INTEGRATING BEHAVIOURAL INSIGHTS INTO SUSTAINABLE MOBILITY PLANNING

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Executive summary

Despite their decisive role on sustainable mobility behaviour, psychological factors have not yet been a major focus of mobility transformation discussions among practitioners and decision-makers. Aspects such as infrastructure, regulation, financial incentives and non-monetary rewards have often been prioritised. This report, informed by a June 2025 expert workshop with **15 leading psychologists and transport researchers,** offers a fresh lens on the mobility transformation debate. Aimed at mobility decision-makers from the private and public sectors, it provides an overview of key psychological models and their implications for the mobility sector. It highlights main barriers to change as well as practical interventions to overcome them.

Understanding the main psychological mechanisms at work when people form mobility choices is crucial to foster the use of sustainable options. In this regard, **leveraging these mechanisms can lead to increased use of specific offers and ensure their success in the short and long term.** As cities struggle with space scarcity and face increasing pressure on public spaces, motivating individuals to change their mobility habits is a must. This means encouraging a shift away from private car use toward public transport, shared mobility, and active modes such as walking and cycling. Part of these efforts can be facilitated by mobility hubs that bundle various mobility offers at specific locations across a given city.

Innovative concepts such as mobility hubs and shared mobility services challenge established travel routines and therefore benefit greatly from a deeper understanding of users' underlying motivators.

Psychology provides the right tools to help understand these motivators. Behavioural change, defined as the transformation or modification of human habits, actions, or patterns, is facilitated or hindered by various factors such as **motivation, perceived control, intentions, social support, cognitive biases, or fear and anxiety.** In the mobility context, this means that part of people's transport mode choice is grounded in personal values, driven by the feeling of control over one's own journey, or shaped by the behaviour of peers. Moreover, psychological models show that a preference for the status quo, anxiety about factors beyond one's control, and the desire for immediate rewards are key barriers that prevent individuals from trying new mobility options.

Deploying the right interventions to overcome these barriers is key for innovative mobility concepts to thrive. **Psychological interventions are most effective once infrastructure and regulation are in place.** These must be **tailored** to individual circumstances to be both relevant and attractive.

They can take the form of **nudges, awareness-raising campaigns, and pilots or testing activities.** Besides, well-timed measures are particularly effective when introduced at moments when change is more likely, for instance during **life transitions.** Importantly, having people **experience** the new, more sustainable behaviour is key to initiate change at individual level but also across a target group. Such strategies help reach so-called **tipping points,** where a critical mass of people – typically around **25%** – adopting a certain behaviour leads the majority to follow.

Effective strategies for changing mobility behaviour need to consider the impact of psychological factors on people's mobility choices. To do so, **decision-makers and practitioners should understand the key cognitive biases and mechanisms that shape mobility habits.** While infrastructure and regulation are major enablers, innovative sustainable mobility concepts such as mobility hubs also depend on activation strategies that **leverage psychological factors influencing users' preferences.** Importantly, interventions should be targeted and individualised, and they should be deployed at strategic points in times when previously established behaviour becomes unstable. The focus of these interventions should be to **provide people with positive first experience** of the desired mobility alternatives, for the new mode of transport to be perceived as a simple, reliable, and convenient alternative.

Introduction

Context and objectives

Behaviour change is one of the main recurrent challenges identified by transport experts and practitioners as an important barrier to the sustainable mobility transition. While numerous publications (see for instance Martin et al[1]; Le Boennec et al[2]) have looked in depth at the role of price-based and in-kind incentives, only little material is available to decision-makers and mobility practitioners about psychological factors that impact mobility choices and behaviour.

To fill this gap, EIT Urban Mobility alongside with Urban Places Lab (UPL) and Roche have identified and gathered 15 relevant experts (see Acknowledgement section) in psychology and sustainable mobility to explore the relevant mechanisms accounting for people's mobility behaviour. Experts were invited to share and discuss their insights during an online workshop, and three interviews were conducted to complement the workshop's insights.

The objectives of this report are to shed light on the complex interactions between psychology and mobility choices. It further provides an overview of the mechanisms driving behavioural change and highlight recommendations for impactful interventions.

Theoretical starting point: Whillans et al.

Among the most relevant publications at the nexus of psychology and mobility behaviour is the paper by Whillans et al. (2021), titled "Nudging the commute: using behaviourally informed interventions to promote sustainable transportation."[3] This publication and its typology of psychological determinants form the basis for the expert discussions conducted for this report. The following determinants, defined by Whillans et. al, were identified by the consulted experts as having the greatest impact on mobility behaviour:

1. **Status quo bias:** "People are reluctant to change their behaviour from an established reference point and therefore need to have strong motivation to overcome their inertia. When it comes to commuting, the status quo bias is reinforced by daily travel routines that have become deeply ingrained habits. Most people drive to work and do it automatically, with little thought. When encouraged to alter this behaviour, they often resist because they tend to focus primarily on the perceived downsides of changing their commute."

2. **Loss aversion:** "People dislike losses more than they value equivalent gains. This loss aversion means them more likely to avoid risk than to take a potentially beneficial action. Thus, they will often continue with a current behaviour unless the threat of a loss motivates them to change. Likewise, when individuals decide which mode of transport to use, the anticipated downsides, or perceived losses, of choosing an alternative transport mode could loom larger than the potential benefits. For example, the anticipated stress of lost independence or having to wait an unpredictable amount of time for a bus may outweigh the anticipated pleasure of being able to relax on a bus instead of sitting behind the wheel in traffic."
3. **Friction costs:** "People tend to avoid difficult decisions and do whatever requires the least amount of effort – that is, whatever presents the least friction. Unless the benefits of sustainable transport are clearly visible, people may be discouraged by factors that make it seem inconvenient, such as weather or unpredictability."

Understanding the psychological levers that influence how people move increases the likelihood of success for innovative mobility concepts, such as the one currently being developed by Roche and the Urban Places Lab:

Case study: Roche & UPL public-private mobility hub

UPL and Roche are developing a **public-private** living lab for integrated mobility in Basel, Switzerland. The pilot mobility hub will launch on Roche's underground parking site, with residential buildings located above the garage. It will offer integrated multimodal mobility solutions and services – including car-sharing, micromobility providers, smart parking, and electric vehicle charging – serving employees, residents, and the surrounding neighbourhood. The hub will begin operations by the end of 2025 with a closed user group. It will open to the public in April 2026 and will be incrementally improved before being replicated in other locations.

The public-private mobility hub introduces an innovative approach that enables better utilization of existing company fleets and expands public access to sustainable mobility solutions. Thus, the hub reduces reliance on private car ownership in the neighbourhood.

The approach taken by UPL and Roche provides a framework for public authorities, mobility service providers, the public transport provider to come together and design a solution that serves Roche's employees on the one hand, and the city development's goals on the other.

The mobility hub is being established according to five key principles:

- The Mobility Hub in Basel should have a model character in Switzerland, inspiring replication across the country and beyond.
- Mobility solutions should be accessible to Roche employees and to residents.
- The Mobility Hub should connect public and private actors.
- The Mobility Hub should be embedded in national, regional, and private mobility infrastructure and strategy.
- The Mobility Hub should be part of a wider ecosystem of connected mobility hubs.

The core objectives of the Mobility Hub are twofold: First, it aims to improve sustainable mobility options for Roche employees and encourage more efficient travel behaviour. Second, it strengthens Basel's urban mobility system by reducing parking demand and fostering the integration of shared and active transport modes. Success will be measured by the number of users, the level of acceptance, and the extent of behavioural change the Hub is able to trigger.

While a single mobility hub has limited impact on its own, this flagship project marks the starting point for a citywide network of connected hubs that will, in the future, include tariff integration and advance Basel's transition toward sustainable mobility.

The situation today:

The Mobility Hub will be developed on an underground parking garage with 450 spaces: 350 reserved for Roche employees and 100 for residents. The garage is located in Basel, just outside the Roche campus, directly beneath a residential complex with 300 housing units and in close proximity to a public transport station.

