be progressive or cutting-edge in their lifestyle.
- Surveillance increases compliance to norms. This can be achieved with speed cameras, for example, but other more novel, more cost effective solutions may exist, such as displaying eyes on level-crossings to reduce idling, or using softer messages to alert drivers to the fact their behaviour is known, where driving behaviours don’t warrant a penalty but should be discouraged (e.g. minor speeding).
Introduction

Though it may not always appear so as we drive to work in private cars and focus more on our phones than our fellow train passengers, we are deeply social creatures with evolved tendencies to conform, seek status, reciprocate and mimic. Our preferences, assumed to be relatively stable and individual by the rational choice theory, are in fact highly context dependent and embedded within our cultural and social existence. As stated by one of the interviewees:

“Like risky driving, [many of the efforts to promote] low-emissions driving and sustainable transport choices miss the point, focussing on choice and overlooking the social element, such as the signalling of personality, social identity and status to ourselves and to others.”

This section is a brief summary of the vast literature on social psychology, principally focussing on social influence (our tendency to mimic and conform to norms) and the importance of social identity (the sense of self we attain from ascribing to social categories and identities). Another major area of research in social psychology is reciprocity, which are covered in Lesson 2 within a discussion on the tragedy of the commons.

7.1 Social influence and conformity

Social influence describes the change in our behaviour resulting from others’ behaviour, opinions, or mere presence. Psychologists typically refer to two types of social influence:

**Normative social influence**: we do what others do because of a need to fit in, avoid embarrassment, be ‘part of the tribe’ and a general desire for consensus, harmony and social acceptance. Colloquially referred to as peer pressure, driven by ‘a need to be liked’. For example we might feel obliged to agree with others’ opinions, or to leave a tip despite not enjoying the food, worried about breaking expected norms.100

Because normative influence (peer pressure) is about compliance with expected norms and ‘fitting in’, it is very much mediated by the observation or presence of others. When we are not observed, we are far more likely to break social norms. Normative influence is therefore predominantly the conformity of the ‘public self’, and linked to the notion of perception management, status, and virtue-signalling. Public surveillance, such as through cameras, or even alluding to such surveillance, such as using an image of a pair of eyes, can increase compliance with social norms.

**Informational social influence**: we do what others do because their actions and opinions are useful sources of information. This isn’t mere compliance to peer pressure, but the true acceptance of beliefs (‘internalisation’) based on the views and actions of other people. For
example, we rely on peer reviews when choosing products, and we might automatically head towards one side of the train when everyone else does, on the assumption they all know which side the door will open on. This is colloquially called social proof, driven by ‘a need to be right’, and it’s a powerful force, often causing us to ignore the evidence in front of our eyes. For example studies have shown that we panic when others are panicking (despite not knowing what we are panicking about), and fail to panic when others don’t panic (for example not reacting to a room filling with smoke when others don’t appear to be worried).

Because social proof is about true beliefs, it is more associated with the ‘private self’, and mediated more by the perceived credibility of the influencing group or authority. The size of the majority is also important (since we draw on the heuristic that if most people believe or do something, it’s more likely to be true or appropriate).

7.2 Identity, messenger effects, and signalling norms.

The process of identification is sometimes considered a third form of social influence – the notion that we do what others do because we identify with them, we consider them as part of our in-group, or want to be like them (a process of self-categorisation). Moreover, the other processes of influence (normative and informational) are very much mediated by the extent to which we identify with the influencing agent. We are more motivated to fit in and comply with the norms of people like us, and more likely to believe and internalise the view of people like us.

One consequence of this is the messenger effect: we are more influenced by some people or organisations than others, and we should always bear in mind the perceived credibility, identifiability, likeability, and degree of social pressure a particular messenger may exert over the people whose behaviour is being targeted. For example, Highways England may have high credibility, but may or may not be as influential as, say, a neighbour or child when talking about road safety.

The broader point is that our social identities are important components of who we are. Social identity theory suggests much of what we do and believe is an expression of our social identity, branding ourselves as belonging to a certain social group. This includes the newspapers we choose to read, the clothes we wear, the type of car we drive, the degree to which we care about the environment, the level of attention we give our own health, and so on. We should therefore be sensitive to those social groups when designing interventions, and recognise that just as much as we tend to conform to our in-group norms, we can also resist and actively do the opposite of our out-group norms. For example, we might automatically disapprove of something said by a politician we don’t like, regardless of the content of her statement.
Social identity is also closely linked to culture since we may derive aspects of our identity from our nationality, ethnicity, class, age, family tradition, gender and so on, and tend to ascribe to the norms, practices, beliefs and expectations within that category. This can present barriers. For example research shows that it is more difficult to encourage men to be sustainable, as the ‘green’ lifestyle is associated with femininity and undermines the identity of masculinity.107 This is perhaps linked to school boys’ disinclination to work as hard as girls, due to the ‘too cool to care’ identity common among adolescent boys.108 However, culture can also provide opportunities. For example we might aim to harness healthy or sustainable aspects of other cultures, finding it easier to ‘sell’ that culture as a whole rather than health or sustainability per se (for example promoting Indian food, which happens to be quite sustainable, rather than promoting sustainable food). A well-known campaign in Texas aimed to harness the identity of proud, tough and independent Texans with the message ‘don’t mess with Texas’, credited with reducing roadside littering by 72% between 1986 and 1990.109

7.3 Obedience to authority

Our subordination to an authority is a specific area of research in social psychology, and one which shows quite disturbing tendencies to relinquish our autonomy in the face of a perceived authority, for example harming others when told to do so.110 This is an extreme example, but is relevant to issues of compliance on the road. For instance, research on compliance and obedience suggests that credibility is important, often signalled through the use of uniforms (it has been suggested that we are more likely to obey someone wearing a high-visibility jacket). Proximity is also important, being more likely to disobey if we are being observed remotely than in person,111 (implying present traffic officers may be more effective than cameras). Particularly important is the perceived extent to which others are complying with the rules.112 113 If others are not complying, our own inclination to comply drops dramatically (assuming we have a motivation to not comply – the disobedience of others has a liberating effect). This fact is observed through the ‘broken windows effect’ – if a street or community area is in disrepair (for example with broken windows, or graffiti), other anti-social behaviour (for example littering, or petty theft) will tend to rise: deviance breeds deviance (a process of social facilitation) and obedience breeds obedience (a process of social inhibition). Overcoming the beliefs that ‘everybody speeds’, or ‘everybody throws litter out of the car window’ may therefore be particularly important for Highways England.
7.4 Minority influence

The study of influence and conformity normally describes the influence that a majority has over a minority. However it is also possible for minorities to influence majorities.\textsuperscript{114} This tends to be restricted to internalisation (social proof, i.e. genuine changes to beliefs and attitudes rather than mere compliance) due to the fact that there is clearly less pressure to merely ‘fit in’ with a minority view or behaviour. As with the various rights movements of the 20\textsuperscript{th} century, widespread social change does often start with minority groups, and this may be particularly relevant to the sustainability movement and sustainable transport adoption (particularly the adoption of electric vehicles) which are still very much minority activities. The research suggests that the most important factors for minority influence are apparent conviction of the message and perceived consistency. When we observe a group who are unambiguous, coherent, and convinced of the validity of their actions\textit{ despite} being in the minority, we become aware that there may be some truth to their message.\textsuperscript{115} Also important are perceived credibility of the messengers, and the extent to which we can identify with them – there is a risk that if a hard core of electric vehicle users are always perceived as ‘other’ and fringe, for example, their influence may not spread as we can all too easily discount their views as belonging to an out-group we would expect to disagree with. Movements of change become more powerful when joined by people with whom the majority identify with.

Harnessing social influence: tax compliance, vehicle registrations and antibiotic resistance

Much of BIT’s work has harnessed social influence. For example in the discussion on reciprocity and conditional cooperation (Lesson 2) team’s work on Tax collection is mentioned where the message “9 out of 10 people paid their tax on time” increased the rate of declarations, bringing forward hundreds of millions in UK tax revenue. Reciprocity is closely linked to the idea of social norms (and in fact is a social norm) as where acts of public good are concerned (for example paying taxes) we perceive our own digressions to be less acceptable if we become aware that most people are complying.

Often, more specific, personally-relevant norms are even more impactful (for example, “9 out of 10 people with a tax debt like yours, in your area”). This may be because it makes it less easy to discount the information as irrelevant to your own circumstances. Moreover, the important point is not always that the referenced majority is particularly large, but rather that it updates our beliefs in the desired direction (e.g. “60% pay on time” may be effective if we presumed that no-one did).

The research on conformity also highlights the importance of surveillance. BIT put this to good effect in an effort to significantly reduce the number of unlicensed vehicles on the road by redesigning the reminder letters send by the DVLA. By referencing the recipient’s specific model of car and including a photo of them driving the car (taken from a road camera with automatic number plate recognition), we made it salient that the DVLA is monitoring their transgressions, increasing registrations as a result of the letters by over 20%.

The identity of the messenger is also very important. In work on charitable giving, BIT managed to more than double the number of people donating a day’s salary to charity by sending the request email from the CEO of a large company, rather than from the HR department. Clearly, we are keen to comply with some people’s requests more than others.

Antibiotic microbial resistance is a rising global problem, caused by the unnecessary prescription of antibiotics to humans and animals who don’t need them. This problem has an inherently social aspect to it, as patients often visit their GP wanting to feel ‘treated’ and expecting to take something away with them. GPs often find it hard to deny them this expectation. BIT tackled this problem by sending letters to the top 20% of prescribing doctors. This letter harnessed a social norm message (“the great majority, 80%, of practices in your area prescribe fewer antibiotics per head than yours”). It also harnessed a powerful messenger effect, being signed by England’s chief medical officer Dame Sally Davies, and aimed to overcome the social pressure from patients by suggesting doctors provide delayed prescriptions (giving the patient a prescription which cannot be redeemed for a number of days, and which therefore would often not be redeemed at all), as well as ‘self-care’ pamphlets so that the patient could go away with something in hand. The letter resulted in a 3% reduction in prescriptions, which though modest, was orders of magnitude more effective per pound spent than a conventional marketing campaign being targeted at GP surgeries at the same time.\textsuperscript{116}
8. Lesson six: It’s not all about behaviour change, sometimes we want to build public consent and acceptance

**Lesson 6 key insights**

- Previous sections (particularly lessons 1 and 2) highlighted that changing attitudes and beliefs can be difficult, and is often not sufficient to change behaviour. However, behaviour-change is not always the key objective. Sometimes we want to update peoples’ awareness or attitudes to increase public engagement with an issue or increase consent with policy interventions such as taxes and bans.
- Lessons can be learnt from the field of planning, suggesting than genuine community engagement is key, giving people a sense of ownership and constructive agency, and highlighting the benefits to people. Objecting should not be the only or primary route to engagement open to citizens.
- Public consent often emerges after-the-fact. Risk-aversion and uncertainty-aversion may skew opinions toward the negative before a change happens. We then update our beliefs in response to our experiences of the policy which may be more positive.
- BIT recommend the use of deliberative forums, used rarely in the UK, to engage the public on complex policy topics such as air pollution.

**Relevance to air quality on the SRN**

- There may be two broad kinds of objections to transport policy: objections from road users (for example objecting to road pricing, speed limit changes or fuel duty changes), and objections from local communities (for example objecting to the erection of roadside barriers). It is crucial to understand the nature of each to maximise the benefits of policy interventions.
- Many of the insights from lesson 1 may be beneficial in increasing awareness and promoting attitudes towards interventions such as roadside barriers. In particular, understanding the emotional response to air quality, engaging communities on the health impacts to them and their children, and making them more attractive.
- Many of the lessons from lesson 4 may also be relevant when considering how best to frame incentives, for example harnessing loss aversion or the endowment effect to increase demand for community infrastructure.
- Air quality is a topic which the public have not been effectively engaged with. It is perceived as something ‘other’ which as individuals we can do little about, and being a complex topic is likely to be mired by misperceptions. The topic may therefore be very well suited to in-depth and high-profile public engagement, with trade-offs presented to a public forum entrusted with soft decision-making power.

**Introduction**

Throughout this report the fact that values and attitudes often don’t translate to behaviour has been stressed, and this can be particularly true for issues of sustainable behaviour, where cost, convenience and enjoyment tend to out-weight our green ambitions.

However, the aim might not always be to change behaviour. Often the interest is in changing attitudes for their own sake, particularly if the aim is to build public support, awareness or consent for new infrastructure, regulation or spending. Announcing the ban of ICE cars in 2040 is sufficiently distant to be relatively uncontroversial, however many changes may be
needed sooner. Policy responses such as building barriers on the roadside, altering speed limits, or increasing petrol prices will all receive public concern and objection to varying degrees.

8.1 How popular are different types of policy interventions?

Generally, public acceptability is quite high for information-based intervention (i.e. we don’t mind being informed), though we know them to be less effective at changing behaviour, while more effective interventions such as pricing tend to be less popular.117 118 119

This point is in spite of the finding that public acceptance of policies tends to increase with the belief that they will be effective.120 121 For example, public acceptance of various interventions to tackle obesity, smoking, weight-loss122 and alcohol consumption123 all increased with the magnitude of their perceived effectiveness. The same is true of environmental policies to promote driving less and eating less meat.124

Unsurprisingly other important factors are the perceived extent to which freedom of choice will be restricted, and whether it is beneficial to oneself: we are more likely to favour strict regulation against behaviours other people are doing, than those which restrict our own behaviour.125 Also important is the degree to which the policy may be perceived as manipulative, reflective, conscious mental processes (explicit information, incentives etc.) are preferred to those based on automatic, non-conscious processes. However this result is not straightforward: support for nudges is still broadly very high across much of Europe (including in the UK), and support tends to increase with evidence of their effectiveness, suggesting part of the dislike (where it exists) may be due to perceptions that they won’t be effective rather than more philosophical concerns (after all, we do tend to underestimate the extent to which our non-conscious processes determine our behaviour). Furthermore, the perceptions of nudging tend to get more favourable when a preferred (partisan) political authority advocates them, suggesting a kind of messenger effect or identity effect – we agree with our leader of choice.126

8.2 How to increase acceptability?

Given the above findings, public acceptability might be increased by communicating the effectiveness of the intervention. Furthermore, increasing awareness of the need for intervention brings obvious benefit (i.e. ensuring people are aware of the state of air quality, and the effect it is having to them, and the benefits to them the intervention will bring). For example, sustainable policies which presented outcomes in terms of health benefits of mitigation, rather than the health risks of climate change, attracted greater support127 (though our strong risk aversion wouldn’t necessarily suggest this framing is always best). Also
important is the need to frame the benefits in the most appealing way: for example health benefits tend to be more convincing than environmental benefits, reflecting the fact they are more tangible, intuitive, near-term, and driven by self-interest. These activities require careful and effective communication, but are largely within the conscious real of our psychology, targeting values, beliefs and attitudes.

One study also suggests that it may help to increase peoples’ understanding of the non-conscious nature of much of our behaviour: the more people attribute over-consumption to the physical environment in which behaviour occurs, rather than free choice, the more they supported policy interventions to tackle obesity which targeted the environment.\textsuperscript{128} This is an issue of correctly identifying the cause of the problem. Given our tendency to blame governments and corporations for environmental problems, building support for policies which operate at this systemic level should be possible (for example, this might include taxes targeted at manufacturers and infrastructural development). However, there will still clearly be dissent among those concerned about trickle-down cost implications for the consumer, and those averse to infrastructure in their neighbourhood.

\textbf{8.3 Retrospective approval}

Our behaviour-change model in Figure 3 highlights the fact that attitude change often comes after behaviour change. This fact is reflected in the finding that support for policies often arise after-the-fact. This may be for a number of reasons, including the fact that our own behaviours and experiences inform our beliefs and attitudes, and our risk-aversive nature, tending to be against change until it has occurred, and only then do we come to realise the benefits. For example, though the evidence is quite weak, it is often suggested this was the case with the smoking ban in the UK (which was fiercely fought but attracts huge public support now) – this may be because many of us underappreciated the benefits of a smoke-free pub or restaurant until we had experienced it. Similarly, the 5p plastic bag charge received popular support after being implemented. Perhaps the most robust evidence of this trend, or

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure3}
\caption{public approval of the London congestion charge, before and after implementation}
\end{figure}
particular relevance to this project, is of the London congestion charging scheme, where public approval increased significantly and rapidly after implementation (figure 3).

8.4 Community engagement and deliberative forums

When it comes to engaging communities to increase support, a lot can be learned from the planning system in the UK. NIMBYism\[iv\] is a common barrier to development, and there appear to be no easy solutions. However, behavioural evidence suggests there is benefit to early engagement (to avoid the impression that communities are being engaged as an afterthought or because they must be), and sincere engagement (to ensure communities feel a genuine sense of agency, to impact the feeling that development is happening with the community, not being done to the community). It is also important to generate a sense of ownership, either real or symbolic: we are much more likely to support something we feel we have had constructive input into, and this is where the conventional planning system tends to fall short: the system is largely focussed on objections, with no way to meaningfully contribute in a constructive manner. For example, allowing community members to vote on aspects of a development will encourage input, allow community members to exert their agency and be heard, but in a constructive way.