The parking garage is well-occupied during peak hours, but demand has decreased outside of those times. This shift has enabled the company to allocate 20 parking spaces to the Mobility Hub on weekdays, and up to 30 on weekends. Given its location beneath a residential complex, opening the garage to broader user groups beyond employees presents a valuable opportunity. This maximises space utilisation both day and night while enhancing the use of Roche's existing vehicle fleet.

E-car sharing is already available in the parking garage as part of Roche's internal programme with Urban Connect, alongside two publicly accessible cars operated by Mobility.ch. These existing car-sharing offers are now being brought together in one location, featuring vehicles of different sizes to meet a variety of use cases. Opening the service to residents allows for more efficient use of the shared vehicles, improving both utilisation and economic viability. The Mobility Hub is designed as a two-level concept: the underground parking area accommodates car sharing, while surface-level areas focus on micromobility. Active mobility offers, such as bikes and e-scooters, will be placed at two key access points of the building to ensure visibility, accessibility, and seamless connections between modes. This offering should be complemented through partnerships with nearby cafés, restaurants, or museums.

The plan for tomorrow (Roadmap):

The Mobility Hub's first version has been developed through co-creation with employees, residents, and neighbours to ensure it reflects the needs of all user groups. It is scheduled to be operational by the end of 2025. The focus of this initial phase is to get the fundamentals right – such as pricing and service design. Over the next years, a deeper integration of mobility services is foreseen to create a scalable model, exploring options such as integrated ticketing across mobility providers but also including adjacent amenities such as restaurants, cafés, and museums. Additional locations could then complement the Mobility Hub and start creating a network of mobility hubs in Basel.

Encouraging multimodality and changes in mobility behaviour is a valuable goal, yet commuting patterns remain predominantly monomodal. To make multimodality and intermodality attractive, it is key to offer a wide range of options that people can choose from, knowing that not everybody will use the full range of options.

Looking beyond specific use cases, an overview of key psychological models of behaviour change and common cognitive biases helps to analyse and understand the factors that shape people's mobility behaviour. This knowledge supports the deployment of more effective sustainable mobility projects.

1 Understanding mobility behaviour

1.1 An introduction to psychological models of behaviour change

To understand the deep motivations accounting for people's mobility choices, it is crucial to explore psychological determinants from a traffic and transportation psychology perspective.

First, the concept of **behavioural change, central to this report, refers to the transformation or modification of human habits, actions, or patterns, often in relation to health, environmental, or organisational contexts.** All three areas, health, environment, and organisational settings, are directly impacted when considering sustainable mobility. Understanding the mechanisms that drive behavioural change enables decision-makers and practitioners in the mobility sector to design services that are more targeted and effective.

A closer look at the literature allows to identify important facilitators of behavioural change:

Intrinsic motivation: The first facilitator of behavioural change is a person's intrinsic motivation, which is linked to a few key psychological constructs such as autonomy, mastery, and purpose.[4]

Example: A commuter chooses to commute by bike not because of external rewards, but because it aligns with their personal values. The sense of purpose and mastery gained from navigating the city independently reinforces their commitment, making the behaviour sustainable even without incentives.

Self-efficacy: The belief in one's ability to perform a behaviour, and be effective in performing this behaviour.[5]

Example: After successfully travelling with public transport a few times, a new user gains confidence in their ability to plan routes and manage transfers. This growing belief in their competence encourages them to use public transport more regularly, replacing car trips with a mode they now feel capable of using.

Perceived control: Evidence[6] shows that when people believe they have control over a situation and feel confident in it, change is more likely to occur.

Example: A commuter switches to public transport after discovering a reliable app that tracks real-time arrivals and delays. Feeling in control of their travel experience – because they know when and how they will arrive – makes them more willing to adopt and stick with this new mode, reducing reliance on the private car.

Social support: Encouragement and modelling from peers, mentors, or groups someone belongs to.[7]

Example: An employee joins a employer's car-sharing scheme after seeing colleagues participate and share positive experiences. Encouraged by peers and supported by company incentives, they feel part of a community effort. This social reinforcement helps them overcome initial hesitation and commit to use car-sharing.

Implementation intentions: Intention is a key construct from a psychological viewpoint to implement behavioural change. "If-Then" plans enhance goal-directed behaviour.[8]

Example: A person sets a clear plan: "If it's not raining tomorrow, then I'll bike to work." This simple "If-Then" strategy helps them act on their intention by linking it to a specific condition. Over time, these cues become automatic, making sustainable travel a consistent part of their routine.

Likewise, research points out to barriers to behavioural change, such as:

Cognitive biases and habits:[9] Status quo bias (the tendency to prefer things to stay the same, even when change may offer better outcomes.), sunk cost fallacy (the tendency to continue an endeavour once an investment in money, effort, or time has been made – even when it no longer makes sense), automaticity (the performance of behaviours without conscious thought, often triggered by environmental cues or habits).

Low perceived control:[10] Feeling powerless to change the circumstances.

Example: A commuter wants to switch from driving to public transport but feels powerless due to unreliable schedules and frequent delays. Despite environmental concerns, they continue driving because they believe they cannot influence or predict the public transport system, reinforcing car dependency.

Fear and anxiety. When people feel fear and anxiety (threat to their wellbeing), this can trigger defensive mechanisms. Like the links of a chain, these mechanisms ultimately drive people to save resources, which is a behaviour at the basis of maintaining the status quo (Leventhal's Parallel Process Model[11]).

Example: A person considers cycling to work but feels anxious about safety and exposure to bad weather. This fear triggers a defensive response: they stick to driving, which feels safer and more predictable. The desire to protect personal wellbeing leads them to conserve energy and maintain the status quo.

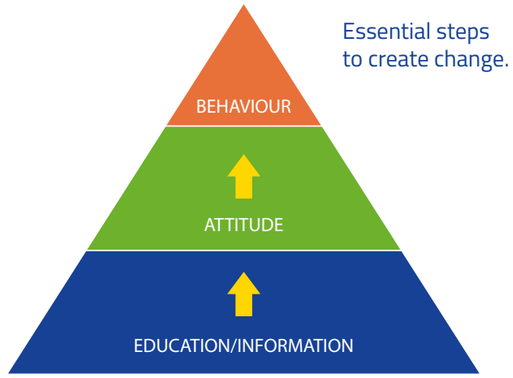
Lack of immediate rewards: Delayed gratification reduces adherence to change.[12]

Example: A resident switches from car to public transport but quickly becomes frustrated by longer travel times and missed connections. Without immediate benefits such as cost savings or comfort, they revert to using their car, which offers instant convenience and gratification, despite long-term sustainability goals.

The psychological processes underlying behaviour may be seen as the interplay between affective and cognitive processes that guide decisions in the short and long terms. Actions that target affective and cognitive dimensions are typically the most effective.

A few psychological models are considered as most relevant to account for behavioural change, also in the context of mobility. An overview allows to consider the most important dimensions to look at when considering behavioural change.

Knowledge based models:[13]



Knowledge-based models assume that providing information increases environmental awareness and fosters a more positive attitude toward the environment. This, in turn, encourages individuals to behave in a more environmentally responsible way. In the context of mobility, this translates into choosing more sustainable modes of transport.

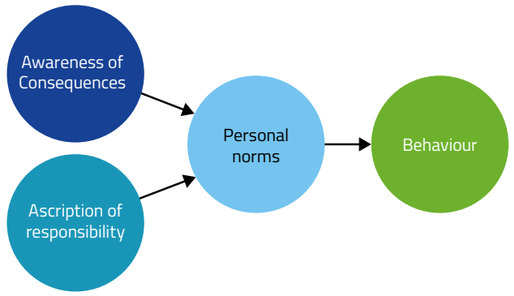
This approach raises the question of what type of information should be provided. When aiming to influence people's knowledge, information about the issue, possible actions, and their consequences must be carefully selected.