One way to harness this approach outside the planning system is the use of deliberative forums. Deliberative forums bring together a representative panel of the public to discuss a policy issue and develop solutions to it, in a similar format to a jury service. They have been used around the world often to good effect.\[v\] Their precise nature can vary, for example the decision of the forum is not necessarily binding but a formal recommendation, and some are short events while others last several weeks and bring in large groups of the public.

Additional mechanisms can also bring in wider views, for example with media coverage during the debates and technological solutions (e.g. through social media) to enable other members of the public to pose questions and views.

Deliberative forums have the potential to create an unusually strong mandate for policy, particularly where difficult trade-offs are required and often officials may feel they are ‘damned if they do, damned if they don’t’ – where a decisions is made by the public, there is far less scope for anger or objective from aspects of the media or other groups.

It is also possible that such forums generate more innovative solutions. By presenting all the evidence to the forum, common misconceptions can be overcome, a plurality of perspectives can be sincerely debated, whilst policy-makers can capture a wide range of views and varying expertise. They also bring with them a unique opportunity to influence

\[iv\] NIMBY = Not In My Back Yard, an aversion to having development take place within your community, even if you support the objective that the development serves, you would rather it happened elsewhere.

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wider behaviour, since public consensus and the policy-making process itself is likely (if done in this manner) to influence wider social norms and attitudes, as well as signalling the public’s views to corporations.

A common objection might be based on the concern that a representative sample of the public would lack the expertise and knowledge to make policy decisions. However, such reasoning undermines the use of juries in the legal process, and evidence suggests that where deliberative forums have been used, this is not the case, and if anything the opposite is true. Clearly there is much potential to use deliberative forums as a creative and open-minded policy-making process when dealing with complex issues like air quality. Where difficult compromises are required, for example introducing new clean air zones, creating a strong mandate is crucial. They have promise for more localised issues, for example the building of barriers along specific stretches of road.
Part II: A review of the literature on behaviour-change in transport.

There are many potential ways to regulate, incentivise, nudge, encourage or otherwise support people to pursue less polluting transport behaviours. Taking our cue from academia, we have organised this evidence review into four sections which naturally emerge from the literature:

- **Modal choice:** how might single-occupancy vehicle use be discouraged and the use of more sustainable modes of transport be encouraged?
- **Purchasing decisions:** how might drivers and fleet operators be encouraged to purchase more efficient vehicles?
- **Driving style:** how might drivers be encouraged to drive in a more fuel-efficient and less polluting manners?
- **Traffic management:** how might traffic be managed best, for example through speed restrictions, congestion reduction and demand-shift, such that the road network is used optimally?

The following chapters provide an overview of key findings across these four themes, providing some commentary and criticism where relevant, and highlighting key points with case studies and in-depth policy discussion.
9. Modal shift

Encouraging people to give up their private cars in favour of buses, trains, bicycles and footpaths has long been a policy objective of governments in the UK and around the world. Not long after we designed our communities around private car ownership through the 1950s, 60s and 70s, efforts have been made to reverse the trend and encourage a more sustainable and healthy approach to mobility.

This dominance of car use has been slightly less pervasive in Europe than in the US, in large part thanks to historic city centres being less suited to the car\(^v\). However as a society we still find ourselves overwhelmingly car-centric, in our policies, our social norms, and our infrastructure. That the car is so ingrained in modern society is highly relevant to the issue of modal shift: the evidence overwhelmingly shows that these ‘structural’ aspects of the world around us (socially, politically, fiscally, geographically, and technologically) are the dominant factors shaping our transport behaviours. By contrast, individual choice (and the measures which aim to influence these choices, such as information campaigns), can explain some of the variation but tend to have less impact than we might hope.

\(^v\) In the UK in 2016, 78% of kilometres travelled were by car (64% of trips), compared to around 90% of vehicle kilometres in the US.
9.1 Structural vs. behavioural interventions

Practitioners and academics study mode shift have long recognised that structural interventions (called ‘hard’ in the literature) are often more effective than behavioural interventions (called ‘soft’ in the literature). ‘Structural’ interventions refer to infrastructural and physical improvements, and legislative or fiscal measures which regulate travel behaviour or fundamentally decrease the attractiveness of car travel relative to other forms. For example, this might include bus lanes, new cycling highways, parking restrictions, road pricing and chargeable emission zones. ‘Behavioural’ interventions aim to target road-users’ attitudes, beliefs and choices to encourage voluntary change, the most common being Personalised Travel Plans (PTPs). Hard interventions not only tend to be more effective than soft interventions, but are often necessary: without sufficient infrastructure in place and affordable public or active transport options available, behavioural interventions to boost uptake will rarely be as effective.

Lessons from cycling initiatives – infrastructure is vital, and there’s rarely a cheap alternative

This report focuses relatively little on cycling, as it is a less plausible (though not impossible) mode choice for journeys taken on the SRN. However, the volume of academic and policy research on cycling means it provides a convincing example for why our social and physical environment is so important in determining our transport choices.

Over a quarter of journeys in the Netherlands are taken by bicycle, compared to just 2% in the UK. This is not because information and awareness campaigns are 15 times more effective in Dutch, but rather because Dutch society and infrastructure are fundamentally more geared towards cycling: the Netherlands was already the top cycling country in 1911, before the rest of the world was re-engineered around the car. and the bicycle has always been elevated as part of the Dutch identity and thus given greater priority in all aspects of policy and urban planning.

The same structural factors generally provide the best explanation for varying rates of cycling within the UK too: cycling trips in London have increased by 133% between 2000 and 2015, the time period over which the bike-sharing scheme and subsequent cycle network and superhighways were introduced. The highest rates of cycling in the UK are found in Cambridge, where the causes are similarly embedded in the sociotechnical context of the city: the population is largely liberal, quite young, with many on a modest student budget; the town is one of the flattest in the UK; the ancient cities are poorly suited to mass car use: restricted parking permits force many commuters to either take the bus, walk, or cycle; there are business incentives to establish bike hire and cycle parking; and Cambridge has over 60 miles of dedicated cycling lanes with cycle priority at junctions.

Most of these factors are either not changeable, or relatively costly, implying there is often no ‘easy fix’ to promote mode shift: Good infrastructure, convenience, and attractive cost benefits are usually necessary a large-scale mode shift becomes achievable.
9.2 Personalised Travel Plans (PTPs)

Personalised travel plans, whether delivered digitally, through face-to-face discussion with an employer, or through other means, aim to provide individuals with tailored advice on their travel options, giving tips on bus routes, train times and cycling opportunities. They predominantly operate on an ‘information deficit’ model of behaviour-change, discussed and critiqued at the beginning of Part I. This means they may be effective on the assumption that many of us have better travel options available to us that we are not aware of, and that we often drive by default giving alternative modes little consideration. Some travel plans move beyond mere information provision, and aim to increase motivation to shift modes by highlighting the importance of sustainable travel or potential cost savings.

The evidence on the efficacy of PTPs is mixed, though broadly suggests they can (though don’t always) lead to a reduction in car use. The research is also limited by relatively poor methodological rigour.

One review of PTP projects in England finds an 11% average reduction in car use\textsuperscript{32}. However, such findings are open to debate – this review questions the methodology of many of the studies citing concern over a lack of independence of evaluators, small sample sizes, and biased survey results. Also concerning is the prevalence of other transport initiatives taking place over the course of many of these trials. For example, many PTP evaluations took place while bus upgrades, pro-cycling and other initiatives were taking place. Another review\textsuperscript{33} identifying 17 studies found reductions in car use ranging from 1% to 14.7%, but also with concerns over methodology. Of these 17 studies, 11 of the reported reduction in car use were not statistically significant, and only 6 of the studies were randomised controlled trials.\textsuperscript{vi}

In 2005 the Department for Transport published a review\textsuperscript{34} of 14 PTP pilot studies undertaken by Local Authorities around the country: 7 targeting residential populations, 6 targeting workplace populations, and 2 at schools. Their conclusion is broadly positive, showing that the pilots targeting residential populations were consistently most effective, all reducing car use. Workplace and school efforts were more mixed. The report also suggests that most studies were undertaken to a high standard of rigour (with few exceptions), however we have greater reservations. All depend on self-reported outcome measures with sample size problems and self-selection bias emerging due to low response rates (e.g. one of the pilots has 18 survey responses out of 2,758 targeted residents). Many also had simultaneous

\textsuperscript{vi} To give one example of the methodological limitations common across this research, one study (Rose, 2009) cited in a peer-reviewed meta-analysis focuses on a voluntary travel planning initiative (inviting self-selection bias), offered to first-year university students (a non-representative sample), comparing the self-reported (not observed) travel behaviours in 2003 to a different cohort in 2004 (i.e. with no randomisation or true counterfactual). A statistically significant 9.2% reduction in car mode share is reported, which is encouraging, but not a result we would consider rigorous evidence.
interventions going on (such as incentives and free bus passes) which makes it impossible to disentangle the effectiveness of the PTP itself.

**Personalised Travel Plans (PTPs) at Heathrow Airport**

In collaboration, the Department for Transport, Heathrow Airport and BIT trialled workplace personalised travel plans to discourage single-occupancy driving in favour of public transport and cycling to work. A key objective of this work was to trial interventions similar to those deemed successful in the existing literature, but using more rigorous methodologies (true randomised controlled trials, observed behavioural outcomes rather than self-reported, and greater statistical power).

The intervention had a two-stage design: Personalised commuting plans were sent by email to 790 employees (with a control group of 305 receiving no plan), with tailored commuting information as well as information on discounted Heathrow travel products. We found that being emailed a PTP had no impact on commuting behaviour. Within the PTP was an invitation for a one-on-one session, with the second part of the trial intending to determine the impact of this session.

Of the 790 recipients, just 21 (2.7%) signed up for this session. This sample is too small to run robust statistical analysis, however we progressed and randomised this group with 11 invited to the one-on-one session, and 10 waitlisted (receiving the session after the trial had finished). These 11 would be asked to develop implementation intentions to plan how they would implement their alternative commuting plans and overcome likely obstacles to their intentions. However, only 4 of the 11 actually attended the session, and as was therefore not possible to detect any significant impact on commuting behaviour.136

Given the frequently poor methodology of published studies and the non-systematic way in which PTPs have tended to be designed and evaluated, it can be challenging to identify which attributes of a PTP underpin their impact (if any). This question is inadequately addressed by existing literature, and indeed one of the above meta-analyses concludes that “[a] priority is to increase understanding of how design elements of PTP projects influence behavioural outcomes and develop appropriate research elements to investigate this”136.

In BIT’s work with the Department for Transport and Heathrow Airport, outlined above, BIT drew upon the wider behavioural science literature to suggest what features could and should increase the effectiveness of PTPs, noting that there is insufficient evidence to move beyond well-grounded theory. Key elements of a successful PTP are likely to include: making the information as simple and easy to use as possible; encouraging public commitments (we are more likely to follow-through on a behaviour we have publicly committed to); using implementation intentions (pre-set plans for overcoming anticipated barriers); personalising the content as much as possible; and harnessing timely moments such as a job change or house move when people are having to adopt a new travel strategy anyway. Of these, the latter may be particularly effective since the existence of a default commute which can strongly pull us into old habits does not yet exist.

One 2006 study attempts to disaggregate the features of PTPs by reviewing 10 Travel Programmes in Japan. Their conclusion, heavily caveated due to the wide variation in the features and effectiveness of the 10 programmes being evaluated, is that the two features most consistently driving behaviour change are 1. personalisation of the information, and 2.
asking participants to make a ‘behavioural plan’, i.e. an implementation intention to outline how they will translate their intentions into action. Given the large intention–behaviour gap common to many pro-social and pro-environmental behaviours, the use of implementation intentions to help people convert intentions to behaviours seems to be a logical inclusion.

Harnessing timely moments to promote mode shift

Many of us do not give our travel behaviour much thought – we tend to take the car by default, even for shorter journeys that do not warrant it, and much of our travel is done on ‘auto-pilot’ (System 1 thinking). We therefore rarely have cause to think about alternatives and change our habits, and part of the function of an effective PTP is to artificially create this opportunity for reflection and habit-change – that is, a ‘decision point’. Where a natural disruption to our habit occurs, we may have an even greater chance at achieving change. Three case studies demonstrate this well.

WWF’s office move in the UK

The World Wildlife Foundation (WWF) moved their UK headquarters from Godalming in Surrey to Woking, just 10 miles away. During the move the company actively encouraged staff to begin commuting by train in an effort to promote a more sustainable working culture. Researchers at the University of Bath took this opportunity to evaluate the impact of this change, surveying staff a year before, a week after, and a month after the move. Notably, the intervention was far more than mere information and messaging from the company: Woking has better rail connections; the office was now a 7 minute walk from the station (compared to 25 minutes at Godalming), and for 6 months WWF paid its staff the difference in cost for rail commuters if their fares increased. However, driving was also quite appealing – the new offices had ample parking which was also subsidised for 6 months.

The result was a reduction in the proportion of employees driving from 56% to 23% (back up to 29% a month later), while train use went up from 18.5% to 56%. By also surveying attitudes and self-reported ‘strength of habit’, the researchers also found that the new habits did not solidify immediately - workers were willing to try the new commute but the change led to a period of flux, less ‘ingrained’ in their new commute, even one month later, than they were in their old commute. This led the authors to conclude that “as well as a window of opportunity for change, a discontinuity also introduces a window of vulnerability to relapse”—a certain amount of time during which the new habit is not fully established and the old habit is not fully extinguished, meaning people might easily revert to their old behaviors in the presence of appropriate contextual cues.”

Though the nature of this study makes it impossible to disaggregate the effect of the ‘timely moment’ from the structural changes that the move brought about, the body of evidence shows that harnessing moments of change is a powerful factor to consider in all intervention types, particularly when trying to disrupt ingrained and habitual behaviours such as commuting.

The benefits of forced experimentation on the London Tube

Recent analysis showed that many people permanently change their commuting route on the London underground after being forced to do so temporarily due to strike action — in such cases people discover the alternative route they are forced to take is actually better, demonstrating that many of us do not ordinarily take the optimal commute. Also revealing is the fact that this was more common among people living in areas where the London Tube map was more distorted, highlighting the importance of easy-to-understand and accurate information in shaping our choices. Other studies have shown that offering free public transport tickets and travel information are particularly effective when issued at the point of moving house.

Promoting cycling after a house-move

Aiming to promote use of a cycle-share system, BIT ran a trial targeting Portland residents who had either moved close to a docking station, or those who had had a new docking station built near to their home. Both instances represent timely moments of sorts, though the former has cause to disrupt existing habits, and the latter brings new possibilities, but is not by its nature disruptive to existing behaviour.

The intervention consisted of postcards advertising the bike-share facilities either framed as a discount (treatment 1) or in terms of what service you got for free (treatment 2). No difference was found between the treatments, but the results showed that residents who had just moved were twice as likely to take up the offer as those who had a docking station built near them, highlighting the power of disrupted habits which can be harnessed at timely moments.

9.3 Financial incentives

There have been numerous studies of the effect of incentives on mode choice, and again, the methodologies are sometimes relatively weak, and the results are mixed.

9.3.1 Road pricing

One common form of incentive is road-pricing, sometimes designed simply to raise capital to fund infrastructure, and sometimes explicitly as a measure to reduce car use. However, with the latter purpose in mind, like any ‘sin tax’ it tends to only be effective if it is relatively easy
to avoid by adopting an alternative behaviour, such as public transport. Where the alternatives are difficult, uncomfortable, expensive, slow, or for other reasons less preferable, then travellers may continue to drive, since driving and paying is still the best option. This outcome is often borne by the evidence, with research\textsuperscript{41} showing that the most common response to charges is simply to pay and continue driving. Many drivers will also try to avoid the charge by taking alternative routes, but without giving up the car. These alternative routes are often longer, and thus potentially more polluting and causing of congestion. Only a minority of drivers switch to an alternative mode of transport. This finding replicates across a number of real-world studies of road pricing schemes,\textsuperscript{142} including in Germany\textsuperscript{143} and Oslo.\textsuperscript{144} One randomised controlled trial (albeit it with a very small sample), tested the combination of road pricing with journey-planning to determine whether better planning (i.e. more time to consider alternative means) led to greater likelihood of modal switch and/or reduced journeys in response to the road pricing. This was indeed the case, though the impact was found to be very modest.\textsuperscript{145}

A common conclusion is that “the lesson for policy makers is that road pricing charges must surpass a minimum threshold in order to entice changes in travel behaviour”\textsuperscript{146}. In other words, if drivers don’t stop driving in response to road charges, then charge more until they do. However, high prices are also likely to be politically unpopular\textsuperscript{47} and regressive, penalising lower-income drivers who have little choice but to pay. An alternative conclusion might be that alongside road pricing, if drivers are to switch mode then the alternative transport must be sufficiently appealing – economical, convenient and available.