Attitude, value, and norm-oriented models:

According to these models, knowledge is important, but on its own it is not sufficient to trigger sustainable behaviour. The affective dimension plays a central role, with values at its core. The literature distinguishes three main categories of values, different reference points that can motivate people to change:

- **Egoistic:** interests, goals, and significant others for the individual; concern for the environment arises from the impact it has on the individual's well-being
- **Social/humanistic:** concern for the environment arises from the impact it has on the well-being of the community and humanity as a whole
- **Biospheric/ecocentric:** concern for the environment arises from the impact human behaviour has on the well-being of the environment itself, other species, and ecosystems.

Norm activation model:[14]



This model focuses on the role of personal norms. According to it, personal norms arise from an individual's awareness of the consequences of their behaviour and the sense of responsibility they ascribe to themselves. These are strong predictors of behaviour. As a result, behavioural change can also be encouraged by reinforcing individuals' personal norms.

Figure 1: Theory of planned behaviour

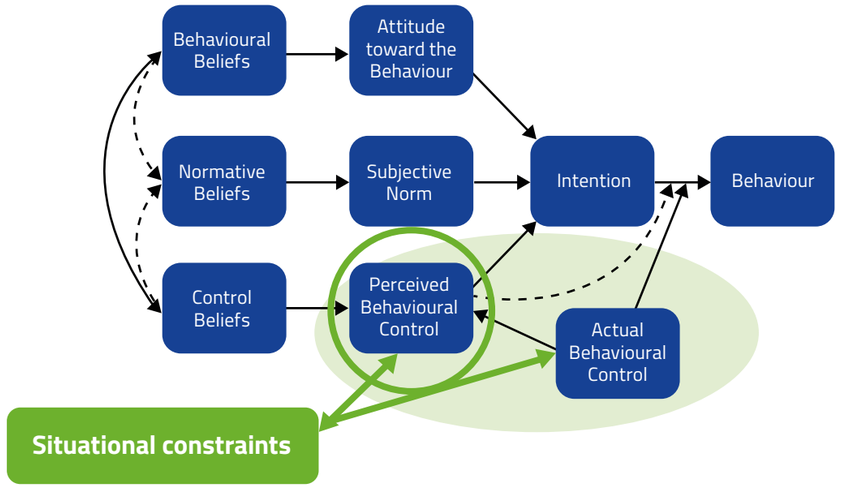
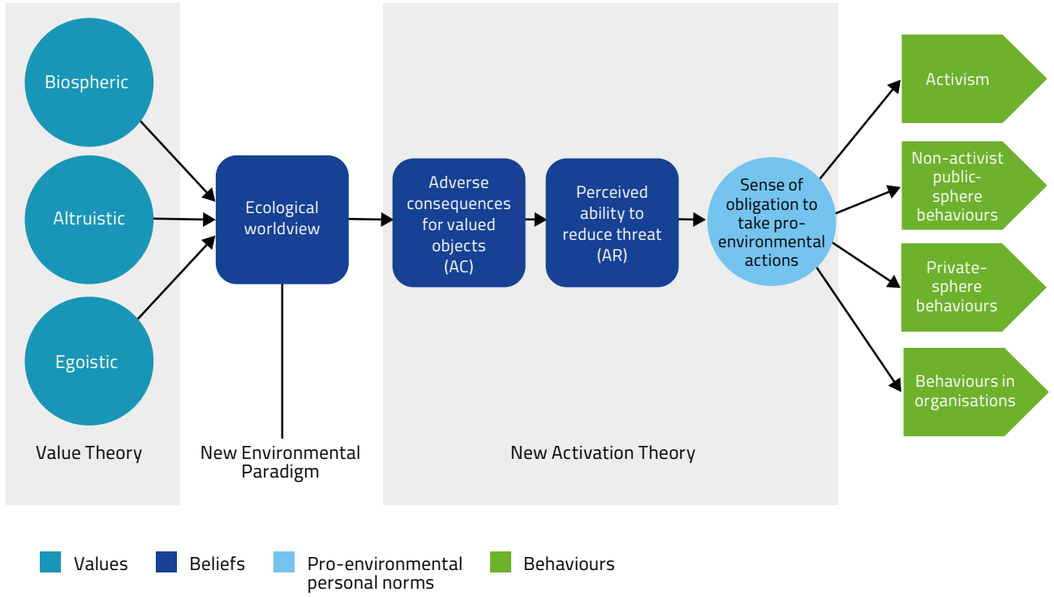


Figure 2: Value belief activation model



Theory of planned behaviour:[15]

According to this theory (see Figure 1), people make decisions by weighing the positive and negative consequences of their actions. The intention to act is considered the strongest predictor of behaviour. The theory of planned behaviours lends great influence on beliefs, as it posits that intention is determined by:

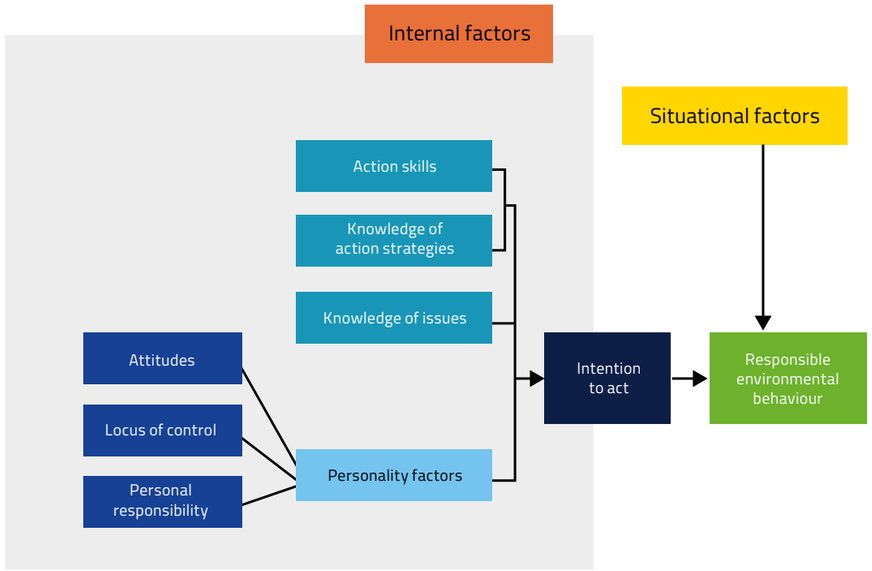
- The attitude toward the behaviour in question
- The perceived subjective norms within one's social context
- The perceived behavioural control

These three elements are in turn influenced by behavioural beliefs, normative beliefs, and control beliefs. In this view, another key point to work on is to focus on people's beliefs.

Value belief activation model:[16]

Developed as an extension of the Norm Activation Model, this theory links values, beliefs, and personal norms in a causal chain that explains pro-environmental behaviour. In this framework (see Figure 2), individual values influence beliefs, such as awareness of environmental consequences and the ascription of responsibility for them, which then activate personal norms that guide behaviour.

Figure 3: Responsible environmental behaviour

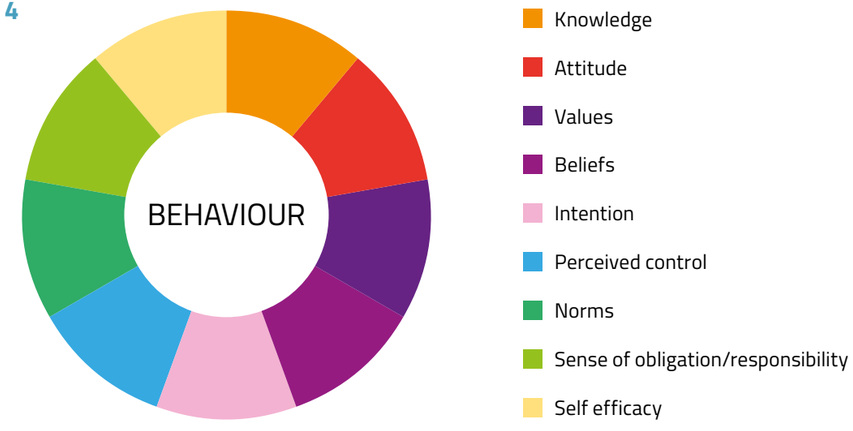


Responsible environmental behaviour:[17]

The main interest of this model (see Figure 3) lies in its ability to integrate both cognitive and affective variables. It also includes external and situational factors. Research shows that environmental, social, and situational factors play a key role in determining whether responsible behaviours are actually carried out. The model shows that nudging through environmental measures can influence cognitive and affective variables, leading to a higher probability of behavioural change.