\subsection*{9.3.2 Other financial incentives}

Beyond road pricing, more novel financial incentives have been tested. However, again, the literature is often undermined by poor methodology. For example, one study\textsuperscript{48} (cited as having ‘high’ methodological quality in a review article\textsuperscript{149} due to the use of a randomised control group) found that cash and non-cash incentives successfully reduced driving, albeit the study was among a group of 24 psychology students with prizes including a trip to a mental health facility. Another study found that lotteries for reducing driving can be effective (achieving an 11.6\% reduction), but not after the incentives were removed, when the rates of driving increased relative to the baseline.\textsuperscript{150} This is a common problem with extrinsic incentives, with recipients having a tendency to become accustomed to and feeling entitled to the payment, therefore backfiring when removed.

There is also a body of literature focusing on the role of incentives in specifically promoting active travel (walking and cycling). Though this is less relevant to the SRN, we note that similar conclusions can be drawn: One fairly recent review article covering research published from
1997 to 2012 concludes that the evidence is patchy and methodology often poor, but that financial incentives clearly do play some part in people’s decision to cycle or walk.\textsuperscript{551}

In South Korea, a ‘green points’ system rewarding environmentally friendly behaviour across a wide range of goods and services (in which points can be traded for travel vouchers and gifts), is described as effective, though BIT is not aware of any robust evaluation.\textsuperscript{652} However, undoubtedly such smart systems have great potential. It is becoming increasingly common to see app-based smart interventions to promote active lifestyles (for example rewarding gym membership and distance walked with cinema tickets and cheaper health insurance premiums), and though robust evaluation of these schemes is scarce, the potential for similar approaches with a sustainability agenda is promising and largely unexplored.

Another common incentive is to offer free or discounted bus or train passes. Two outcomes are of interest with such interventions: uptake of the public transport in response to the incentive, and continued use of the public transport after the incentive is expired (if it is temporary). The risk is that, like the lottery example above, uptake drops after the incentive expires. However, the counter argument is that new habits may form, and preconceptions may be overcome if drivers can be encouraged to try taking public transport. In this vein, one small-scale experiment targeting 43 drivers finds that bus use increases in response to a 1-month free pass and sustains after this period, supported by more positive attitudes to bus travel after experiencing it\textsuperscript{655}. Interestingly the original authors frame this as a success, though another review article\textsuperscript{654} deems it a null result, since a significant reduction in car use was not achieved and what reduction there was, was only relative to the control group’s increase, not absolute – a problematic finding with such a small sample size and thus low confidence that the control group offers a robust counterfactual.

In an effort to replicate this finding, BIT trialled a similar intervention with the Department for Transport and Heathrow Airport. Running a robust Randomised Controlled Trial we tested the impact of a one-week free bus pass offered to 7500 employees (with a control group of 2500 who received similar information on the buses, but no free pass, in order to distinguish the impact of the incentive itself from the informational content). No effect was found, with registrations of free bus passes being 2.21% and 2.22% in the control and treatment group respectively, and purchase of travel cards subsequent to the end of the free trial being 1.45% and 1.31%.
9.4 Infrastructural interventions

Studies which evaluate the impact of substantive infrastructural improvements tend to quite be low in methodological rigour but the few studies that do exist are useful indicators of the significant impact that infrastructural improvements can have.

One of the most powerful structural changes we can make is to move workers closer to their place of work. This is precisely what one employer did as part of Washington’s Commute Trip Reduction (CTR) programme, transferring worksites closer to homes by switching banking staff between branches, leading to a significant reduction in miles driven among staff. The wider CTR programme, adopted into law in 1991, obliged large employers to develop programmes to reduce single-occupancy car use, though left employers to develop their own strategies to achieve this. This legislative approach has led to various innovative solutions emerging, including support for flexible and remote working, introduction of parking fees, car-sharing and ‘van-pool’ incentives, and even mortgage discounts for staff to move closer to work and money to furnish a home. Though most employer’s schemes have not been evaluated individually, an over-arching evaluation concludes that vehicle-miles travelled reduced by 4.6% and the frequency of driving alone to work fell by 3.1%, between 2007 and 2012 – this is while trip rates among other employers and the Washington population at large significantly increased, implying that the effect of the legislation is significantly greater than these numbers imply. The impact may be even more impressive if one assumes a lot of the improvements might already have occurred during the 16 years
prior to 2007 that the legislation had been active. Similar impacts have also been found with a similar scheme in California, though again the evaluation is quite weak. It is rare that the impact of major infrastructural upgrades such as new railway stations are evaluated, but one study aimed to do exactly this, finding that average distances travelled by car significantly reduced. This resonates with the truism that alternative options need to be readily available and convenient, though the authors nonetheless express caution as it is impossible to control for other changes in time which may have influenced rates of driving. Other studies also find a positive effect of making alternative transport substantively easier, more available and convenient: for example, providing free company bikes has also been shown to reduce car use.  

9.4.1 Parking  
Most employers give little thought to the influence they have over staff transport behaviours. However, evidence shows that they are in a prime position to promote mode shift by virtue of the parking and other transport benefits they provide. For example, one study found that offering a cash alternative to parking passes successfully reduced the number of vehicle trips and miles, and even more so the proportion of solo drivers (colleagues began car-sharing and splitting the cash from the foregone parking space). Similarly, increasing parking costs has been found to be effective at reducing driving (though one might suspect this to be less effective if other cheap parking options are available nearby – just like with road pricing schemes, drivers may first seek alternatives before giving up their car).  

The detrimental impact of free parking  
In the UK it is common for employees to receive parking ‘benefits’ (though rarely framed as such) in the form of free parking on site. In contrast it is rare for employees to receive public transport benefits other than loans to cover season tickets. This one-sided approach ignores the fact that free parking comes at a significant cost on bought or leased land with high value and opportunity costs. Such costs may be as much as providing free or subsidised public transport, and is an approach which incentivises driving.  

This pro-car bias is not adopted everywhere. Analysis has been undertaken on survey data from over 4,600 commuters in and around Washington D.C., correlating mode choice with the transport benefits provided by employers. They found that with no commuter benefits (no private parking or subsidies for public transport), 76% drive to work, and 22% take public transport, suggesting that driving may be the preferred option where all else is equal. When only free parking is offered (akin to many UK employers), single-occupancy car use goes up to 97%. When only ‘transit benefits’ (i.e. bus and rail passes) were offered, the use of public transport increased to 76%, with car use dropping to 25%. When both parking and transit benefits were offered, rates of driving and public transport use were 83% and 16% respectively – that is, more car-biased than when no benefits were provided, suggesting the offer of free parking does more harm than the offer of free public transit can correct for. The enormous magnitude of these fluctuations reveals the power that employers have, and whilst the absolute numbers would not necessarily translate to the UK Strategic Road Network context, there is no reason to believe the direction of effect would be any different.  

This is an issue pertinent in BIT’s own work with the Department for Transport and Heathrow Airport. Despite great efforts being made by Heathrow to encourage cycling, car sharing and public transport use, staff are currently eligible for free parking passes, which were found to be a major contributor to the lack of impact that the interventions had. Driving is inadvertently promoted among new staff, with the application for the passes being one of the first points of administration prior to a new member of staff starting work. The significance of this as a barrier to modal shift was revealed through our qualitative research with employees at Heathrow who viewed the passes as highly valuable (which they are, given the opportunity cost of these occupied parking spaces, with high demand for long-term parking among holiday-makers). Having this benefit available not only makes driving cheaper relative to public transport which is unsubsidised, but being given it by default also leads employees to be motivated to use it, lest ‘waste’ something of substantial value.  

Events during the London 2012 Olympic Games were also revealing: due to unprecedented staff numbers (due to restricted leave), it was necessary to introduce a parking pass swap system. 4,500 staff applied, happily (indeed, voluntarily) taking free public transport passes in exchange for giving up their parking pass for a month. In other words, these people demonstrably preferred free public transport to free parking, but because the latter was available and the former was not, they ordinarily chose to drive to work.
There is clearly enormous potential to promote mode shift by working with employers to review their benefits packages. However, other levers may also be available. For example, first adopted in Nottingham, the Workplace Parking Levy gives local authorities the right to charge local businesses for parking spaces they have on their premises. In the case of Nottingham, parking spaces cost £387 per year, raising £9 million for the Local Authority. In around half of instances this cost is paid by an employee, who are thus encouraged to shift to alternative modes. Moreover, the money used must be used to improve the local public transport (extending the existing tram system in the case of Nottingham), and thus offers a powerful mechanism through which to shift what is effectively a subsidy for driving towards one for taking alternative modes.

9.5 Car sharing and car clubs

Car sharing in the UK describes the practice of carrying multiple passengers in a single car (owned by one of the passengers) in order to share petrol or parking costs among people taking a similar journey, e.g. work colleagues who live close to each other. Car clubs in the UK are rental arrangements allowing people to access a fleet of vehicles on an as-need basis, avoiding the need to privately own a car and thus popular among people for whom car trips are infrequently necessary. The most popular car club provider in the world is Zipcar.

Both car-sharing and car clubs have the potential to reduce vehicle miles, though this is not inevitable. Car-sharing can reduce the number of cars on the road, but only if the passengers would otherwise have driven in a separate vehicle, rather than taken public transport. Similarly for car clubs, the effect on vehicle miles is nuanced: if members otherwise take public transport, renting from a car clubs will increase vehicle miles. If members would otherwise own a car, car clubs may have no impact (members may drive just as much as they would with a private car), or, more likely, would lead to a reduction in miles since the car is now paid for per-trip, and so tends to be viewed as one option in a multi-modal lifestyle. In particular, very short trips are more likely to be walked or cycled as the car is unlikely to be stored immediately outside the member’s home. For many people, cars are only infrequently necessary, but frequently used because car ownership makes it the default choice. In contrast car clubs facilitate the practice of cars being infrequently necessary and infrequently used. They also bring the major benefit of not requiring drivers to give up the private car experience entirely.

It is therefore unclear whether car clubs should be promoted from an air quality perspective. One 2014 evaluation of a Vancouver scheme attempts to quantify the net impact of car clubs, reporting that on average each club car in existence led to the selling of up to 3 personal vehicles, plus the foregone purchase of between 5–11 vehicles. This is encouraging, though
fewer vehicles does not necessarily mean fewer vehicle-miles, as club cars may be typically driven for several hours per day or more, being used by multiple drivers. Their assessment of miles travelled proves inconclusive, noting that around half of members who previously had no car had increased their driving mileage, and around one-third of people who previously had cars reported decreasing their mileage. Other literature has suggested that mileage driven does in fact reduce as a result of car club membership, though this will always be context specific.

9.5.1 How to promote car clubs and sharing schemes?
Robust evaluations of the impact of car-sharing schemes and car clubs, and of interventions to boost the uptake of these, are rare. One relatively exhaustive 2002 review of the literature, including expert interviews and public surveys, draws the following conclusions (main points are merged with overlapping conclusions from elsewhere in the literature):

- Car club membership would represent a cost saving for many drivers, but it is difficult to persuade drivers to take the fixed costs of car ownership into account, and people value convenience and ‘just in case’ car access highly. As such, cost savings are unlikely to be persuasive in convincing existing car-owners to join.
- The motivations among non-car-owners to join car-clubs are potentially stronger – gaining access to private vehicle use without the cost of purchase. However this is not the population policy-makers want to encourage to join car clubs.
- Decisions to join car clubs tend to be part of a ‘multi-modal’ lifestyle, with trips commonly taken by bicycle, taxi, bus, train etc., rather than as a viable alternative for someone who drives everywhere.
- Owning an old (i.e. more polluting) car with minimal depreciation is still cheaper than car club membership, making them less promising interventions for owners of old cars.
- Car clubs have most potential in urban areas with good public transport. This may undermine their benefit to the SRN.
- Workplace parking levies may help promote car clubs (by making the most common use of cars – commuting – less viable, and thus making many people only occasional drivers).
- Car clubs currently have an image problem, with low awareness, poor status compared to ownership, and a negative ‘green’ stereotype.
- Car sharing is more unambiguously beneficial reducing traffic volumes.
- Car sharing can be promoted with dedicated ‘high-occupancy-vehicle’ lanes, priority parking and other benefits, and similarly be penalising single-occupancy vehicle use (such as through parking levies).
The same 2002 review also draws attention to a number of promising policy options, including promoting car clubs and sharing schemes at new housing developments (which is a timely moment for change); and harnessing the leverage that local authorities have (for example in introducing parking levies, and in providing direct financial support). The call for greater local and national government support for car sharing and car clubs (which is often minimal or non-existent) is echoed elsewhere in the literature,10 often with a focus on parking charges as the obvious lever to use.

One of the most commonly cited barriers to car sharing is finding a suitable match. It is often presumed that there will be very few people living nearby who take a similar route at a similar time. However this is often a misconception, and so a common intervention is the introduction of smart systems to provide matching. For example, a scheme in Preston did exactly this and reported success97 (though details of the evaluation are not available). In contrast to this, however, note our own car-sharing trial at Heathrow Airport, which found no effect of matching riders (see below). Another common barrier which emerged from our staff survey work at Heathrow Airport was the reluctance to give up ‘just-in-case’ flexibility of private car ownership (for example, in the case of a family emergency). One possible solution to this is to offer car-sharers free taxi-rides home in the event of an emergency, though no schemes which have trialled this approach have been found as part of this report.

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**Car sharing at Heathrow Airport**

BIT’s recent work with the Department for Transport and Heathrow Airport, trialled two interventions to increase registrations for an existing car-share scheme and subsequent active use of the car-share scheme. The first tested the effect of behaviourally-informed letters which harnessed a number of nudges informed by qualitative research with Heathrow staff. These included testimonials of Heathrow staff who used the scheme, addressing the perceived barriers around shift-patterns, convenience and distance to fellow car-sharers. Three variations of these letters were sent to 15,000 staff (with nearly 40,000 in a control group receiving no letters). According to the results, sending letters led to a significant increase in registrations, though absolute numbers were very low: well below 1%, questioning the value of such an intervention.

The second aspect of the trial focussed on registered users (existing and those we’d successfully nudged to register) and aimed to increase active use of the scheme. This was done through an email campaign with three variations: a control group (n=300) receiving just the basic information, a matching group (n=314) who would receive an automatically matched passenger to address the most common perceived barrier that it would not be easy or convenient to find someone with similar shift-patterns who lived nearby, and a third group (n=314) who were also matched plus has messaging making the opportunity costs of not using the scheme salient. These emails were found to have no effect on active use of the car share scheme, with only 1 member from the trial being active within the month after the emails were sent (despite this being a self-selected group who had voluntarily signed up to the service, thus presumably significantly more motivated to car share than the average driver).

This result highlights the stark difference between stated preferences and actual behaviour. In simultaneous qualitative work conducted as part of that project, a large proportion of Heathrow employees said they would be interested in car sharing, yet registrations were extremely low. It was also stated that the main barrier was the inconvenience of finding a good match, and yet provision of a system which did this automatically had no impact.102
9.5.2 Are people interested in car sharing?

The result of our Heathrow study raises the question of whether most people (bar a very small minority) are interested in organised car-sharing schemes. The very low uptake at Heathrow was despite staff survey responses suggesting very high interest, highlighting the gap between self-reported preferences and revealed behaviours.

It is often suggested that given our attachment to cars, car sharing offers a more sustainable mode of transport without asking people to give them up. It also has obvious appeal to drivers who are making a journey anyway, but can significantly reduce their petrol costs if a passenger can be easily found and picked up en-route. However, others point out that car sharing is in some ways the worst of both worlds: you lose privacy, it is less convenient than driving alone but also less convenient (for the passengers, if not the driver) than taking public transport. This is due to the need to cooperate, communicate, and compromise flexibility of departure time and location\textsuperscript{75}.

It’s plausible that many of these barriers could be overcome if there was sufficient critical mass in the number of car-sharing vehicles and passengers. Combined with a sufficiently sophisticated management system car-sharing could be on-demand with very close route-matches possible and almost no wait time. This sounds technologically demanding, though is in essence what many developing parts of the world achieve with ad-hoc shared taxi and minibus arrangements: enough vehicles and passengers are travelling in all directions at all times, aided by the cultural norm of sharing, flagging-down, and alighting anywhere on route. This can be highly efficient, and technological solutions may provide a similar service. UberPool aims to achieve this by providing an option to share your Uber, though in the UK this option is not the default setting. Liftshare, an online platform for connecting car-sharers, similarly aims to have wide reach and a large enough membership to achieve feasibility through scale. However by creating individual networks of sharers (for example associated with a particular workplace or university) Liftshare focuses on addressing another barrier: distrust and risk-aversion to sharing with complete strangers. This may come at the cost of maximising routing flexibility and efficiency of matches, but may also increase membership.
9.6 Conclusion – Modal shift

The literature on modal shift is both encouraging and frustrating. Encouraging because there appears to be good potential for a variety of intervention types to influence consumers’ mode of transport; costs matter to commuters and businesses, so incentives can be effective; We tend to lapse into habit and inertia, and so there is scope for personalised travel plans to help us find better options we’d overlooked, particularly at timely moments of change; Moreover, innovations in peer-to-peer and organised car sharing may be the beginnings of the sharing economy and a move towards ‘mobility as a service’, rather than as an act of material consumption. These are all promising findings.