Based on the key psychological theories discussed in Chapter 1.1, Figure 4 provides an overview of the main psychological determinants that influence sustainable travel choices.

Figure 4



1.2 Cognitive biases and perception

The status quo bias reflects a major pattern in the way the human brain works. As far as the functional level of the brain is concerned, people process information linked to familiar stimuli more easily and faster. Thus, **a familiar situation requires less effort to be processed** and tends to be preferred by the brain that is geared toward efficiency maximisation (to save resources) through automatisms.

A relevant point for discussion is whether the status quo bias should be considered a bias at all. The routines that form the status quo begin as deliberate decisions made by individuals. These decisions are strongly influenced by the existing design and structure of mobility systems, suggesting that the bias operates not only at the individual level, but also at **a collective level.** Moreover, the term "bias" itself may carry the risk of discouraging change, as it can imply that such tendencies are beyond personal control. Referring instead to a "status quo preference" may make it easier for people to recognise and actively address these behaviours.

The status quo preference accounts for the fact that habits developed for instance by employees during their daily commutes are hardest to change. The main barriers lie in creating awareness by ensuring that employees receive complete and up-to-date information, enabling them to consider alternative options. To this extent, the status quo bias is very much related to the so-called "default bias", which is the tendency to go with pre-set options.

It would be an oversimplification to link the status quo and default biases to laziness. The situation is much more complex and requires distinguishing between cognitive and affective levels.

- On the cognitive level, we should look at **human beings as savers of cognitive resources.** This tendency means that people often avoid mentally demanding tasks unless absolutely necessary. Change requires a lot of cognitive resources to elaborate new stimuli, to find new solutions to existing challenges or move beyond the status quo. Humans per nature tend to **preserve these resources,** which in turns negatively impact their ability and willingness to change.
- On the affective level, change is always disruptive while humans tend to look for pleasure and positive emotional states to avoid any disrupting factors. An important part of the affective level is the **sense of perceived control.** Changing a commuting pattern – especially from private car to public transport – may upset this feeling of perceived control, which is central in people's everyday experience and wellbeing.

Perception plays an important role in mobility decisions. For instance, the Swiss 2021 microcensus about mobility choices[18] shows that **simplicity & convenience** are the most influential factors. When a mobility offer is not simple, for example, if it requires downloading multiple apps to access the service, people are less likely to adopt it.

In fact, more than 35% of respondents in Switzerland cited convenience as a key reason for choosing individual motorised transport. However, simplicity in this regard is more precisely defined as **"perceived" simplicity.** For instance, people using bike-sharing systems will have a different perception of their simplicity of use than people who are not familiar with such systems. The same should be kept in mind when considering travel time, which often reflects perceived rather than actual time. This notion is especially important when comparing travel modes, for instance the train in which one can be productive versus the car where attention is focused on the driving task.

In addition to the above-mentioned biases, **social norms and values** shape mobility-related decisions: witnessing different commuting types in someone's immediate work, family, or friend's environment influence mobility behaviours by showing what is possible and feasible. Therefore, interventions in group setting are most effective, because of the group accountability it creates (peer-pressure). The group setting is also particularly valuable to share experiences, promoting positive ones but also highlighting how negative ones can be mitigated. This is linked to the status quo bias, meaning what you see as social norm influences what you think you should be doing. Therefore, cultural aspects are important to consider when trying to get people to change their behaviour. People hold different values but generally strive for consistency between what they believe and how they act. It is therefore important to foster consistency between values and behaviour, as individuals tend to avoid discrepancies between the two. This is the reason why when someone in a people's peer group starts changing their behaviour, group proximity can lead to other people of the same group adapting their behaviour too.

The different psychological models and the way preferences are built show the complexity of mobility behaviour as results of several contiguous, sometimes overlapping, processes. From there, it is relevant to look in more details at the mechanisms driving behavioural change, to better understand the opportunities and challenges of modifying deeply rooted habits.

Key takeaways

- Important facilitators for behavioural change include intrinsic motivation, self-efficacy, perceived control, social support, and implementation intentions.
- Main barriers to behavioural change include cognitive biases and habits, low perceived control, fear and anxiety, as well as the lack of immediate rewards.
- Familiar situations requires less effort to be processed and tends to be preferred by the brain that is geared toward efficiency maximisation through automatisms.
- Group settings are most efficient to motivate change, especially if change generates consistency between values and behaviour across the group.

2 Mechanisms of behavioural change

2.1 Breaking habits: cognitive and emotional barriers

People seeking to change their mobility behaviour must engage at a metacognitive level: becoming aware of their own thought processes and habits in order to modify them effectively. However, the human brain is primarily built for cognition and action – that is, for direct interaction between thinking, sensory processing, and doing – rather than for metacognition. Changing behaviour means to find a new way to plan behaviour, to decide what is good and what is best. These processes of planning, evaluating, and deciding take place on different levels of cognition, requiring a shift from automatic routines to conscious reflection. Lateral thinking is a metacognitive process that takes a lot of energy. It refers to creative problem-solving that approaches challenges from new and unconventional angles rather than following linear logic. This is a barrier for a lot of people who do not want to invest such a large amount of energy to generate a new plan of action. In many cases, the energy required is the main reason why new action plans immediately collapse and are not followed through.

Changing behaviour in the field of mobility is not about changing a single habit. Mobility is a fundamental human behaviour that has shaped our species and its brain since early evolution. Two million years ago, walking and running were directly linked to hunting success, supported by two behavioural control systems: the goal-directed and the habitual. Changing mobility behaviour today therefore means rebalancing routines deeply rooted in human evolution.[19] **Mobility is in most cases directly connected to reaching key goals,** and humans react strongly when they sense these goals may be at risk, especially when such goals are per default linked to survival. For example, when drivers experience high levels of stress, they lose the ability to plan the best route. Their thinking becomes narrow, similar to a fight-or-flight response. In this state, rational discussion or decision-making is no longer possible. Since behaviour is goal-oriented, stress can displace the true mobility goal (e.g., arrive safely and efficiently from point A to point B) with the immediate goal of stress relief. Since behaviour is very much goal-oriented, it is essential to keep sight of the true purpose of being mobile. Any mobility alternative should therefore help people meet their essential needs, as described in Maslow's hierarchy of needs.[20]

In addition to the thinking patterns inherent to the human brain, self-referential behaviour is another important barrier to behavioural change. People tend to be connected with other people like themselves, sharing common interests and views. These homogeneous groups are usually very stable and not much open to change. However, with this barrier comes an **opportunity to break habits by changing one referential** for decision-making and information-processing to another referential. In such cases, people can be

confronted with other perspectives they were not aware about, creating opportunities for the most open-minded to change their behaviour.

The complexity of mobility preference formation is also reflected in the importance individuals assign to different factors. This importance differs across geographic contexts. For instance, in Germany, reliability comes as the first concern, with over 80% of passengers surveyed stating they prefer reliable connections to more frequent train services.[21] This is linked to loss aversion: the tendency for people to be more concerned about losing an existing benefit than about gaining something they do not yet have (see the typology by Whillans et al. mentioned in the introduction). In mobility systems where reliability is a lesser issue (e.g. in Switzerland, where train punctuality is above 90%[22]), people tend to take this factor for granted. They may not realise that reliability is something that could be lost, and therefore prioritise other aspects instead.