However, under closer scrutiny there are very few studies with a genuinely high standard of rigour. This brings doubt to many of the findings and makes it difficult to conclude that a particular style of intervention works. Many interventions are confounded by other factors, for example combining PTPs with incentives, meaning that even where findings are robust it can be difficult to attribute success to a particular mechanism. A review of the literature also makes it clear how important structural issues are, with fiscal, infrastructural, or regulatory intervention tending to be most impactful and often necessary. This is not to say that soft measures and conventional campaigns are entirely fruitless, but often they are successful when other, harder measures are simultaneously at work. This suggests the combination of behavioural interventions and awareness campaigns (designed to change public perceptions and willingness) and the provision of infrastructure and/or sterner financial or legislative changes, may be an effective combination.

This reflects the fact that driving is currently a fundamentally preferable option for many people. Commonly cited benefits include the personal space, convenience, enjoyment of driving, status and pleasure of car ownership, perceived safety (from other passengers, more than from accidents), and the greater flexibility that driving affords. For example, when interviewing staff at Heathrow during previous work BIT found a major barrier to mode shift was their concern that public transport would be inconvenient when staff wanted to pick up groceries on the way home, drop their children at school, or when finishing late. Others simply liked using their car, having been aspiring to car ownership for a long time. Replicating or competing with these preferences through public transport is often difficult, particularly when the cost of public transport is often quite high compared to the marginal cost of driving. Car ownership is expensive, but in order to convince existing car owners to change mode, public transport must compete with the cost of petrol, in addition to competing with the aforementioned benefits of driving.

Encouragingly however, there is still much that hasn’t been tested, and much that behavioural insights might contribute further to. Technology brings opportunities for more imaginative incentive structures to reward sustainable behaviour, for example building on ideas like the Green Points system in Korea discussed above, and harnessing gamification and social networks. There is clearly huge potential here when combined with technologies like autonomous vehicles and smart, on-demand public transport. Relative to other policy areas there is also much behavioural-science territory which remains altogether unexplored: across the literature there is almost no creative harnessing of the behavioural biases and heuristics which dominate our decision-making processes, despite these techniques becoming increasingly common in other policy areas.174 For example, the inconsistency with which we judge costs associated with cars and those associated with public transport has received relatively little attention. This leaves us cautiously aware that mode choice can be very difficult to influence, but also cautiously optimistic that there is much that is worth trialling.
10. Purchasing decisions

Despite air quality being poor in most urban areas of the world, and in many places declining, private vehicles are and will remain the dominate mode of transport for many years to come. The previous section on modal shift highlights how challenging it can be to replace cars, vans and lorries with less polluting modes of transport, often requiring major infrastructural change supported by ambitious regulation and fiscal policy. In the short and medium term, therefore, private vehicles are not easily replaceable in a world largely designed around automobile use.

A large-scale shift in the types of private vehicles we use is therefore a promising option: if we refuse to get out of our cars, let’s at least drive cleaner ones. This section looks at how we make vehicle purchasing decisions, why fuel-efficiency seems to receive inadequate attention by consumers, and how we might overcome the main behavioural barriers to greater uptake of alternative fuel and higher efficiency vehicles.
10.1 The decision to buy a car

Buying a car is often one of the first big purchases people undertake in their lives, and given the vast range of options, it is arguably one of the more complex. When making complex decisions we draw upon heuristics (simple rules of thumb, cognitive shortcuts) and focus on certain factors over others. We struggle to make complex trade-offs on more than a few factors simultaneously, so we give weight to factors of lesser importance only if a clear winner is not found based on the few factors we care most about. Department for Transport’s research shows drivers to consider cost (85%), reliability (78%), safety (66%) and comfort (53%),\textsuperscript{vii} as most important.

Interestingly however, though cost is the dominant factor, fuel efficiency of the car (which greatly impacts the lifetime cost) seems to receive relatively less attention. This fact deserves our attention because low running costs are perhaps the most obvious, and potentially most powerful, motivator towards less polluting vehicles, particularly for electric vehicles (EVs) which are substantially cheaper to maintain, to tax, and to run. It is generally better, where possible, to harness existing powerful motivators (such as cost) than to try to elevate weaker ones (such as concern for the environment). This is particularly pertinent given the finding in the same survey that only 11% of drivers indicated that environmental benefits would encourage them to consider buying an EV. In 2017 just 1% of new car registrations were for electric cars, suggesting that their green credentials are far from enough to outweigh concerns about upfront cost and practicality.

10.1.1 Focus on upfront cost

Greater fuel-efficiency tends to come with a higher price tag, and this initial investment is the number one barrier to low-carbon transport.\textsuperscript{vii} This is particularly the case with EVs where prices are very high, despite very low per-mile running costs. This is partly an issue of access-to-finance, with the high price-tag of EVs and newer, more efficient ICE vehicles, preventing purchase even if the consumer would like to. Buyers with modest budgets are often limited to more polluting vehicles as a result. However it is also because we heavily discount future costs and rewards relative to those of the present, and therefore focus heavily on the price tag even if long-term savings could be had by spending more up front.\textsuperscript{\textsuperscript{vii}} Classical economic theory would suggest that our future discount rate is linear and broadly rational,\textsuperscript{\textsuperscript{vii}} however behavioural economics has shown it to be hyperbolic, that is, initially very steep, leading to a disproportionate focus on the present.\textsuperscript{\textsuperscript{vii}} This myopia often leads to

\textsuperscript{vii} Note that these surveys often overlook factors which are ‘givens’ and so rarely mentioned, such as the suitability of the vehicle for one’s needs. For example a family would not consider a vehicle that wasn’t adequate in size, and by restricting the list of options to suitably-sized cars, size need not be a major factor in the subsequent decision.
choices which are not in our best interests, as defined on our own terms. This is visible in many consumer decisions, including our tendency to inadequately insulate our homes, or our proclivity for risky behaviours such as smoking or unsafe sex, which are immediately gratifying but harmful in the long-term. Subsidies or finance solutions which solve the lack of up-front funds, and which spread the higher cost into the future or bring the savings into the present, are clearly very valuable.

Where car buyers do consider fuel efficiency, evidence suggests they do so over a 2–3 year period, rather than the full 15-year average lifetime of the vehicle, the value placed on it therefore accounting for only a fraction of fuel savings potential. Salient information provision highlighting the lifetime savings potential of efficient technology has been successful to partly alleviate this bias and get people to place more weight on long-term costs, for example with BIT’s own work encouraging the purchase of energy-efficient white goods by highlighting the lifetime running costs on product labels.\textsuperscript{581} This intervention has however not yet been shown to be successful with regards to vehicle purchases, suggesting either that consumers genuinely don’t care about fuel economy to a great extent (the ‘rational’ explanation); that the bias is sufficiently strong that mere information provision is inadequate; or that the design of the information tested was not good enough.

A study interviewing 58 Californian households highlights that our computational capacity required to make the complex financial judgement of life time running costs of a car is limited.\textsuperscript{583} People were asked how much they’d be willing to pay for a vehicle with higher fuel economy. Only two households made a reasonable suggestion based on net present value calculations, but even they, when asked about their own recent purchases, revealed not having used this calculation.

Further, evidence from several lab experiments suggests that one underlying barrier to consumer’s poor estimation skills is what was called the “MPG (miles per gallon) illusion”. It describes that “people perceive fuel costs to scale linearly in miles per gallon instead of gallons per mile.”\textsuperscript{585} For example, consumers might think that the difference in fuel costs between cars using 15 mpg and 16 mpg is the same difference as between cars using 30 mpg and 31 mpg given the 1 mpg difference in both pairs. Given that fuel costs scale linearly in gallons per mile, the difference in fuel costs is about four times smaller for the latter pair. Reviewing the way this information is presented may therefore be of benefit.\textsuperscript{viii}

\textsuperscript{viii} Better yet might be a cost per mile based on average petrol/diesel costs, since pounds are more meaningful, salient and intuitive than gallons, and comparing diesel versus petrol efficiencies with MPG information requires knowledge of diesel and petrol costs and sophisticated calculation by the consumer. Even better still would be a cost per 1000 miles, and/or a cost per 20 miles (assuming 20 miles is a typical, common trip length) since the
However, the evidence is mixed on these points. Another study conducted a simulation exercise matching empirical results of consumer estimates for the value of a vehicle’s lower fuel economy with a simulated counterfactual where assumed biases were accounted for. More specifically, the study tested for the existence of two biases. One, whether consumers systematically misestimate the value of a higher fuel-economy car, and two, for the presence of the MPG illusion. The results state that consumers accurately, or slightly underestimate the value of fuel economy, though it did also find trends confirming the MPG illusion, corroborating earlier studies. However, the welfare costs to consumers, associated with making less than optimal decisions due to the MPG illusion, turned out to be less than US$4 per new vehicle sold. In other words, the two biases in question don’t seem to be significantly undermining people’s vehicle choice, though lab studies are of course distant from the real world. More robust empirical evidence from real car-purchases finds that providing lifetime running cost information to buyers has no significant impact on the vehicles being bought. However, this study has its own limitations: it focussed only on Ford dealerships, i.e. would have failed to capture any decisions to buy another brand (perhaps because of fuel efficiency concerns). Opting for a different vehicle within the Ford brand, motivated by fuel efficiency, is less likely since different models tend to differ significantly on other attributes too (size, intended use, etc.). This raises another important point: the variation in fuel efficiency between models is often quite low once other attributes such as cost, size, and performance are determined, at which point it is likely that two fuel efficiency values quite close together (52mpg and 58mpg, for example) are viewed as ‘essentially the same’.

Given this varied evidence, and given the benefits that have been found from providing lifetime running cost information with other types of products, attempts to influence car-purchasing decisions by making long-term costs salient and intuitive still deserve further research, particularly in the UK car-buying context.

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cost-per-mile would be very low and depend on the consumer scaling this up to have a meaningful influence on purchasing decisions when put alongside far higher vehicle price-tags.
10.2 Attitudes towards electric vehicles

A report by the Department of Transport shows that the majority of people in the UK (55%) have never thought about buying an electric vehicle, while 5% were currently thinking about buying one and another 16% had thought about it at some point but decided not to.\textsuperscript{187} Sales figures paint a more conservative picture, where between January and March 2016 only 1% of all cars registered were ultra-low emission vehicles (ULEV). This represented a 31% increase compared to last year’s sales, though is clearly still very low.

The UK public has relatively high concern for the environment, with 86% believing in man-made climate change, and 62% claiming to be fairly worried, worried or extremely worried.\textsuperscript{188} The low sales figures of EV’s therefore demonstrates not a lack of concern for the environment, but the fact that other concerns, such as cost and convenience, still prevail, with EVs failing to deliver on these metrics.

Familiarly and uncertainty are also important. In particular, uncertainty about re-sale value, charging infrastructure availability, battery longevity after years of use, and real-world range versus that claimed by the manufacturer, are all barriers to EV adoption. These perceived risks are exacerbated by our tendency to plan based on a ‘just in case’ mentality. For example, we tend to choose mobile phone contracts which have sufficient minutes, messages and GBs of data to cater for our highest-consumption months, even though we’d often be better off choosing a cheaper package and occasionally paying to top up. Similarly, we want a car which can accommodate the once-in-a-year family trip, even if an EV could meet 99% of our needs, requiring us to rent a car for the 1% of occasions.
Specifically, when asked what factors would deter them from buying an electric car or van, 45% expressed concern about recharging, in particular about the availability and transparency of charging locations; 39% were concerned about the battery power, i.e. range anxiety; and 28% were concerned about the cost. Interestingly, cost also ranked the highest when people were asked what factors would (hypothetically) encourage them to buy an electric vehicle, suggesting there may be good potential to harness their very low running costs, albeit many may not be aware of this benefit, and high upfront costs still need to be addressed. Only 11% said being environmentally friendly would be an encouraging factor, whilst 27% indicated that nothing would encourage them to buy one.

When asked about financial support, one of the expert interviewees confirmed that:

“The main barrier to EV uptake is the upfront cost. There is support available but not enough to cover the difference.”

This point is normally made in reference to the higher cost of new EVs compared to new ICE vehicles of a similar specification, however the point is made even more pertinent by virtue of the fact that there is a very small second-hand market in EVs at present. In the UK in 2016 there were less than 2.7 million new car registrations,\(^\text{189}\) compared to 8.2 million used care transactions.\(^\text{190}\) In other words, most people’s budget for a car purchase lies in the thousands of pounds, not tens of thousands, and EVs are simply not readily available at this price point. Moreover, with EVs constituting just 1% of new car sales, it will take a long time for them to trickle down to the lower price-points of the used market, and longer still for this to occur at the volume required to service the majority of the car-buying public.

One of the expert interviewees further pointed out that government’s efforts to make EVs less expensive, are met by manufacturers with reducing prices of ICES:

“Manufacturers make more money from combustion engines. In general, there is less scope for making profit on EVs, estimates suggest that they will only make profit around 2020. The cost of batteries have fallen but prices of EVs did not follow mostly because manufacturers are investing in bigger batteries to provide more driving range [rather than keeping the battery size the same and reducing the car’s cost].”

Overall, costs are undoubtedly a barrier to EV uptake, both to those who have the means to buy a new car but cannot justify the premium of EVs compared to similar ICE vehicles, and more fundamentally to the majority of the population who rely on the second-hand market.
10.3 Structural and practical barriers against electric vehicles

Beyond cost, other structural barriers and practical considerations are important. ‘Reliability’ is frequently cited as a top concern among drivers, and on this count EVs may have an advantage: though anecdotal evidence suggests many EVs are no more reliable than other cars, this tends to be true with regards to failures not related to the engine/motor (i.e. panelling, peripheral electrics etc.) – the core drive system is far simpler and, in theory, less in need of maintenance than an ICE. This also has benefits on the long-term running cost, and these benefits should perhaps be promoted more strongly to overcome an uncertainty aversion that may exist around their reliability. This may be particularly pertinent once the market matures and second-hand EVs become more common, at which point manufacturers’ warrantees will be expired and consumers may be concerned about the relative lack of mechanics with EV expertise or general unfamiliarity with what might go wrong and how much it might cost to fix.

When asked about the factors they find discouraging, the two most prominent factors beyond price are the lack of charging infrastructure and limited range on a single charge. Both of these contribute to what has been coined ‘range anxiety’, i.e. the fear of not reaching a charging station before running out of battery life when driving an EV, or of the inconvenience of needing to change the car midway through a long journey, taking considerable time and bringing considerable risk (if the charging point is not working, or occupied, for example). As discussed during our interviews:

“(people tend to perceive that) EVs are too expensive and they don’t drive far enough. More rapid charging stations would be big win for EVs. Think about it, it’s a scary business to undertake a long journey in EVs. The charging network is inadequate – charging stations are not enough and too sparse. And there is lots of uncertainty as well. Will the charging station work, and will I have to queue?”

A study looking at the German market found very similar trends regarding structural barriers to alternative fuel vehicle uptake. Refuelling stops are time-consuming and inconvenient, and accordingly buyers assign a high value to improvements in battery life and the density of the recharging network. Speed of charging is also important, though it does not necessarily need to be as instantaneous as putting petrol into an ICE’s tank: research suggests waiting 10 minutes to top-up the battery is not a deterring factor (particularly as most charging will be done at home, with only occasional need to charge on-the-go). On longer journeys one half-hour stop tends to be considered reasonable (enough time to take the battery from 10% to 80% on a high speed charger). Most drivers would take a short break on a long journey anyway, and can reasonably fill half an hour at a service station. One other major benefit of
fast-charging is the need to build fewer charging points, since each would be occupied for a shorter period.

10.4 Test-driving electric vehicles

Most surveys recording people’s preferences for electric vehicles target the general population, the majority of whom have limited information and experience with electric vehicles. A few studies look to see if preferences change after a period of test-driving, finding that preferences often do change significantly, though not always in the expected or hoped for manner. For example one study[^94] finds that after having an electric vehicle in the household for 3 months, concern for range was in fact reinforced, indicating this is not an issue of misperception, but rather a genuine failure of EVs to meet many people’s needs and expectations (note however, this 2013 publication, based on an experiment prior to that, is already out of date in this regards, with range having increased significantly in recent years). Naturally, the importance attached to range was lower for households with multiple cars where they rely on the ICE to drive longer distances.

Concern about charging time was also present to a degree, but also seemed less important than sometimes assumed because, at least among those likely to be early adopters, charging would tend to be done at home with the vehicle used (as a second vehicle) for shorter distances and therefore rarely charged outside the home. This suggests an extensive charging infrastructure may not be critical, at least for early adopters who have a second vehicle, though charging points at workplaces is considered likely to encourage EV purchase.[^95] This said, 78% of participants would pay £2000 to reduce at-home full recharging time from 8 hours to 1 hour (or to pay £300 to reduce it from 8 to 3 hours), indicating the value to manufacturers in further developing rapid-charging technology.

In another study, 58 participants were invited to a test ride with an electric vehicle for a few hours and surveyed afterwards about their experience and attitudes towards EVs[^96] (there was no pre-survey, so no change in attitudes was recorded). Approximately 57% of respondents strongly agreed (and another 31% agreed somewhat) that EVs emit less carbon dioxide than conventional vehicles, indicating that people understand their benefit to the climate, though not overwhelmingly so. People seemed to not be worried about remembering to recharge the vehicle. In terms of costs, more than 81.1% said that compared to a conventional vehicle, an EV would be much or somewhat cheaper to run, and similarly 88% said that it would be somewhat or much more expensive to buy – indicating that the large majority understands that currently EVs are more expensive to buy but cheaper to run than conventional vehicles. Results suggest that a majority of participants would be willing to make this trade-off if the payback time was around 4 years.[^97]
Another slightly more recent field study found that people have generally positive attitudes towards EVs, which are enhanced after a few months experience with them, however this does not increase people’s intention to purchase an EV, showing that their appeal is only part of the equation when the high costs and practical considerations render them unsuitable for many buyers.\textsuperscript{98}

\section*{10.5 Social identity and status}

Looking beyond barriers related to cost, lack of infrastructure and range anxiety, there are a range of socio-cultural and psychological barriers and opportunities. For decades, since the wide-scale adoption of cars as the primary mode of transport in the 1960s/70s, cars have been status symbols, laden with cultural meaning and imagery.\textsuperscript{100} Studies have documented that affective and symbolic motives are important to car use, more generally,\textsuperscript{200} with vehicle choice and vehicle use being more than just a function of cost and functionality. Even long before cars became a mass market, the term ‘conspicuous consumption’ was coined to explain the ownership of luxury goods through their signalling value of prestige.\textsuperscript{201} In a world where environmental awareness is ever-increasing, this looks to be a positive opportunity to attach electric vehicles to positive notions of identity and status, something that can already be seen in some communities (such as the liberal elite in California, for example). In other words social norms have shifted somewhat to focus not only on the ownership of luxurious
output, but also the virtue of exhibiting pro-social behaviours, such as making the effort to protect the environment – a concept referred to as ‘conspicuous conservation’.\textsuperscript{202} Indeed the function of ownership to signal status is itself suggested to be declining, as we move towards the ‘experiential economy’, whereby we derive status from visiting places and doing things, and posting pictures of these experiences on social media, more than we derive status from owning things. This bodes well for the de-materialisation of the economy, critical in order to move towards the concept of ‘mobility as a service’ (e.g. through car-pooling and leasing and smart public transport).

Car purchases are among the most ‘visible’ purchases people today can undertake. They ranked second in the “survey-based consumption good visibility index”, just behind cigarettes, indicating the signalling value they possess.\textsuperscript{203} With this in mind, a study tested whether the presence of conspicuous conservation norms could be explained by demand patterns in two US states for Toyota’s Prius\textsuperscript{ix}, and they found that it could. On average, they find, depending on their location consumers would pay US$ 430–4,200 for the green signal provided by the distinctive design of the Toyota Prius. This effect has important implications for policy-making in the attempt to increase social welfare by harnessing conspicuous conservation.

One interviewee highlighted that this change in norms and the signalling value of pro-environmental behaviours is especially strong among younger generations, and presents an opportunity for change:

“\textit{The symbolic value of faster/ bigger/dirtier cars, no longer have the same social status attached to them. There is a bit of hope here – these motivations are less prevalent among young people. The tide is turning with the generations, and we can harness the positive status and signalling value of greener cars. This is a slow-moving process but older attitudes die out (as in literally – people dying, not changing their mind).}”

The influence of social norms was confirmed by a study on EV acceptance in Germany. More specifically, they describe that in the early stages of socio-technological innovations, such as EVs, people’s decision for or against adoption is influenced by the extent to which they find social validation. In addition, the study examines social identity also as a function of ‘collective efficacy’, which is the “\textit{belief that the in-group is capable of affecting important aspects of its environment}”.\textsuperscript{204} They find that collective efficacy also has a significant effect on EV acceptance. Recall the discussion on self-efficacy in lesson 2, highlighting the need to help and enable people, to lead by example, and to instil a sense of agency if feelings of

\textsuperscript{ix} They selected this model on the basis that its design is uniquely distinct from other alternative fuel vehicles and is most easily recognised as such, meaning it’s conspicuous conservation value is higher than for other vehicles.
defensiveness and helplessness – which too often are the product of environmental concern – are to be avoided.

These results suggest that messaging around social norms of EV acceptance, affirmative images and feedback with social validation could be effective in boosting EV acceptance and desire. The results also indicate that in this case, emphasising the collective impact could also be effective. However some caveats should be noted – these processes of change can be slow, difficult to predict and even more difficult to control. Moreover it would be naive to assume that the ‘leading edge’ of this cultural shift (i.e. the green, liberal elite) represent what is yet to come in the mainstream for whom the values being signalled may be quite different.

10.6 Conclusion – Purchasing decisions
There is strong evidence that the structural barriers (including cost, infrastructure, and the capabilities of the technology) tend to outweigh any purely ‘behavioural’ barriers when it comes to purchasing decisions. For many car buyers, the high upfront costs of alternative fuel vehicles are often the primary barrier for uptake, particularly among those not at the top of the income distribution who largely rely on the used car market. The potential for fuel saving is rarely fully factored into these decisions, and though evidence here is mixed, there may be scope to address this with some benefit on uptake. This may be particularly true among those who have the means to afford an EV, but who don’t fully offset the upfront premium with the long-term savings. Given the lack of consensus on this but the obvious potential it has, we suggest it deserves further study.

However even if the cost factors are addressed, there remain a number of substantial structural barriers: Range anxiety is a major issue, and though some of this might be unwarranted (since we do have a tendency to base our decisions on a ‘just-in-case’ mentality, exacerbated by risk-aversion), the fact that hands-on experience does not alleviate this concern (at least, it did not in a 2013 study) suggests it cannot be explained-away by mere cognitive bias. Rather, perfectly ‘rational’ car purchasers acting in their best interests would still be averted by range concerns, though technology is clearly advancing rapidly in this regard. As might be expected, range is far less of an issue among two-car households.

In one sense therefore, there is a feeling of inevitability to the transition to EVs, particularly given recent UK policy announcements to ban the sale of new ICEs by 2040. Over the next decade technology will presumably become the obvious choice for a much larger fraction of the public, as range increases, prices reduce, and the second-hand market grows. But there is still much that can be done to support and accelerate the transition to EVs, as well as to promote more less polluting ICE vehicles which are likely to be the dominant vehicles on our roads for many years to come. This includes further research on our tendency to overweight upfront costs, and the role that status and identity might have (and how they might be harnessed) in conspicuous purchasing. There are also other areas with little existing research at all. For example, uncertainty and perceived risks with public charging stations is something to be addressed – a smart, connected charging network providing information on availability at
upcoming service stations, or even allowing users to book a charging slot an hour ahead of time, for example, might overcome some of these aversions. Similarly, there may be scope to introduce a new kite-mark or guarantees on battery life to support and reassure the second hand market. There may also be potential for behaviourally-informed financial products similar to the UK’s Green Deal (a pay-as-you-save scheme whereby high upfront costs are paid through the savings on bills, or in this case, paid through the savings on fuel). Though major structural barriers still exist, there is much that behavioural insights can offer to expedite the transition to a cleaner vehicle fleet in the UK.
11. Driving style

What constitutes a ‘good’ driver? Typically this might imply safe or considerate driving habits. However we can also drive to maximise fuel efficiency, and in the focus in this section is on ‘eco-driving’ – the micro habits we exhibit behind the wheel which have a significant impact on the level of exhaust emissions and particulates generated by tyres and brake pads.

Defined by the Department for Transport, an eco-driving style encourages the following behaviours.205

- Maintaining a consistent speed;
- Avoiding acceleration and braking where possible;
- Anticipating traffic flow and signals;
- Not driving faster than 70 miles per hour;
- Shifting gears up early, usually at or below 2500 rotations per minute;
- Staying in gear when slowing but removing pressure on the accelerator early; and
- Not idling for more than one minute.

In addition, the definition of eco-driving often encompasses a few broader behaviours, decisions and vehicle optimisations which reduce vehicle emissions:

- Minimising air conditioning usage;
- Regular vehicle maintenance;
• Using the correct engine oil;
• Maintaining appropriate tyre pressure;
• Minimising the weight of the vehicle; and
• Streamlining the vehicle (e.g. removing unused roof racks).

Alternatively, eco-driving behaviours can be split into three different categories: Operational decisions (driver behaviour), tactical decisions (road selection and vehicle load) and strategic decisions (vehicle choice and maintenance). This section of the review will focus predominantly on operational decisions, that is, driving style. Tactical decisions such as route choice will be covered in the following section on traffic management.

### 11.1 The impact of eco–driving

The main motivation behind eco–driving techniques is to reduce fuel usage, and fuel usage is positively correlated with pollutant emissions such as NOx and particulate emissions (PM) that have adverse health effects.

Estimates of the potential impact of eco–driving on emission levels vary significantly. These depend on a number of assumptions and variables that differ across studies, for example, the type of eco–driving behaviours measured, the baseline comparison (i.e. what is ‘normal’ driving), car models, individual driver differences, as well as differences in the road types with different topology. Estimates of potential fuel savings and emission reductions can range between 5% and 40% given different contexts, though these are often modelled, not measured in real world conditions. Studies based on lab and field measurement find a reduction of fuel usage of around 5% through informational interventions and one–off training, while continuous feedback (in–vehicle telematics and training) have been found to reduce fuel usage by around 10%. A meta–review of 25 eco–drive related studies confirmed that applying eco–driving techniques on average can reduce fuel usage by around 10%. Clearly, real–world emissions reductions are expected to be significantly less than those modelled or measured in the lab, particularly as adherence to the training is likely to be partial at best. On the whole, extensive rigorous evidence on real–world eco–driving is still lacking, especially evidence that tracks whether eco–driving techniques are applied consistently over the long run.

### 11.2 Encouraging eco–driving

Interventions to encourage eco–driving have tended to fall into one of four categories:

• Information provision;
• Training programmes;
• In–vehicle feedback (telematics); and
• Post-trip feedback (potentially including rewards and gamification).

The main findings from the literature for each of these four approaches is discussed below.

11.2.1 Information provision and raising awareness

Evidence from a survey in the UK states that 25% of respondents indicated that they know ‘a lot’ or ‘a fair amount’ about efficient driving, but also that 40% knew ‘a little’ and 35% knew ‘nothing’. These figures highlight a substantial lack of awareness among large parts of the UK population, and thereby might warrant information campaigns focusing on raising awareness about the fact that driving style can have an impact on fuel consumption and pollution.

The EU has developed an umbrella framework under which a number of Member States built up eco-driving promotion initiatives (see below case study). However while such communication campaigns can be effective to raise awareness and influence attitudes towards eco-driving, they are often not enough to achieve a significant change in behaviour on a larger scale. Most of these were not rigorously evaluated so the impact remains quite uncertain, and we stress the point made in section 4, that providing information is rarely enough to change behaviours, particular where those behaviours are ingrained, habitual, and subject to the influence of our surrounding more than due to deliberative choice – driving style being a perfect example.

Eco-driving initiatives in the Netherlands

As part of the EU framework (AID-EE) to encourage eco-driving across its Member States, the Netherlands put together a programme running between 1999 and 2004 to stimulate more energy efficient purchases and driving behaviours. It encompassed a number of different interventions, one of which was a subsidised (free-of-charge) training course for groups of professional drivers. To ensure sufficient uptake of the training, an extensive promotional campaign was run using TV, radio, website and leaflets to advertise it and raise awareness. The objective of the communication campaign was to get 60% of drivers in the Netherlands to recognise the programme. Approximately 25–30% of the total programme budget was spent on this communication campaign.

It is one of the few communication campaigns where evaluation has been attempted, though rigour of the results is not high mostly due to a weak counterfactual and self-reported outcome measures. Through telephone surveys (N=1100) researchers found that spontaneous recognition of the programme has risen from 18% in 1999 to 31% in 2004, while supported recognition increased from 31% to 50%. Television was found to be far the most effective medium of communication, with 78% of respondents learning about eco-driving training from TV, while only 17% learned about it from newspapers and 16% from the radio. However, recognition of the name and existence of the programme outweighed recognition of the eco-driving principles communicated through the programme. Only 14% of surveyed drivers associated early gear shifting with the programme, 9% thought of driving at constant speed and 7% of steady acceleration.

Overall, the communication campaign seemed to have successfully raised awareness among Dutch drivers of the existence of the programme, but was less successful in educating people about the principles of eco-driving. It is also reasonable to assume that the actual application of eco-driving techniques was lower than the self-reported figures indicated in the surveys. While the robustness of this campaign’s evaluation is weak, it highlights how often raising awareness and informing people is not enough to change actual behaviour.

The actual training was suggested to have been successful on the basis of self-reported variables indicating the extent to which participants applied eco-driving techniques. “Between 2000 and 2004 more than 90% of all respondents familiar with the EcoDrive programme applied some (74–85%) or a lot (10–22%) of the EcoDrive drive style suggestions.” (pp.18) These figures are in comparison to 1999 data where 83% of drivers indicated to use eco-driving “a little” and 10% “a lot”. However, these self-reported results should be taken with extreme caution, as it is rare for respondents to admit retaining and adopting nothing from a training programme.
11.2.3 Training courses

65% of respondents to a DfT survey on transport choices indicated “to know something” about efficient driving. Moreover, studies have found that many of us have an intuitive sense of ‘eco-driving’, and when asked to drive fuel-efficiently, we save around 7.7% of fuel. Lack of knowledge may therefore not be the problem. However, most people do not apply these techniques even where they have some awareness.

A number of studies and government initiatives have therefore been investing in the idea of training programmes for eco-driving skills. The aim of training is to inform drivers about more fuel-efficient techniques, to educate them about the respective benefits and train them to change their old driving habits. Most eco-driving training, as observed in the UK, takes the shape of either theoretical training (presentations and workshops), and/or in-vehicle training in which the trainer accompanies the driver akin to a typical driving lesson.

In this spirit, the Driving Standards Agency in the UK has incorporated safe and sustainable driving techniques in their driving syllabus, and in addition since 2008 eco-driving techniques have been integrated into the driving test (though not as a point which would lead to a test fail). They are also part of the Certificate of Professional Competence needed by professional drivers. Note, also, that a safe driving style is broadly similar to an efficient driving style (particularly with regards to maintaining a lower speed, anticipating traffic and signage, and avoiding harsh acceleration and braking).

From a behavioural and administrative perspective, focusing efforts on training new drivers makes sense, particularly because they don’t have to break with old driving habits which can be deeply ingrained and automated. Moreover, unless such training is mandated or encouraged through strong incentives (significant insurance premium reductions, for example) uptake of post-test training in the UK is only about 1% – a large fraction of which was involuntarily a result of sanctions for speeding. This leads to the conclusion that eco-
driving tuition is likely to have minimal impact unless it is incorporated into initial driving lessons.

Another area of potential may be with businesses and fleets, where drivers might be induced to undertake training by their employer, who has far greater motivation to reduce fuel costs. One interviewee supported this claim saying that eco-driving is more likely to be a success for fleets (though note the suggestion is for telematics, more than for one-off training courses):

“In terms of driving style, eco-driving is much more likely to be a success with fleets. Fuel is a big cost, especially for haulage/freight, it’s often the biggest cost factor even. Many companies try to manage their fuel economy, and telematics can monitor this. Various forms of reward or punishment for fuel efficient driving can be a strong motivator for fleet drivers to keep their job.”

DfT undertook a qualitative research study looking into eco-driving for heavy duty vehicles. They conducted a literature review and stakeholder interviews investigating the low uptake of eco-driving training among lorry drivers. The key barrier seems to be a cost factor for the training, and also for getting telematic devices installed to be able to monitor developments. Moreover, with relatively few studies showing the benefit of eco-driving (and those studies not part of common public knowledge) small companies in particular do not see an incentive to invest in training or telematics. Other barriers include the lack of availability in tailored training courses and also an anticipated resistance of lorry drivers to change their driving habits.