Attempts to abruptly change mobility preferences, such as approaches focused on banning car access or heavily restricting it, can backfire as they **directly threaten people's feeling of controlling the situation.** In such cases people may start to protest and this triggers psychological reactance, whereby people behave in the opposite way than the one incentivised, as a form of protest. This theory, developed by Brehm,[23] posits that when individuals perceive their behavioural freedoms are being threatened or restricted, they experience a motivational state – **reactance** – which drives them to restore those freedoms.

2.2 Timing and life transitions

Time is a relevant dimension to consider in any effort to motivate sustainable mobility behaviour. It is key to be conscious about the **time frame** within which behaviours should be changed, as this will directly inform the methods to be used. Changing behaviour in the short term requires different methods than aiming for long term change, which involves a cycle of deliberation, intention, implementation, experience, and renewed deliberation.

Substantial behaviour change does not happen overnight. It requires continuous repetition (the basis of behavioural change) of proven processes that challenge the status quo and enable positive reinforcement. As one expert puts it, **"You should not expect a quick win".**

Beyond the timeframe, research concurs to indicate that timing is of utmost importance. From a theoretical perspective, it is relevant to consider experiments linked to stable behaviour. Increasing the frequency of stable behaviour changes the status quo from stable to instable. As a result, people try immediately to re-instate a new, stable behaviour. **To motivate a change in mobility behaviour, it is relevant to look for the right moment when a stable behaviour becomes instable and looks for a new point of stability.** This approach offers an alternative to the traditional idea of steering behaviour from A to B, where B represents the "better" option. Here, the old behaviour fades without being replaced by a prescribed new one, allowing self-organisation to take place. To maximise effectiveness, it is essential to identify the factors that keep old

routines in place, such as travel times or convenience. By reducing the appeal of these factors, the attractiveness of the old pattern diminishes. Once the **old pattern is destroyed,** then people build together the next choices or solutions.

More concretely, identifying moments when it is easiest for people to change their status quo behaviour has proven most effective. For example, campaigns encouraging a shift from car to bike commuting, such as Munich's Stadtradeln[24] challenge, where participants track their cycling in teams, are far more effective in summer than in winter. Likewise, choosing less stressful periods for the target groups yields better results. The best moments can also be points of change in life: when people move to a new location, have their first children, or start a new job. This is linked to the fact that when a context change disrupts individuals' habits, **a window opens in which behaviour is more likely to be deliberately considered.** Such context change can activate important values that guide the process of negotiating sustainable behaviours.[25] Once people took the habit of cycling, they are more likely to keep it, even when the weather gets colder or rainier. A study[26] about London metro strikes shows that unexpected disruptions are also opportunities for behaviour change. When regular routes were unavailable, some commuters were forced to alter their routines and many did not return to their previous, deeply ingrained patterns. Results show that the analysed disruption in public transport in London increased the total number of bicycle sharing trips by 85%. For some, this event produced long-term change in behaviour because they realised that they were not using the most cost-efficient or time-efficient option.

Overall, the status quo preference can be changed more easily when there is a change in a target group's own status quo (family situation, place of living, job), or at least when there are frictions to their existing way of life. These are times when habits are questioned anyways due to changing circumstances. For instance, people do not decide in the morning about their commute, but this decision happens much earlier and is often linked to questions related to place of work, or choice of residence. Some smaller events in life can also be seen as opportunities to influence mobility behaviour, like when people come back from summer vacations.

However, to wait for such changes in life conditions is not always the most feasible approach to accelerate change. Indeed, one limitation of approaches that aim to break habits during key life transitions is that they do not seek to change the broader context in which people live and make decisions. For example, if car driving remains as easy as it used to be, why should people consider a change even if they experience life-changing moments?

2.3 The role of information and experience

In a 2020 article,[27] it was shown that **people consistently underestimate the costs of car ownership by around a half.** This is partly related to sunk cost fallacy: once people have bought a car, they do not consider the impact of depreciation. Similarly, there is a present bias to the extent that people tend to overlook a vehicle's total costs of ownership, focusing rather on the upfront costs.

This highlights a broader point: **people may lack the knowledge** required to use shared mobility options. It is therefore important not to assume that everyone is familiar with how mobility services work. Many of these options are accessible by apps, which leaves off some elderly people and sometimes the poorest part of the population. Likewise, the benefits and comfort that can be gained thanks to sustainable mobility options may not be well advertised. Better awareness-raising about these options and their benefits is needed to stimulate mode shift: In this case, perceived friction – rather than real barriers – often discourages action and can be reduced by improving people's practical knowledge.

Knowledge, in this context, can be distinguished between awareness of available mobility options (and how to use them) and understanding of the benefits these options offer. Users should have better access to information on both dimensions.

Practical information about the services available and how to use them is often more effective than communicating their benefits when it comes to prompting people to act. Most individuals focus on their immediate, day-to-day mobility needs, a tendency explained by the so-called "present bias". From a holistic point of view, this is one of the major barriers to overcome: professionals tend to focus on the bigger impacts of transport, but this does not necessarily filter down to users looking primarily at ease of transport to move from A to B. Increasing practical knowledge, particularly to demonstrate that alternatives to the private car can be time- and cost-effective, is a prerequisite for achieving behaviour change in mobility. **It should be prioritised over more idealistic knowledge** pertaining to long term climate benefit, as this type of knowledge – whilst important – does not motivate actions as strongly as the practical knowledge.

Showing external costs of transportation (information) can in some cases be a good way to change behaviour. However, research shows that the effect is often short-term and quite small. Indeed, providing information alone is rarely sufficient to change mobility behaviour. One 2008 meta-analysis[28] found that soft policy measures like travel planning and awareness campaigns led to behaviour change in **up to 15% of participants,** but only when psychological factors like habits and perceived control were addressed. Findings from additional relevant studies[29] as well as from the GISMO project[30] support this conclusion. The studies show that information can raise awareness and intention, but without opportunities to experience alternatives and the right supporting structures, change is unlikely to follow. The **e-bike city project** in Zurich reached similar conclusion, with the interesting aspect that experience does not need to be necessarily a physical experience: within the project, people's acceptance increased after they were able to see the benefits of the planned infrastructure through a visualisation experiment.[31]

Effects of information provision on behaviour can be largely open and depends on external factors such as geography. In Norway, a project by the Institute of Transport Economics (TØI) and Statistics Norway provided 20,000 people with information comparing the costs of car ownership and car sharing. This led to a 15% increase in car-sharing uptake within the target group.[32] However, sometimes, **providing information has unintended consequences,** for instance if people deem the costs of using a car are acceptable. This represents only one level of intervention. On a broader scale, providing such information contributes to shifting social norms, which in turn positively influences behaviour.

Good information matters, but many people still continue behaviours they know are harmful, like smoking or unhealthy eating. One reason is that the negative effects don't feel immediate or physical. **People don't experience the risks directly, which makes them harder to act on.** Understanding these risks requires abstract thinking, which takes mental effort and is difficult for many. As a result, only a small group of people responds to such information-based strategies.

Beyond information provision, it is crucial that people can **experience both successful and non-successful behaviour.** Research shows that experience is directly linked to biochemical reactions in the brain. Successful behaviour is answered by a dopamine release in the brain, which supports this kind of behaviour in future. However, when people have a negative experience, **dopamine** release stops. This interruption often leads them to reflect on what went wrong. **Experiencing non-successful behaviour is a strong motivator for change.** It is much stronger to experience non-successful behaviour than to get positive feedback. The stopping of the dopamine release triggers stronger reactions in the brain than the release of dopamine. Therefore, it is key that decision-makers or entities that promote change enable people to experience what they do. It is not enough to theoretically discuss issues; people need to feel the pain or the success of behaviour. Such experiences are a pre-requisite for people to question their behaviour.