To test the actual effect of training, a study analysed the responses over time of ten individual bus drivers to a training course. The course consisted of a pre-training drive with a test vehicle, a four-hour session on fuel-efficient driving and a post-course test drive with the same vehicle. On average, after the course fuel usage was about 6% lower, ranging from -12% to +3%, with significant improvement in lowering the rpm at the point of gear shift, increased distance coasting (i.e. slowing without braking), and increased distance driven with low rpm. On-board logging devices tracked driving parameters for 10 months after the course. This shows that drivers are able to adopt the trained techniques when being observed in a test environment immediately after training. However the more encouraging finding is that after four months, the average fuel consumption was still 5.8% lower than before the course. Most drivers had positive responses to the course in the short run, but for some fuel consumption increased to pre-training levels over time. Given the small sample size of this study, however, results are not representative but rather indicative of the extent to which the persistence of the effect of eco-driving training depends on the individual
driver. Overall, the results indicate that in-vehicle training can achieve a reduction in fuel usage, though the long-term effects are still very much under-studied.

The Energy Savings Trust has subsidised eco-driving training for about 50,000 drivers in England and Scotland. The evaluation faced some methodological challenges, but on average, estimates suggest that on the day of training they observed a 14% reduction in fuel usage, and over time these seem to wear off. Beyond the benefits in fuel consumption, the Energy Savings Trust outlines that fleet operators could benefit from substantial savings from reduced maintenance costs due to smoother driving styles resulting from eco-driving techniques.

These successes tend to emerge from practical driving instruction. Undergoing only theoretical training on the other hand seems to be less effective. A study with drivers of light commercial vehicles of a German logistics company examined the short and long term effectiveness of theoretical training and of rewards (monetary and non-monetary) on eco-driving behaviours. Results indicate that the theoretical training only had minor short-term effects or no effect at all on fuel consumption. Even when theoretical training is combined with monetary or non-monetary rewards, there appears to be little benefit.

One study in Australia focussed on individual (private) drivers, and tested five different interventions:

- An online learning module of up to one hour in duration, and a hard copy brochure;
- Online learning module plus two-hour classroom session;
- Online learning module plus a 50 minute driving lesson with an instructor;
- Online learning module, plus the classroom session, plus the driving lesson; and
- Online learning module plus a half-day training course with in-vehicle telematics to measure real-time improvement.

These interventions were evaluated using a simple experimental design comparing fuel use of six weeks prior to any intervention to fuel use twelve weeks after completion of the interventions. On average, drivers that received eco-driving training reduced their fuel use by 4.6%, though only the half-day workshop was found to be more effective than the others, perhaps due to the longer learning period, or the use of real-time feedback (generally thought to be a critical component of learning a new skill).

In summary, there is indicative evidence that in-vehicle training programmes can work to communicate eco-driving techniques and achieve short-term reductions in fuel usage.

Whether training is effective longer term and able to address ingrained driving style habits is questionable, though it seems, likely to be plausible for some drivers.
11.2.4 Feedback systems

11.2.4.1 Post-trip feedback

Performance feedback is another tool often used to encourage a certain behaviour, and in particular it has been frequently applied with regards to environmental behaviours. The US company OPower (now acquired by Oracle) for instance, pioneered using social-norm based feedback to reduce households’ energy consumption. Customers receive written feedback about their consumption level printed onto energy bills. It compares their consumption to the average consumption of their most efficient neighbours and uses happy–sad faces to indicate whether their behaviour (i.e. consumption level) is socially desirable or should be improved. Customers receive this feedback on a regular basis with every billing cycle, and can thereby track improvement, or changes in their own behaviour.

Novel forms of feedback, such as those including a social comparison or league table, or those attached to an extrinsic incentive, may generate a motivation to change behaviour. In the absence of such motivating elements, however, feedback in itself does not necessarily motivate. As discussed with one expert interviewee:

“Those with motivations to change already, they are best changed by feedback – enabling something which they wanted to do anyway. Otherwise it’s tough to change habitual behaviour. Driving is like walking, it’s something that people automate. The cognitive effort needed to drive (or walk) more carefully / slowly than they normally would – this is stressful, requires more effort. Going against your habit and usual behaviour, works against you, at least for the learning period. That’s why you need a motivation to overcome that initial period.”

A field study with 46 drivers who were given in-vehicle feedback and later asked about their experience, found that about 75% of drivers felt that personalising the feedback enhanced
the motivational value of the information. Average performance feedback was felt to be effective in conjunction with goal-setting strategies, highlighting the point that feedback on its own is mere information, useful for tracking progress and learning, but does not itself provide the motivation.

In cases where drivers might not exhibit the intention and motivations to drive more efficiently, incentives like rewards can be used to increase engagement with feedback. One natural field experiment with fleet drivers in Germany found that ‘tangible’ non-monetary rewards (tangible indicates its monetary value is easily compared, e.g. a voucher) are effective at reducing fuel usage by 5%. Monetary rewards in comparison only induced a 3.5% reduction, though it’s not clear whether this truly reflects that non-monetary incentives are in fact more effective. It is possible that fleet drivers are more willing to talk to each other and compete over the non-financial rewards than they are with money, bringing some benefit, whilst vouchers ‘on-hand’ may be more salient and rewarding than money paid straight into a pay-check.

11.2.4.2 Real-time feedback: Telematics
The importance of constant, real-time feedback to help drivers overcome ingrained habits was highlighted in one of the expert interviews:

“It takes quite a while to un-train such an automatic behaviour as driving. Once you try to disrupt it and teach new skills, like for example, pressing the decelerator before a gradient started and lift off before the peak – this is really difficult to train, even if you have a visual to support and prompt you. We found that if the feedback was there, participants could do it, but as soon as the visual guide went, their behaviour reverted.”

This illustrates the wider trend in eco-driving research more recently, which is moving to real-time feedback through the use of telematic devices built into vehicles. These enable the application of many digital tools to provide in-vehicle, real-time and continuous feedback. They also provide plenty of opportunities to test and identify what type of feedback works best – is it visual feedback on screen, and if so how should the display be designed? Or haptic feedback through pressure on the accelerator pedal, for example?

This question has not yet been answered in the literature, though there is a fair consensus that in-vehicle feedback systems can be effective. To date, most feedback is given directly through information on fuel consumption but others are more discrete and targeted on driving behaviours like acceleration/ deceleration, speed, pedal pressure and gear shifting.
Driver engagement and safety: continuous vs. intermittent feedback

One study tests how truck drivers react (in terms of glancing) to visual eco-driving feedback and whether continuous or intermittent feedback intervals would be preferred from a traffic safety perspective.\textsuperscript{232} Moreover, the content of the feedback varied as different metrics are more or less suited to continuous or occasional feedback.

Tested in a driving simulator in Sweden, the continuous feedback condition displayed average fuel consumption; speed guidance; acceleration/deceleration guidance, and coasting guidance at crests. The occasional feedback condition presented information only at ‘timely moments’ while driving, and consisted of an intelligent speed advisory system; feed forward advice; and an indication of how well the driver performed during the last event (star rating).

While the feedback systems require cognitive attention from drivers, the simulator results suggest that drivers prioritise the traffic situation and spend significantly less time glancing at the display when traffic is demanding, in both conditions. Not much is yet known about how continuous and intermittent feedback compare in terms of behavioural responses and fuel usage, but this research suggests both are valid avenues for further research.

A follow-up study compared similar feedback systems to establish truck drivers’ perceived usefulness for the type of information displayed.\textsuperscript{235} Participants were generally positive towards eco-driving feedback systems. There was a large variation in the type of variables and information participants found useful, with the majority wanting simple and clear information. Gas pedal pressure, speed guidance, feedback on manoeuvres and fuel consumption were the most popular variables, suggesting that drivers prefer a mix of intermittent and continuous feedback. Indicative behavioural data suggests that drivers were more compliant with the feedback which drivers had themselves chosen, suggesting there may be merit in having systems which can be tailored to individual preferences.

![Interruption display](image1)
![Continuous display](image2)

Figure 4: Illustrations of the two displays used in Kircher et al. 2014.

11.2.4.3 Types of feedback

There is a distinction to be made between ‘feedback’, which provides the driver with information on their performance on some outcome measure, for example their fuel use, speed, or some efficiency score,\textsuperscript{235} versus that which aims to teach or prompt drivers into pursuing particular behaviours. With the former, drivers must explore their own driving style and work out for themselves the actions which lead to improvement. With the latter, discrete behaviours are prompted, such as acceleration, braking, gear choice, and coasting.\textsuperscript{236 237} There are no studies which systematically address this distinction or identify which type of feedback may be more effective, though it seems likely that they serve two separate but complimentary purposes, the latter teaching, and the former providing feedback on performance, and as such some combination of the two may be best.

The optimal mode of feedback delivery is also open to debate. The majority of studies use visual feedback systems, however as technology develops different means are becoming possible. For example, haptic accelerator pedal technology where the pedal pressure changes to nudge the driver to maintain the fuel-optimal level of speed and acceleration (without precluding the possibility of accelerating harder), has also been found effective in encouraging eco-driving.\textsuperscript{238} In some ways this is a more ‘direct’ form of engagement than
using visual information which must be processed and interpreted, leading to conscious and deliberate modification of driving style. Haptic feedback can in contrast be entirely intuitive if designed well, and also has the advantage that it does not compete for drivers' visual attention which should predominantly be dedicated to matters of road safety.

One study, for instance, compares various modes of real-time feedback on accelerator pedal usage. The study compares a number of haptic, visual and visual-auditory interface systems. Among the haptic feedback system, the most effective one was where an abrupt change in force was applied against the driver's foot when the acceleration rate was inefficient. This was in comparison to systems where the stiffness of the pedal changed gradually rather than abruptly. These findings conflict with a study where the gradual stiffness of the pedal was more effective than a step change force condition. Clearly, the detail of design, implementation and user-experience matters a great deal. Combining modes of feedback was also found to be successful (visual and haptic, audio and haptic, visual and audio), and visual-audio feedback outperformed haptic feedback in optimal accelerator pedal positioning.

Another study found the same trend, where visual interfaces outperformed haptic feedback in terms of pedal error (referring to the deviation from the optimal pedal angle) but at the same time the study observed that the haptic force system led to a more consistent accelerator pedal position – and smooth driving is also considered to be fuel-efficient. One plausible explanation is that visual cues give more detailed information than haptic pressure, which though intuitive, is quite crude. As such visual feedback allows more accuracy in drivers’ efforts to hit the optimum pedal position. However the downside of this may be a tendency to continually modulate your pedal pressure in an effort to maintain that optimum, by the very nature of the system being able to display more minor deviations from the optimum. Again, it is clear that a lot of variation exists in the details of the system design, though the overarching conclusion is that they can be effective.

Objectively, visual feedback systems tend to perform better but when asked which system they preferred, participants had a fairly strong preference for haptic rather than visual feedback systems, likely due to the fact that engagement with the haptic pedal force requires less cognitive bandwidth than visual feedback. Taking all these factors into consideration, a combination of these systems could perhaps be considered and tested for effectiveness and user-friendliness.
11.3 Conclusion – Driving style

Differences in driving style have a significant impact on fuel usage and consequently on driving emissions. Traditionally, environmental behaviour change campaigns have focused on information provision and awareness raising as the main tool to change behaviours, but often this is ineffective, and particularly so where the behaviour is habitual and ingrained.

Training programmes are a common approach to promoting fuel-efficient driving styles. Fleet drivers and those still learning how to drive should be the main target groups for training because companies have the largest potential gains to make from investing in training, and new drivers are least prone to existing bad habits (with the added administrative benefit of better uptake than with voluntary post-test training). However, currently there is little conclusive evidence of the effectiveness of training – some studies suggest success, but methodologies are not always strong.

Feedback systems have been found to yield the highest and most consistent reductions in fuel usage. Post-trip feedback in terms of rewards, or provision of average fuel performance provides individual drivers with good benchmark to aim towards. Real-time, in-vehicle feedback provides continuous reminders. There is great variation in the design of feedback systems and their efficacy for different drivers, so some form of personalisation is likely to be beneficial.

Overall, the body of evidence in this space is growing, and fundamental questions around how feedback should be designed are open to debate and further research, but broadly speaking, the approach has a lot of potential.
12. Traffic management

Traffic management is a term used to describe a set of measures and techniques applied to control traffic flow and safety. This typically includes road signage, speed limits, road markings, flow management, re-routing, and road pricing. This section focuses on aspects of traffic management with a clear impact on air quality: the control of traffic flow; congestion reduction; and the overall use and demand for the road network.

12.1 The impact of congestion on air quality

Congestion occurs when the volume of traffic approaches the available capacity. Unlike common belief, most congestion in the UK is due to exhausted capacity rather than accidents or construction sites, and this type of capacity-induced congestion on the UK’s road network and in cities is increasingly severe. It bears economic costs associated with longer travel times for workers and also for goods transported via the SRN. Congestion can therefore have severe impact on a country’s productivity and output. As it is not straightforward to measure congestion, quantifying the impact of congestion is complex and results vary depending on the methods used. In comparison to free flow, it was estimated that congestion costs the UK £20 billion a year. In turn, DfT estimated that a national system of charging could save the UK about £10-12 billion a year. Highways England themselves suggest congestion on the SRN alone costs an estimated £2 billion per year, with 25% of that resulting from incidents.
The graph below depicts travel mode choice in kilometres travelled over time. Rail use has increased slightly, offset by a slight reduction in bus and coach. The dominant narrative is one of significant increase in the use of cars, vans and taxis. Though there have been major technological developments and infrastructure investments over this period, the road capacity has not grown at the same rate of road demand, and in many instances further growth is limited by space as well as cost and environmental impact. Moreover, though this graph indicates total vehicle-kilometres, it is worth noting that many of these journeys occur within concentrated periods of the morning and early evening, further increasing the strain on the SRN.

![Figure 5: Mode choice in billions of passenger-kilometres. (Source\textsuperscript{246})](image)

DfT’s forecasts anticipate that road traffic in England will increase by 30% in the period to 2030. Under these forecasts, traffic growth would translate to a 40% increase in congestion across all roads by 2030 and a 72% increase in congestion on the Strategic Road Network specifically.\textsuperscript{247}

Congestion is also associated with increased levels of pollutant emissions as emission rates are highest in slow-moving and irregular traffic due to constant acceleration, braking and gear-changing (and at the extremes of congestion, idling). At the other end of the spectrum, in free flowing traffic the objective is to keep speeds relatively modest: emission levels of pollutants such as carbon monoxide (CO), hydrocarbons (HCs), NOx and particulates, are at their lowest between 25 mph and 55 mph, and they rise steadily with speeds beyond 55 mph.
as most cars have no higher gearing available and so increase rpm in order to increase speed.\textsuperscript{248}

One interviewee provided a more nuanced perspective on the impact of congestion on emissions:

“When you start digging into it, it’s actually difficult to answer. People behave differently in congested areas, they accelerate at a slower rate for instance. And once you get into a moving queue, you avoid a lot of start/stop manoeuvres - so a moving queue is not as bad as people generally think. To really know the impact of congestion on pollutant levels we need real data from telematics.”

The above is likely to be true, but so is the fact that free-flowing, 60mph traffic is preferable to heavy stop-start traffic on a road which otherwise has little cause for varying one’s speed (few junctions and bends, for instance). The impact of measures intending to address congestion and other traffic management aspects is unclear as the evidence is sparse and often methodologically compromised. This section reviews the current level of evidence.

12.2 Congestion reduction

12.2.1 Lower speed limits

Speed limits have long been at the heart of the debate on traffic management. Based on models, studies have predicted that lower speed limits have positive effects on smoothing traffic and thereby reducing the excess pollution occurring in congested traffic. Lower speed limits are not just positively associated with traffic flow but also have a direct impact on the emission levels as the average ICE burns more fuel (for a given distance) when driving above 70mph.\textsuperscript{249,250}

A number of studies have attempted to test these predictions in the field. One of the first studies attempting to measure the impact of lower speed limits was conducted in 2006 on one Amsterdam’s busiest highways (A10) that forms a ring around the city and in parts is surrounded by building blocks less than 20 metres away. On the western part of the ring, speed limits were reduced to 80 km/h from 100 km/h (approx. to 50 mph from 62 mph). Air quality was measured consistently at the roadside of both the western part of the ring (intervention) and in the southern part (no intervention). In the western part since the intervention, they found that PM\textsubscript{10}, PM\textsubscript{2.5} and black smoke (BS) pollution levels decreased by 27%, 11% and 21%, respectively. No significant reduction in NO\textsubscript{x} emissions was observed. However, this result is not entirely without caveats as a lack of robust counterfactual means confounding factors may partly account for the improvement (such as varying weather or traffic volumes for example). This said, the result is particularly encouraging since the
benefits of reduced speed limits depends on the baseline speed: dropping from 70 mph to 60 mph will be more beneficial than dropping from 60 mph to 50 mph, for instance, since most cars must work significantly harder above 65 – 70 mph.

A couple of years later, the longer-term impact of the 80 km/h limit on emissions was tested again in a similar fashion in Amsterdam and Rotterdam. Comparing actual emission measurements with emission estimates based on changes in traffic dynamics yielded results indicating a reduction for NOx between 5–30% and for PM10 between 5–25%.²⁵¹

A study estimated the effects of a reduction from a 120 km/h (approx. 75 mph) to 80 km/h speed limit on a Swiss motorway to examine the impact on ozone levels.²⁵² Specific to their model, they found that this reduction in speed limit would decrease NOx emissions from road traffic by 4%, no reduction in volatile organic compound (VOC) emissions, and a 1% reduction in peak ozone levels.

Is compliance the issue?

Estimates suggest that if current speed limits (70 mph) were more strictly enforced through average speed camera detection systems, for instance, CO2 emissions would fall by 2.9%, NOx by 4.0%, and it would also mean 37 fewer deaths per year on motorways.²⁵³ If the current limits were lowered to 60 mph and enforced strictly, 94 deaths could be avoided per year, CO2 emissions would decrease by 7.3% and NOx by 10%.²⁵⁴ A speed limit of 50mph would, however, have a significant adverse effect on travel times.

The behavioural question, therefore, is twofold: 1. Would such reductions ever be publically or politically acceptable? And 2. How can we increase compliance with speed limits? There is very little literature on rates of compliance with speed limits. The current approach tends to be based on the rational account of criminal behaviour, that is, that self-interest will lead us to commit a crime (speed) unless the risk of being caught, and the consequences thereof, are sufficiently severe that self-interest tips in favour of not speeding.

To some extent this appears to be true. More severe punishment does reduce crime in many contexts (though not always), as does increasing the chances of getting caught. For example, having average speed cameras tends to be more effective than static cameras, simply because it is harder to avoid them.

However there are other behavioural approaches to increasing compliance, which generally have not been studied in the context of speeding. For example, much of our own work has led to increased compliance in a range of contexts (fine and tax payments, for example), by simplifying rules and processes, and harnessing social norms (for example, including that statement "9 out of 10 people pay their tax on time" in an HMRC letter sent to late payers, significantly increases payment rates. A similar intervention may be particularly relevant to speeders because the deviant behaviour is often rooted in the misperception that ‘everyone does it’ (and therefore it is socially acceptable).

Most relevant is a recent study BIT conducted in which compliance was increased with the payment of speeding fines by explaining the consequences of their actions as a letter (sent with the fine). 6 months further data was collected and the results showed that the group of people that sent the letter were 20% less likely to be a repeat offender than a control group of similar speeders who did not receive the letter.²⁵⁶
Overall, the evidence is mixed, tending to suggest that lower speed limits would have a marked effect on levels of pollutants, but often based on modelled assumptions with quite weak empirical evidence. One of the main issues with producing real-world evidence is that measurement of emission levels is complex, and always context dependent, which makes cross-study comparison difficult. Even comparisons of the same motorway over time present challenges because weather, the level of traffic, and compliance with speed limits are all confounding factors and extremely difficult to control for. Moreover, these studies rarely look at the trade-offs on journey time and productivity. As such, though speed reductions would almost certainly bring air quality benefits under certain road conditions, the wide-reaching real-world impacts are not fully understood.

12.2.2 Variable and smart speed limits
Variable speed limits have first been used in the 1970s in Germany and have ever since grown in popularity around the globe. These are dynamic speed limits, displayed typically through digital signage on motorways and adjusted in response to weather conditions, traffic flows or incidents on the roads. Their main purpose is to ensure safety in difficult weather or traffic conditions.

A review of variable speed limit (VSL) strategies outlined their benefits:

- **Improved safety**: VSL reduces speed differences among vehicles travelling in the same and/or adjacent lanes. This has an interesting effect on drivers’ behaviour where more synchronised speeds and less lane-changing is observed. This decreases the risk of accidents;
- **Pre-empting traffic flow breakdown**: When roads are close to full capacity, VSL help avoid bottleneck situations thereby reducing the risk congestion;
- **Efficiency and environmental benefits**: Congestion is associated with increased pollutant levels, so by improving traffic flow VSL help to reduce emissions. Across a number of different studies, an average decline of 4–6% in fuel consumption during flee flow periods have been found.

One interviewee suggested that:

“*Smart motorways can be effective in reducing congestion, but not when traffic flow is really high. They are expensive and slow to build, but effective and they are being rolled out.*”

And when prompted to think about interventions worth testing, another interviewee pointed towards the possible effectiveness of LEZs and variable speed limits in winter when high pressure weather is frequent (given the relationship between weather and the severity of pollution):
“I’d like to see LEZ implemented when you get high pressure in winter, and then putting variable speed limits up to get people to drive 50mph. And then measure emission levels.

A study in Barcelona evaluated the impact of a newly implemented variable speed limit zone on air quality. This meant incremental reductions of 10 km/h from a maximum of 80 km/h to a minimum of 40 km/h. This zone was established a year after a more universal reduction of the speed limit to 80 km/h. This static reduction was found to have no impact on air quality (NOx and PM10 concentrations), and was lifted again a year later (in contradiction to the studies referenced earlier). In the variable speed limit zone however, they observed that the risk of extreme NOx pollution was lower (taking abatement into account during low and high pollution episodes caused by weather conditions). While this effect was observed in most scenarios, the reduction level is very dependent on the constitution of the initial pollution level. Specifically, variable speed limits have been found to be most effective when NOx concentrations are high and PM concentrations low – in general, variable speed limits are more effective in addressing the issue of NOx.

Overall, the literature suggests that variable speed limits can be effective in smoothing congestion and reducing speeds, though their effectiveness in these regards and thus in reducing air pollution does depend greatly on the context, weather conditions and level of enforcement. Compliance with variable speed limits is therefore an important challenge to which behavioural insights may have a lot to contribute.

12.3 Road pricing

Road charging is another intervention used to address congestion. The implications of road pricing on modal shift has been discussed in section 9.3.1, but findings around the acceptability of road pricing remain to be addressed. A meta-review confirms the finding that there generally is low acceptability for interventions like road pricing systems. Beyond this overall resistance, attitudes to real-life examples are more nuanced. Acceptability generally depends on the extent to which the intervention is perceived as necessary and how well this need has been communicated. Moreover, it depends on the extent to which the individuals expect to benefit from it, and in the case of congestion charges, acceptability tends to be high among those who regularly get stuck in traffic.

The study also highlights the importance of timeliness of communication and intervention using the example of referenda and public support. Both Edinburgh and Stockholm have held referenda about the introduction of a congestion charge, and the key difference between these cases is that in Stockholm a congestion charge had been tested already in a trial phase before the referendum was held. It seemed as if this trial had swayed the majority to ultimately support it, while in Edinburgh the majority voted against the introduction of a
congestion charge. This is a nice example of how personal experience and behaviours often pre-empt attitude change, as discussed earlier in Lesson 6.

**12.4 Reducing peak-time travel**

Congestion is typically the worst during rush hour, usually soon before 9am and soon after 5pm, regularly exceeding the SRN’s capacity. Though capacity expansion of the SRN would be one solution, it is not an efficient one given it would be underutilised during off-peak hours of the day and night. Smoothing out peak-time travel demand is therefore an appealing alternative solution to the rush hour crush.

Employers sit at the heart of this solution as much of the peak is driven by people commuting to work. More flexible work times may smooth peak-time travel – i.e. providing employees with either core office hours that allow flexible working in the mornings and the evenings, or setting time windows during which arrival and departure from work is expected. Having flexibility at the workplace and at home is strongly correlated with the extent to which drivers can and are willing to consider changing their travel behaviour away from peak-hour travel. This approach clearly has great potential to improve congestion, though challenges remain: implementation depends on a widespread shift of employers’ expectations, and there may also be major consequences for UK productivity.

There are two behavioural challenges to overcome here: encouraging employers to adopt more flexible rules, and subsequently encouraging employees to make use of them. One study tested whether rewards (€3–7 per day of avoiding peak-hour travel, or collecting credits to keep a smartphone they were given in the beginning of the trial) would effectively dis-incentivise peak-time car travel (this included driving in non-peak hours, or taking an alternative mode, or working from home). The idea behind giving smartphones at the beginning of the trial was to harness loss aversion. We are more sensitive to losses than gain, and consequently we place greater value on something we own than something we do not yet own (the endowment effect). The study found that both types of rewards (monetary + smartphone) were effective in reducing peak-hour travel, but also highlighted that commuting behaviours were mostly reversed once the trial ended (see Lesson four on incentive design, noting that this backfire effect is a common finding with temporary incentives). Further analysis is required to determine whether rewards can be effective in encouraging long-term avoidance of peak-time travel. Relatedly, other studies in the Netherlands have found that when using rewards to discourage peak car use, the most common shift is to non-peak car use. Encouraging uptake of altogether different modes of transport appears to be more difficult.
Using gamification to shift peak travel demand in Singapore

The Singapore metro operator (SMRT) uses incentives in an innovative and behaviourally-informed way to encourage off-peak travel. To encourage the use of public transport overall, they set up a system where for every kilometre travelled on public transport you earn one credit in your account. To encourage the use of public transport during off-peak hours, the amount of credits earned is tripled during those times of the day.

The credit score has a monetary value, which can either be paid out in cash or can be used to bet on an online games platform to win bigger prizes or lose all credit. 87.6% of participants chose to bet their credit on the gaming platform, which is a valuable insight in itself – the odds were poor (i.e. on average it is better to take the lump sum, as with most lotteries), but it highlights our tendency to overestimate our chances of winning. The online system was also designed around a series of games, including social media elements to recommend friends (earning you more credits). This is a textbook example of using ‘gamification’, and by making a certain behaviour fun (or perhaps even addictive, in the manner than much online activity is) is likely to keep people engaged.

Singapore found that since the introduction of this system, peak travel load was reduced by 7.49%. Unsurprisingly, commuters were also found to be optimising their travel time around this system in the sense that the intervention only marginally smoothed out peak-hour travel as a new peak emerged just before the old one, at the threshold at which they could earn triple credits.

Figure 6: travel density on the Singapore metro, before and after the gamified reward system was introduced. Source 268

12.5 Reducing road travel demand

It is also possible to reduce outright demand on the SRN. Modal shift, discussed in section 9, is the most common approach, however it is also possible to reduce the demand for travel by encouraging working at-home or reducing business trips through greater use of teleconferencing. There are several studies evaluating the effect of these interventions, and broadly the conclusion is that they can be quite effective at reducing miles travelled. For example, permitting flexible working hours and compressing a working week to 4 days has been found to reduce the miles travelled by car per week (though had no impact on mode of travel, with commuters still driving in single-occupancy vehicles).265 Similarly, allowing or encouraging staff to work remotely from home (teleworking) has been found to successfully reduce the number of car trips and miles driven in the Netherlands.266

As a reminder that unintended rebound effects are always a possibility, one study finds that providing two teleconferencing locations instead of a single meeting site reduces the miles driven per meeting attendee, however, the greater convenience of having a shorter distance to travel increased the number of meeting attendees, and so increased the total vehicle-miles driven.267 However, given the era of this study it is reasonable to assume that such problems would not arise today, where teleconferencing facilities are in every office and most homes. Promoting teleconferencing is therefore likely to be a relatively ‘safe’ way to reduce miles driven by employees.

Other rebound effects from teleworking are also a possibility however. Studies in the US estimate that it reduces total vehicle miles travelled by only 0.8%.268 The spare car left at
home might now be used by other members of the household, or someone who is teleworking 2–3 times a week might decide to live further away from the office, adversely affecting overall kilometres travelled. As such, national energy savings in the US and Japan from teleworking are estimated to be at most 0.4%.

Highlighting the complexity involved with changing commuting behaviour, one interviewee pointed out that most governments have a too narrow understanding of what traffic management entails:

[translated from German] “Housing policy ultimately is also transport policy. If people are forced to live outside of cities because of unaffordable housing, you are effectively placing them into their cars.”

He overall argued that no one single measure will be efficient, but that there is the need for an overarching ‘mobility strategy’ to address air quality challenges effectively.

[translated from German] “Technology is not a barrier. We have had the technological solutions to address transport related emissions 40 years ago. In Germany, there is no overarching mobility strategy linking up central goals, instead everything happens within individual sectors.”

Thinking about labour-market policies such as flexible working arrangements is therefore a useful approach to think about transport policy although the broader economic impacts across productivity, housing and health also need to be carefully considered. For the greatest impact, these measures should be seen as complementary to other transport policy interventions supporting overarching mobility goals, including improving air quality.

12.6 Encouraging alternative routes

Another option to reduce demand on the SRN during peak-hours is to get people to choose alternative routes to their usual one. Interventions to encourage alternative route choice are mostly based on the assumption that drivers are unaware of effective alternative routes.

Uncertainty about the duration of alternative routes is a major barrier, although one which can readily be overcome with modern GPS technology. Prospect theory also suggests that people are also likely to become more risk-seeking (that is, more willing to take a gamble with an unknown route), when their existing situation is poor (e.g. they are stuck in heavy traffic) – essentially when we have relatively little to lose and much to gain, we become less sensitive to an even worse situation and highly sensitive to an improvement. In other words people may welcome prompts to try alternative routes on very busy days, though this theory is yet to
be tested in the real world in the context of traffic management. Anecdotally, many people prefer to feel like they are making progress (moving more quickly) even if the route is longer.

There is very little research in this space. One study investigates the effect of real-time information through so-called advanced traveller information systems (ATIS) on drivers’ route choice. It identifies information and experience as working together to influence route choice, with more informed drivers tending to be more risk-seeking than uninformed ones. This begins to hint at possible approaches to disrupting commuters’ route choices (who are experienced travellers), and those taking a route for the first time (e.g. holiday-makers travelling on a bank holiday). However, far more research needs to be done in order to usefully translate this highly abstract laboratory finding. Nonetheless, we suggest there may be potential in prompting drivers to modify their route in the face of heavy congestion.
12.7 Conclusion – Traffic Management

The car has long been and continues to be our primary mode of transport. With a rapid rise in miles travelled, our existing road networks are increasingly running at or over capacity. More frequent and severe congestion is the consequence. Traffic management measures have evolved over the past years to address congestion and safety issues more effectively, for instance variable speed limits are now successfully in use in multiple countries. To date, the focus of traffic management solutions has been on safety and efficiency, with their impact on air quality relatively unstudied, though the mechanisms can be modelled with reasonable accuracy.

Lowering speed limits from 100 km/h to 80 km/h, for instance, has had a positive impact on congestion in some regions, but associated pollution levels have not yet been successfully measured in isolation. Stronger enforcement with existing limits may be an effective route, though there are limits to this given the need to maintain a reasonable margin of deviance before penalising, to account for mis-calibrated speedometers and to keep penalties proportionate to the crime (in the UK, the rule of thumb used by police is 10% plus 2 mph over the nominal limit).

Road pricing can sometimes be effective at reducing or diverting traffic. However, public resistance can be significant, which limits its large-scale use. Acceptability of road pricing is largely dependent on how effectively the need for it is communicated and to what extent individuals would experience the respective benefits. In the case of congestion charges, for example, letting people experience the impact first-hand through a trial phase is likely to tune them to be more favourable to it.

Congestion tends to be most severe during rush hour. Addressing peak-time travel demand through non-traditional measures like the promotion of flexible working schemes should be considered as part of the wider air quality agenda. However, this suggestion should not be viewed in a policy vacuum, with implications on productivity and housing policy of some concern. Though it can be difficult to compare the findings from different studies, rewards to avoid commuting during peak hours may have as much or greater impact than penalties during rush hour, and may prove more acceptable.

The impact of policies like teleworking or teleconferencing to reduce the overall number per of commuting trips taken, is more complex than one would anticipate. Rebound effects are likely to limit the positive impact on air quality if these measures are not met with incentives to change one’s mode of transport more generally.
Next Steps

The purpose of this report has been to equip readers with the knowledge necessary to develop behaviourally-informed interventions to improve air quality on the SRN. In doing this it provides a detailed overview of the existing transport behaviour research, as well as providing key lessons on behaviour-change more generally, with a focus on pro-environmental and health behaviours.

The report provides a solid foundation from which to develop a wide range of potential interventions. In order to do this, the next stages of this project are to:

- Identify a longlist of possible behaviours to target;
- Prioritise those behaviours on impact (i.e. what impact does to action or choice have on air quality, and to what extent might those behaviours or choices be feasibly encouraged or discouraged?) and on feasibility (to what extent does Highways England have capacity to run the intervention, what is the timeframe, cost, and public/political acceptability?); and
- With 3–4 priority areas in mind, develop intervention proposals by drawing upon the research in this report, and implementation strategies and robust evaluation plans for each.
Appendix A. Policy in focus: Are conventional information and awareness campaigns enough to change transport behaviour?