For many actors like cities and private companies it is often easier to produce satisfactory experiences than harsh ones in trying to get people changing their mobility behaviours. Many stakeholders already try to provide people with good mobility experiences, for instance thanks to free public transport or shared mobility trials. Encouraging people to rethink their behaviour requires giving them the chance to try something new and ensuring that these experiences are positive. Indeed, if someone has already taken the step to reflect on their habits and test alternative forms of transport, a negative experience can easily discourage them from trying again. In addition, since **experience** and new behaviour shape knowledge, it is **essential that people's encounters with sustainable mobility options are extremely positive**. This helps update their understanding and ensures that future mobility decisions are better informed.

Experiments and pilots are important to find out what works and what does not in the short term. However, **sustainable mobility behaviour is about the long-term and the holistic system view,** which is mode-agnostic. Therefore, it is very important to pay attention to the perpetuation of the experiment, giving people the possibility to prolong the experiment if they liked it. For instance, after an e-bike trial, people could benefit from a discount to purchase one.

A key point concerns how people were attracted to these experiments. In this case it is relevant to distinguish between **intrinsic and extrinsic motivations.** For instance, some participants joined the experiments out of intrinsic motivation, driven by personal values or shared norms. Others did so for extrinsic reasons, such as the opportunity to try a new mode of transport for free.

In the first case, reward should for instance focus on being part of a community who shares such values. In the other case, reward should rely on empowering the extrinsic motivation that drove them to take the experiment. In general, **motivation factors** such as self-enhancement, growth, life-improvement (pleasantness) can be leveraged to instil new, more sustainable behaviour.

Chapter 2 provides a deeper understanding of mobility behaviour architecture, choice formation, and the unique role of mobility in human cognition. This understanding helps to grasp the complexity of breaking, sometimes deeply rooted, mobility habits. In chapter 3, the interventions that can change behaviours are in focus. It presents behaviour change strategies, the role of nudging, and the importance of structural and policy measures for long-term success.

Key takeaways

- Changing mobility behaviour requires so-called „lateral thinking", which belongs to metacognition and requires a lot of energy. The large amount of energy needed to generate new action plans is a barrier to behaviour change.
- Mobility behaviour is in most cases goal-oriented; any alternative mode must enable people to reach their goals and meet their everyday needs.
- Self-referential behaviour, loss aversion, and people's perceived control of situations are key elements to consider when analysing barriers to behavioural change.
- Substantial behaviour change takes time. Patience is required as well as the identification of relevant points in time when external factors make people more likely to reflect and change their behaviour.
- Practical information helps raise awareness and supports people in planning alternative behaviours.
- Experiments play a crucial role in encouraging people to change established habits.

3 Designing effective interventions

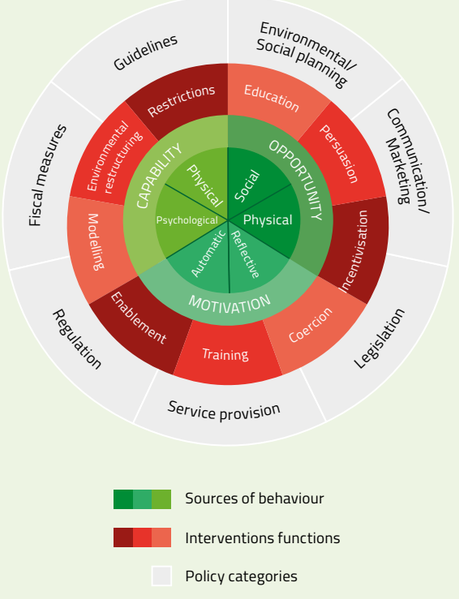
3.1 Behaviour change strategies and frameworks

To understand interventions that can motivate sustainable mobility behaviour, it is relevant to consider the key **factors, theories, and frameworks** that explain behavioural change. In particular, five frameworks can be highlighted:

EAST:[33] Developed by the Behavioural Insights Team, this framework posits that change should be Easy, Attractive, Social, Timely:

- **Easy:** makes the desirable option the default option. Reduce the hassle of taking up a service. Simplify the service.
- **Attractive:** attract people's attention. Design reward and sanctions for maximum effect.
- **Social:** show that most people perform the desired behaviour. Use the power of networks to enable collective action. Encourage people to make a commitment to others.
- **Timely:** prompt people when they are most open to change. Consider the immediate costs and benefits. Help people plan their response to events.

COM-B (Capability, Opportunity, Motivation – Behaviour):[34] This model explains behaviour change through three interacting components: Capability (having the physical and psychological ability), Opportunity (external factors that enable or prompt the behaviour), and Motivation (internal processes that direct behaviour). Change occurs when all three are present. It is a practical framework for designing effective interventions, as illustrated by the so-called "Wheel of change" below.



Nudge: Nudges can be defined as per the words of Richard Thaler and Cass Sunstein in their influential book Nudge,[35] published in 2008:

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

Boost: This theory emphases individuals' own decision-making competences so people can make better choices themselves. It is defined by Hertwig and Grüne-Yanoff[36] as follows:

"A boost may enlist human cognition (e.g., decision strategies, procedural routines, motivational competences, strategic use of automatic processes), the environment (e.g., information representation or physical environment), or both. By fostering existing competences or developing new ones, boosts are designed to enable specific behaviors. Furthermore, they have the goal of preserving personal agency and enabling individuals to exercise that agency. Consequently, if people endorse the objectives of a boost…they can choose to adopt it; if not, they can decline to engage with it. To this end, a boost's objective must be transparent to the boosted individual."

Nudge plus:[37] "This framework incorporates an element of reflection – the plus – into the delivery of a nudge, either blended in or made proximate. Nudge plus builds on recent work combining heuristics and deliberation. It may be used to design prosocial interventions that help preserve the autonomy of the agent."

When looking at behaviour change strategy, the question of the tipping point at which a modified behaviour becomes mainstream is relevant. Research shows that **getting 25% of a group**[38] to change their behaviours will lead the rest to adapt and modify their own behaviours. To get to this critical mass of first movers, it is valuable to **focus on the "low-hanging fruits",** meaning people who are most likely to change. Often, discussions will crystallise on the difficulty for people with deeply entrenched car-dependent behaviours to change the way they move around. Starting a change process focussing on this target group is very difficult. Many people are already multimodal in their behaviour (for example people driving and cycling frequently), and therefore more inclined to gradually change their behaviour. This should be the first target group for sustainable mobility behaviour change strategies.

However, the tipping point is not necessarily about the number or about the majority but also about the composition of the group. Creating a competition or challenge situation between groups can therefore be a solution to spur more sustainable mobility behaviour. For example showing how other groups perform in using more sustainable mobility modes. In this regard, studies[39] have been investigating how nudges that use social salience can help people to reduce their energy or water consumptions. **When people are provided with a benchmark,** for example if they are told how much they are consuming compared to other people living in their buildings, it is shown that people consuming above average reduce their consumption.

In the case of mobility, it should be acknowledged that creating consistent target groups among a population is a challenge to the extent that mobility behaviours are so individual and resulting patterns so diverse. In the case of public–private mobility hubs, the ambition is to improve overall mobility behaviour, not just commuting. This makes the challenge more complex, as it **involves addressing multiple mobility patterns and stakeholder groups simultaneously.**

Moving from groups to individuals, effective behaviour change strategies and incentives need to be tailored **(individualisation)** to achieve positive behaviour change. For instance, in the field of medicine, changing behaviours in patients from a pathological behaviour to a physiological behaviour is crucial to formulate specific goals that should be reached. Depending on the subjects, different dimensions are more important than others. It is key to identify these dimensions.

At individual level, **putting people already mentally in the implementation stage** (i.e. forming a so-called "implementation intention") supports them to change their behaviour. In an experiment by Gollwitzer,[40] people were asked to elaborate a plan to leave their partner, and to think about rolling it out. People who had designed a plan to leave their partners were then more likely to leave them than the control group.

The diverse behavioural change strategies, whether at individual or group level, can be analysed in terms of **push and pull factors that motivate change:**

- Push factors are **internal or external pressures** that drive a person **away from a current situation.** They are often associated with discomfort, dissatisfaction, or negative experiences.
- Pull factors are **positive attractions or incentives** that draw a person **toward a new situation.** They are often associated with hope, opportunity, or desire.

Creating opportunities that push people to act, combined with pull measures that make change more attractive, is essential for success. Yet, the question remains: which stage of the action cycle should be addressed first? Should efforts focus on the deliberation stage, where pull measures are more effective, or on the implementation stage, where push measures work better?

Push and pull factors are always shifting, so strategies may need to start with pull factors at the beginning, before moving toward push measures, and shifting back again. However, it is difficult to assess the point in time when a push or a pull measure if more efficient. Pilot projects and small-scale experiments can help by allowing trial and error, building acceptance, and easing the introduction of push measures, which are often less popular and politically sensitive.

Overall, clear communication about the benefits of pull and push measures increases acceptance, especially when people can experience these benefits firsthand.[41] For instance, in the case of a push measure like parking price increase, explaining the rationale and the practical benefits can support change. The more a city already is implementing progressive mobility measures (both push and pull), the higher the acceptance. In heavily car-dominated cities the acceptance of these measures is lower, as they mean a bigger change compared to the status quo. Importantly, communication on such strategies needs to consider that push measures are not necessarily connoted negatively if the **right framing** is used. Indeed, people may want to be pushed because they are not aware of all the alternatives.

The success of pull and push measures or interventions is target-group dependent. Therefore, it is difficult to assess the effectiveness of one type of measures in general without considering target-group specific conditions and background. More research is needed on the effectiveness of specific interventions in specific contexts.

Pricing psychology can inform pull measures related to sustainable mobility behaviour like public transport use. Subscription-based tickets, such as Germany's "Deutschlandticket" (a nationwide pass allowing unlimited travel on local and regional public transport for a flat monthly fee) offer greater convenience. In addition, users are less aware of the cost than when they have to pay for each public transport trip individually. The continuation of the Deuschlandticket was also successful because it is a way to perpetuate the experiment. Psychological factors are key to design successful **pricing strategies** that take into account how people behave. One example is the frequency of charging. In the United States, an experiment has explored different approaches between charging people for parking once in a month and charging them every time they access the parking lot. Although the prices are the same, people perceive them differently depending on how often they are charged. Those who pay each time they access a parking lot tend to use it less than those who pay a monthly fee.[42] Decision-making strategies are often more complex than any model purely based on utility maximisation.

Once positive behaviour change has occurred, strategies and interventions must ensure that the factors motivating this change **are not taken away from people.** This also applies to mobility infrastructure. For example, the promotion of cycling infrastructure should remain consistent to prevent people from falling back into old habits.

3.2 Nudging and motivation

Nudging is one option among many for decision-makers seeking to promote sustainable mobility and should be applied in combination with other measures.

One of the key questions in behavioural change concerns the core idea behind nudging: that behaviour can be changed quickly by reshaping people's choices rather than appealing to deliberate thought. This idea has made nudging popular in recent years. It is tempting to approach the topic of behaviour change so people would not need to make conscious choices to change their behaviour. However, **nudging does not work in all context and cases.**[43] Sometimes it is key to make people understand the underlying reasons why they need or should change their behaviour.

Example 1: The Climate nudge research project:[44] The project applies behavioural insights to co-create and test nudge interventions. It examines the nudges' effectiveness, fairness, and acceptance, as well as their economic and health impacts.

In the Climate Nudge Research Project, a three-month pilot was launched at a car repair shop: people bringing their cars in for servicing were offered a free e-bike trial instead of a replacement car. This was a critical moment in a car owner's life as their car was not available anymore. The service was popular.
The top three reasons people chose the e-bike as a car replacement were:

- They wanted to try out an e-bike: 78%
- The e-bike seemed the most convenient option: 78%
- The trial was free: 44%
- The experiment ended with people stating being satisfied (66%) or very satisfied (33%) with the e-bike.

Example 2: MOBIS experiment (ETH Zürich and University of Basel)[45]
The experiment included both pricing and nudging dimensions. A total of 3,000 participants took part over eight weeks. During the first four weeks, all participants completed a survey and used a GPS app to track their mobility behaviour. In the second phase, they were divided into three groups: a control group; a second group that received a mobility budget in which prices reflected the externalities of each transport mode; and a third group that received informational nudges through pop-up messages about alternative mobility options. The experiment showed that information nudges alone were not enough to induce a change in transport mode. They were effective only when combined with pricing measures.

The two above-mentioned examples show that the efficiency of nudges vary according to context and target groups. There are also important ethical considerations linked to steering behaviour (not only through nudging) which raise questions about justice both locally and globally: How should steering methods be used? Who should be targeted? Who should bear the costs of behaviour change? Are these behavioural methods too soft to tackle a vicious problem like climate change or mobility?

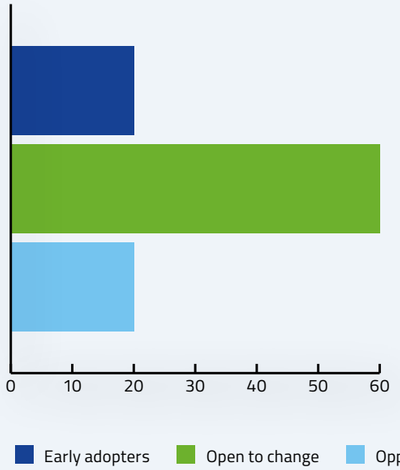
Research needs to pay more attention to involve more diverse groups in behaviour change studies, in order to gather more insights about **responses to specific nudges.**

At the same time, nudging presents distinct advantages as a complementary policy instrument. It is comparatively low-cost, minimally intrusive, and can be tailored to specific decision-making contexts. By lowering behavioural barriers and highlighting feasible alternatives, nudges can facilitate the uptake of more sustainable practices, as demonstrated in the e-bike trial. Increasingly, digital nudges delivered through apps and online platforms, expand these benefits by enabling scalability, hyper-personalization, and continuous engagement, (e.g. by prompting users of parking apps to consider shared mobility alternatives in real time). When systematically designed and evaluated, nudges can strengthen the alignment between individual behaviour and collective goals, offering a pragmatic way to support broader structural measures.

Nudgd: leveraging behavioural insights to support change

Defining target groups is a must to design effective nudges, because people have different motivations and their everyday lives vary strongly. Important differentiators between target groups are factors such as local cultures, age, gender, family. Depending on these, motivations to commute sustainably vary from a focus on health, convenience, or time-efficiency. However important these differentiators are, they are not enough on their own to develop efficient personalised nudges, as their impact depends on individual-level factors. For this reason, nudges need to be well-aligned with an individual's personal motive and drive.

Considering the group level, nudges should focus on the people open to change their existing behaviour to a more sustainable one, as illustrated below:



Within the 60% of people that form the target group, different subgroups will respond differently to specific types of nudges. Using the COM-B model (defined in section 3.1) allows to produce hyper personalised nudges by understanding people's context, meaning their capabilities, opportunities, and motivation to change. Solutions like Nudgd digital platform "Smart Nudges" can identify suitable nudges by combining input from a short survey (three to four engaging questions) with contextual data about individual mobility behaviour.

Nudges are time-sensitive, and delivering them at the right moment is crucial. Different types of nudges should therefore be applied at different times.

At an organisation level, this means that not all employees or people should be targeted in the same way or at the same time with the same nudges. For instance, people who have recently moved will not respond to incentives in the same way as others. In addition, active modes like cycling may not be equally attractive at all times of the year or in every location.

Nudges can be co-created to increase their efficiency, as co-creation enhances people's feeling of ownership and commitment, while adding a social dimension thanks to the group feeling. It also contributes to more transparent processes.

When it comes to evaluating the performance of nudges, randomized controlled studies combined with continuous measurements provide valuable insights into behavioural change. Nudgd observes behaviour change after about three months. At this point, individuals report more positive attitudes toward sustainable mobility and begin to plan and adopt new habits, such as cycling to work or carpooling with colleagues. Results from the Smart Nudges digital platform show an average reduction in car use of 10–15%. In addition, 43% of users report having changed their behaviour as a result of using the platform. Nonetheless, newly formed habits may not persist on their own, underscoring the importance of continued nudging over time, complemented by friendly reminders, adjustments in framing, and personalised goal-setting to support the long-term maintenance of sustainable behaviours.