The limited impact that conventional campaigns have on transport behaviour has been discussed throughout the report. By relying on the provision of information, and/or by promoting certain attitudes, they can have modest impact where information deficit is truly a major barrier (just as Personalised Travel Plans can sometimes be effective by alerting people to better options they were unfamiliar with). However conventional campaigns usually fail to address other, often more important, barriers such as ingrained habit and the cost, inconvenience, or unavailability of alternatives to the car.

As such, campaigns can sometimes be effective, but upon closer inspection it is often the case that behind a successful campaign, a lot of other activity is also taking place. It is therefore more common that a successful campaign provides a modest ‘push’, while other structural issues are also being (or already have been) resolved. It is also possible that campaigns do a good job of raising awareness and changing attitudes with no objective of behaviour-change in mind, but instead bringing public consensus in-line with forthcoming regulatory change. Two particular cases studies illustrate this well.

‘No ridiculous car trips’ in Malmo, Sweden

Often referenced as a clever and successful health campaign, the community of Malmo worked to purge the habit of using the car for ‘ridiculous’ trips of less than 3 miles. They posed the question ‘what is a ridiculous car trip?’ asking people to reply, like a confessional, harnessing humour, social norms/peer pressure, and guilt/public embarrassment. The campaign has had good success, but it should not be overlooked that the campaign was building off much other work in the city to promote cycling. A few years previously in 2007 the town had been named as one of ‘15 Green Cities’ across the world, highlighting the strong pro-environmental culture, identity, and infrastructure that already existed (recall from earlier in this report our warning that environmental campaigns tend to be most successful for people who already agree with the message, and who therefore need only minor encouragement or a gentle prompt). Moreover, the town had been undergoing extensive cycling infrastructure improvements over recent years, among other pro-cycling initiatives, with the ‘no ridiculous car trips’ campaign intending to harness and boost uptake of these, rather than to be an isolated intervention in itself. There was also an extrinsic incentive to get involved, with the most ridiculous responses to the campaign awarded free bicycles.

The campaign and surrounding initiative are cited as a success, with the number of people cycling increasing from 20% in 1995 to 30% in 2010. However there is no reason to assume
that the conventional ‘campaign’ aspect of these initiatives was largely responsible for this increase.

‘Clunk Click’ seatbelt campaign in 1970s UK

Throughout the 1970s the ‘clunk click’ seatbelt campaign was prevalent in the UK. The campaign was well designed and harnessed a number of ‘behavioural insights’ – for example, highlighting the benefit to one’s family members more than to oneself; highlighting that accidents may be caused by other drivers, (playing into the fact that we tend to overestimate our own driving ability relative to others); and the use of a memorable heuristic to ‘clunk’ (shut the door) ‘click’ (put on the seat belt) every trip. The campaign is often cited as highly effective at changing behaviour though this is not necessarily the case. With the campaign active for over 10 years, seatbelt use increased from around 30% to 50%, though over this time period seatbelts also become more convenient and comfortable (the ‘inertia’ belt used today, allowing greater movement and comfort, was invented in 1967, with adoption taking several years thereafter as the stock of existing cars was gradually replaced). In the UK there were 13 attempts to mandate the wearing of seatbelts, finally coming into force in 1983. Studies by the AA showed that seatbelt use was around 50% the day before the law came in, jumping to 95% the following day.

The key insight here is that such high overnight compliance, from a law which is difficult to enforce and which requires the changing of ingrained habits, is remarkable. The most plausible explanation is that over a decade of high-profile campaigning (which had only a modest impact on actual behaviour) public awareness, attitudes, and consent to government regulation had been greatly increased, such that the nation was ready and willing for the change in law which is ultimately what was needed to shift behaviour. This building of public consent is a powerful and valuable function of campaigns, even where the campaign itself fails to change behaviour.
Appendix B. Policy in focus: Low emission zones explained

In response to EU regulation in 2008 mandating significant reductions in pollution levels in urban areas, many EU Member States established Low Emission Zones – areas that restrict access based on emission levels of the vehicle which are typically based on the emission standard the vehicle was constructed to and measured against in a lab setting. Restrictions can take effect either as a complete entry ban, or a charge to enter the LEZ. Studies suggest approximately 200 low emission zones have been established across 12 EU countries\(^{271}\), some with stricter thresholds than others.

EU emission standards apply to passenger cars, light duty vehicles (LDVs) like vans, two/three wheeled vehicles and heavy duty vehicles (HDVs), and each of these vehicle types have different emission requirements and test procedures. Most LEZs are conceptualised in a way that focuses on the reduction of PM emissions (and more marginally also NO\(_x\)), for which diesel fuels are the main contributor. HDV fleets consist almost entirely of diesel vehicles, and on average HDVs emit 30 times more PM and 26 times more NO\(_x\) than LDVs.\(^{272}\) Most LEZs therefore focus on restricting HDV access to urban centres, while all German LEZs also restrict LDVs. There is quite a large variance internationally as to what type of emission levels are included in the LEZ. Germany, for example includes most diesel vehicles but also old petrol engines pre– Euro 1 standards.

In the short run, the goal of an LEZ is to divert traffic and to reduce the use of highly-polluting cars out of the city centre to achieve fairly quick reductions in pollutant concentrations. In the longer term, LEZs are also thought to impact people’s vehicle choice by incentivising the use of low-emission vehicles.

Countries like Germany, the Netherlands and Sweden have national frameworks to provide a consistent approach to LEZs across the country (while in most places the municipalities/local authorities are in charge of implementation and enforcement), for example in Italy, LEZs vary in setup and standards across municipalities. LEZs are enforceable either manually, or with the support of automatic license plate recognition technology, though many require special sticker labelling in addition.

But are these low emission zones actually effective in reducing pollutant levels? Compliance with EU emission regulation is typically assessed using monitored data. Given this, it is surprising that there are only a handful of attempts at rigorously evaluating LEZs using post-implementation monitoring data. A review, comparing various LEZ evaluations in a number of European countries, found mixed results\(^{273}\): in German cities, with some of the stricter LEZs, annual average PM\(_{10}\) and NO\(_x\) concentrations were reduced by 7% and 4% respectively. In other countries, the effects seem to be less clear-cut and mostly show no reduction in
pollutant concentrations. The German LEZs differ from others in that they also include restrictions on diesel passenger cars, as well as HDVs.

On the whole, more research in this area is required, especially with regards to using monitoring data, but controlling for confounding factors like changes in traffic (e.g. congestion) or weather impact.
Appendix C: Catalogue of relevant cognitive biases and heuristics

<table>
<thead>
<tr>
<th>Bias or Heuristic</th>
<th>Real-world examples and possible nudges.</th>
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<tbody>
<tr>
<td><strong>Future discounting (present bias).</strong> Costs and rewards in the present loom large, those in the future are heavily discounted.</td>
<td>We smoke, drink and have risky sexual encounters in part because the pleasure is immediate and the costs are long-term. We also tend to forgo expensive energy-efficiency home improvements and buy less efficient washing machines, cars and light bulbs to save money in the short-term, even though we may waste money in the long term. In a trial, BIT altered the price labels on white goods at John Lewis to highlight lifetime running costs. This lead to a tendency to buy more efficient goods. When students are asked to pre-order their food (when the pleasure and the health impacts are both in the future), they are twice as likely to order the healthy options compared to choosing at the canteen (when the pleasure is immediate but the health impact still in the future).</td>
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<td><strong>Ordering effects (primacy and recency effects).</strong> We tend to recall information which is first and last in a list.</td>
<td>In memory tests using lists of words, the first and last few words are more frequently recalled. Put the healthy or more sustainable food options first and last on the menu to increase their rates of ordering.</td>
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<td><strong>Availability Heuristic.</strong> We judge the likelihood of something on our ease of recall of examples.</td>
<td>Terrorist attacks, air accidents and shark attacks are easy to recall, and so perceived as more likely than deaths by falling coconuts or falling from bed (which are statistically far more likely). This may be an issue to overcome as the world adopts autonomous vehicles, which are likely to be statistically safe, but major news stories in the event of an accident.</td>
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<td><strong>Loss aversion.</strong> We are more sensitive to losses than to equivalent gains.</td>
<td>Paying teachers in advance (for their performance) and requiring them to return their money if their students did poorly, was more effective than paying them if (i.e. after) their students did well.</td>
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<td><strong>Illusion of superiority.</strong> We tend to think we are better at X than we are, relative to peers.</td>
<td>The vast majority think they are better drivers than average (mathematically impossible in a normal distribution), are better than average at our jobs, and have higher than average IQ. This is a major issue with regards to safe driving campaigns as many people will discount the risk, though clever campaigns might play into this by acknowledging that ‘you’re not the problem, other people on the road might be’ (as the ‘click clunk’ seatbelt campaign in the 70s did).</td>
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<td><strong>Decoy effects.</strong> Choices between option A or B change when option C is presented</td>
<td>Offered a choice between small and medium coffee, more people will choose the medium when a large is subsequently added to the choice-set. It is therefore possible to increases sales of an extreme option (most expensive, for example), by offering an even more expensive option to change perceptions of what’s normal. Similarly, offering obviously bad deals makes other deals look good. Offering a print + online subscription for £59/year seems attractive if the print-only subscription costs £55 and the online-only subscription costs £40.</td>
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<td><strong>Proportional price evaluation.</strong> We perceive magnitudes (including price) proportionally, not</td>
<td>A saving of £10 from £20 pounds feels far greater than a saving of £10 from £200. We would go to greater effort for the former, undermining the axioms of economics.</td>
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<tr>
<td><strong>absolutely.</strong></td>
<td>Bundling expenses together can therefore have an effect, for example we tend to spend more on furniture if we do it while buying a house than several months later (relative to the cost of a house, an expensive sofa seems less expensive).</td>
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<tr>
<td><strong>Endowment effect.</strong> <em>(not to be confused with endowed progress)</em> We put more value on something we own than something equivalent we do not own.</td>
<td>People’s ‘willingness to sell’ price for something they are given is higher than their ‘willingness to pay’ price before they are given it. Increasing a sense of ownership over something (e.g. public land) can encourage them to value it far more, and thus potentially treat it differently.</td>
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<tr>
<td><strong>Framing effects.</strong> We draw different conclusions from the same information depending how it is framed (this is a general term, and could utilise, e.g. loss aversion as one example of framing).</td>
<td>Food described as 99% fat free may be evaluated more positively than food described as 1% fat. Asking medics whether they would opt for a treatment that saved 400 people out of 600 leads to a different response to asking if they would opt for treatment that kills 200 out of 600.</td>
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<tr>
<td><strong>Mere exposure effect.</strong> The tendency to like things more due to mere familiarity</td>
<td>Much advertising is based on mere brand recognition, hence why some adverts seem to have little informational content or relevance to the product. They are effective because we will tend to opt for a product we have heard of over one we are less familiar with.</td>
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<tr>
<td><strong>Optimism bias.</strong> A Tendency to be overoptimistic and expect favourable outcomes</td>
<td>We believe we are less at risk of ill-health, crime, accidents etc., relative to others. We also tend to believe we are more likely to achieve goals than we really are (e.g. career success, health goals, avoiding setbacks and failure).</td>
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| **Post-purchase rationalisation.** *(More generally, choice-supportive biases).* We justify our actions to ourselves. Having chosen and spent money on an item we are motivated to believe it was a good decision (regret avoidance). | In choosing second hand cars in experimental conditions, purchasers rated their choice as superior, even though their choice would demonstrably have changed if the purchase hadn’t yet been made.  

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| **Status quo bias / inertia / default.** The tendency to stick with existing options, go with the flow of defaults, and not make changes. | Automatically enrolling people into pensions (with the option to opt-out) dramatically increased rates of saving in the UK. Energy providers default customers onto expensive standard variable tariffs, and many of us fail to change and thus waste money. Only a third of people quit subscriptions even when told they are fraudulent, compared to 100% when it is defaulted.  

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| **Scarcity bias.** We are more attracted to goods if supply is limited. | ‘For a limited time only’ campaigns or marketing gimmicks, for example ‘only 2 seats left at this price’ are effective. Coupons with use-by dates are more likely to be used than those without.  

Highlighting the scarcity of goods can make them more attractive, while creating deadlines (get the application in by DD/MM) can overcome complacency. |
| **Escalation of commitment (foot in the door effect).** We are more likely to comply with a big request after complying with a small | Marketers aim to get a ‘foot in the door’, e.g. people agreeing to sign a petition for a cause were then more likely to donate money. Agreeing to give blood may increase your odds of agreeing to join the organ donor register,
| **request.** | while agreeing to join a friend at the gym once a week may increase the odds of joining. These are consistency effects (acting consistent with and rationalising past behaviour) separate to (in addition to) any effects of habit formation, or formation of new preferences. |
| **Head start effect or endowed progress.** A head start can encourage us to complete goals. We are more inclined to complete something we feel we have made progress on (related to sunk cost). | A coffee stamp card with 2 pre-filled stamps and 12 to collect encourages repeat custom more effectively than a blank card with 10 to collect. After one purchase, having a 3-twelfths completed card is more motivating than a 1-tenth completed card. Emphasising the progress someone has already made can encourage them to continue, e.g. with a diet or fitness goal, because we think proportionally not absolutely (see proportional price evaluation), and therefore being 30% of the way towards completion feels better than being 10%, even if the absolute remaining task is identical. |
| **Choice overload.** More choice often leads to suboptimal outcomes. | Limited cognitive bandwidth leads us to make suboptimal decisions when options are too plentiful. This is the basis 2013 legislation restricting the number of energy tariffs offered by energy providers to 4 variations, as well as the development of the ‘tariff comparison rate’ (TCR) allowing tariffs with multiple dimensions of price to be compared on one metric. Comparison websites and ‘choice engines’ can help consumers make better comparisons and more informed choices, for example with mobile phone contracts. Without such tools to support us, we tend to first start with our most important attribute (e.g. model of phone), rule options out, then consider the next important attribute (e.g. duration of contract) until we find a localised optimum – however this process of sequential elimination risks overlooking combinations of attributes which might have been better. |
| **Attribute overload.** We struggle to compare options on multiple attributes. | The minimum payment amount on credit card statements influences the payment amount even when customer pay more (i.e. the presence of the number has an impact, not just the requirement to make the minimum payment). Manipulating this value can therefore reduce rates of consumer debt. |
| **Anchoring.** An initial estimate or exposure to a number will anchor our subsequent choice or estimate. | The risk of insufficient range of an electric car may overrule other significant benefits. These perceived risks should be a priority issue to resolve in order to boost uptake. A guaranteed £10 is more appealing than a 50% of winning £20, yet a £50 chance of losing £20 or losing nothing may be more appealing than a guaranteed loss of £10. With extremely large or small values this may not hold. For example, a tiny change of winning the lottery is often preferable to a guaranteed £1 (the ticket price) for many. In part this is because we over-estimate very small probabilities, and in part because the potential gain is huge (i.e. we focus on the size of the prize), and the loss (ticket price) is negligible. |
| **Risk aversion (and risk-seeking).** With potential gains, we tend to be risk averse, choosing a sure-thing over a risk with a potentially ‘better’ payoff. With losses, we tend to be risk-seeking, choosing a risk of big loss (but chance of no loss) over a modest sure loss. | Salience Heuristic. Our attention is drawn to that which is novel and seems personally relevant to us. Personalising information and making it more salient is a good way to increase attention and action, for example putting handwritten messages on the outside of envelopes to increase responses. Mental accounting. We tend to hold costs in separate psychological ‘accounts’, rather than treating money as fungible. Gamblers will treat the money they have won (house money) very differently to that they brought with them (their money) despite the obvious interchangeability. Making certain costs salient as separate mental accounts can help people become aware of the expense. E.g. the deposit on a plastic bottle deposit-return scheme should be separate, not fudged into the drink cost, to encourage returns. Perceptual Illusions (various). Our | Serving food on smaller plates leads to less food being eaten, bringing health benefits, (as it
| sensory system is subject to its own biases which can be harnessed. | looks like a bigger portion) T98. Tall, narrow containers look larger (and thus better value, e.g. if filled with food), than wide, short containers.

Visual illusions have long been used in transport, for example road lines at decreasing spacing giving the perception of acceleration (to slow traffic on dangerous roads). |
Endnotes

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164. For a short summary of the scheme, see page 48 of iScape (2017) Challenges and Opportunities in the iScape cities, WP1 Task 1.1


A brief summary can be found here: http://civitas.eu/measure/promoting-carpooling-and-car-sharing though we have been unable to find details of the evaluation.


A good critique of car-sharing can be found here (termed car-pooling in the article in-line with US terminology, with car clubs confusingly called car-sharing): https://www.ptua.org.au/myths/carpool/

The Behavioural Insights Team Update Report 2016-17


The report is based on a survey module, which was included in the Office for National Statistics’ (ONS) February 2016 Opinions and Lifestyle Survey (formerly the Omnibus Survey). The questions were commissioned and designed by the Department for Transport.


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