3.3 Structural and policy enablers

Psychological factors by themselves do not fully account for mobility behaviour. It is key to consider structural factors as well, (e.g. extensiveness, coverage, frequency of sustainable transport options). Research shows[46] that limiting free parking options around offices is the most effective trigger to discourage people from commuting with their private cars. **Effective change requires combining psychological nudging with supportive regulation and infrastructure.** To maximise impact, it makes sense to consider the right combinations of structural and psychological factors that can lead to the best outcomes depending on the target groups and modal shift objectives. Acting on structural factors or barriers include for instance reducing available parking, or introducing a user-pay principle. As far as these factors are concerned, it all boils down to cost and time: overall people want to be able to pay less and to travel faster. To this extent, **reducing the comfort of using a private car** yields positive results. In the case of Roche, changing parking policy to provide only employees living further than 45 minutes away by public transport from the office with a permanent parking slot reduced the share of employees commuting by private car from 50% to 30%.

Focusing on people's needs through proper mobility assessment is currently missing from most transport planning practices. It nevertheless remains a cornerstone of mobility change strategies, as the built environment largely shapes the mobility behaviours it enables and reinforces. In this regard, **bottom-up processes** are useful especially in areas where new projects are contentious. Such bottom-up approaches should be more considered and **set up as**

experiments and can be applied to almost every intervention. One example[47] of a bottom-up project focussed on car use around school areas, directly involving children by using Minecraft to identify their needs and take them into account for the planning phase.

Similarly, developing a **shared narrative** with the people whose behaviour is expected to change supports the transition toward a desirable future and gives purpose to behaviour change efforts. An effective way to do so is to negotiate jointly what this desirable future looks like, and to commit together to the type of change that the majority agrees should be achieved. Acting in this way fosters a sense of ownership among the people changing their behaviour. It also shifts the focus from targeting individuals to prioritising interventions related to regulation and infrastructure.

To create the right infrastructure framework for long-term change in mobility behaviour, **it is crucial to focus on public transport.** In the case of Geneva, the addition of a new light rail line led to a decrease of individual motorised traffic at the French border by 30%. This is a best practice from a planning perspective. Another example is improving the alignment between public transport planning and the needs of large employers. Providing mobility options, including those centred around mobility hubs, that reflect employees' actual travel patterns, such as aligning service frequency with work-related rush hours, has been shown to deliver the best results.

There is also a role for private actors such as **companies to support behaviour change by changing the default situation.** For instance, instead of providing employees per default with parking spaces, bicycle garages, lockers, and showers can be installed. Leading by example can also support change, for example when a company's management level travels sustainably, or when reserved parking spaces for management are removed.[48]

Before designing strategies, interventions, and experiments, it is important to **be clear on the objective:** achieving climate-neutrality in transport is a different goal than trying to get rid of traffic jams and increasing space-efficiency. This should be reflected also in terms of evaluation, where more rigour is needed. For example, when testing the causal impact of new transport modes on sustainable mobility behaviour, a control group is needed. This is true especially if the ambition is to generalise the results and inspire replication.

Once it is certain that a measure works, it is easier to allocate additional funding to establish specific measures in the long term. A lack of understanding about the success factors of a specific measure makes it much harder to establish in the long term, to sustain positive behaviour, or to replicate in other contexts.

Overall, promoting long-lasting sustainable behavioural change **requires alignment** between governments (set the overall framework through regulation and taxation), the private sector (corporate responsibility), and individuals (responsible for their actions).

Best practices

Workplace parking levy in Nottingham (UK). This policy charges companies for off-street parking spaces in the city centre, with the revenue reinvested in sustainable transport measures such as the tram network. A 2023 analysis of the scheme,[49] found that it raises around £9 million per year, has increased public transport use thanks to improved bus services and new tram lines, and has reduced the number of workplace parking spaces by 25%.

Public transport planning processes: Geneva has introduced in December 2019 a new urban rail line (so-called Léman Express), which counts 80,000 daily trips and has led to a reduction of up to 36% of traffic in certain city areas at peak time.[50] This illustrates that well-planned infrastructure is important: if it allows to reduce travel times people will use the alternative options.

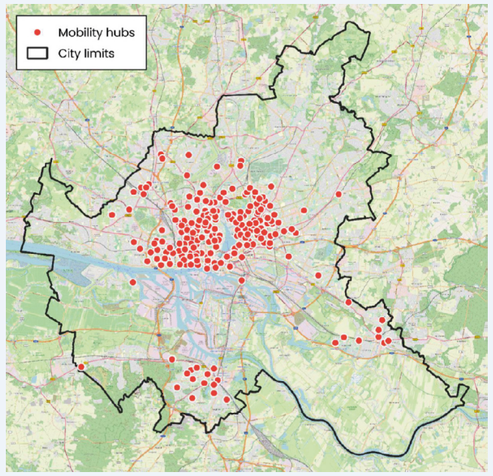
Adoption of remote working: This trend, which accelerated dramatically during the Covid pandemic, has impacted mobility habits of many people by reducing their need to commute daily. The impact on transport systems, however, varies from city to city: from alleviating pressure on some overloaded public transport lines to jeopardising the viability of others.

Congestion pricing: For example, in Stockholm, despite early opposition, the congestion pricing scheme has been embraced and showed results of about -20% traffic during peak hours. After its introduction, support for the scheme increased.[51]

Reduction of parking places: Progressively reducing parking places. A prominent example is the city of Paris, whose climate plan 2024–2030[52] foresees the creation of one main pedestrian centre per arrondissement, transforming 60,000 parking spaces to recover 100 hectares for pedestrians and vegetation.

Digital nudging: Through digital interventions such as the Smart Nudges platform with personalised reminders, framing of mobility alternatives, and goal-setting tools, individuals are supported to test and adopt new transport habits. For example on the on the island of Gotland, Sweden, that has a wide mix of both urban and rural areas, it has been used to encourage more sustainable commuting among employees. When being nudged with hyper personalized digital content, participants show both a more positive attitude towards sustainable mobility as well as concrete behavioural changes. Car use was reduced by 14%. This demonstrates the effectiveness of digital nudges as a scalable, cost-efficient, and user-centred policy instrument that can complement infrastructure investments and regulatory measures.

Figure 4: Key indicators of Hamburg's mobility hubs



216 mobility hubs (as of June 2025)
- First mobility hub opened in 2013
- First neighbourhood mobility hub opened in 2017

Common features/services:
(Percentage of hubs that have the feature)

• Bus stop	42%
• Metro/S-train station	20%
• Bike-and-ride facilities	14%
• EV charging stations	11%
• Bikeshare system	28%
• Car-sharing services	100%

Use case: Hamburg Mobility Hubs in practice

Mobility hubs have been installed in Hamburg since 2013. They are offered as part of the hvv switch app,[53] operated by the Hamburger Hochbahn AG. Mobility hubs are defined in Hamburg as having a minimum of four car-sharing places operated by at least three different providers. The focus on car-sharing lies on the fact that car-sharing has been shown[54] to be particularly effective in reducing private car ownership in cities.

The deployment started in dense areas of the city, typically the city centre, before expanding to outskirts, in areas with less density. Mobility hubs in Hamburg include both larger, mostly central hubs that are well connected to major public transport stations (typically closer to the city centre), and smaller hubs that are implemented at a neighbourhood level.

An **evaluation** of mobility hubs in Hamburg shows that users of these hubs have a much better perception of car sharing as a genuine alternative to private cars (over 50% compared to slightly less than 25%). They are also **twice as likely to reduce or give up car ownership** compared to car-sharing users who do not use mobility hubs.[55] It also stresses the importance of proximity for shared mobility to be considered a valuable alternative to owning a car. Results show that residents living **200m or closer** from a mobility hub are significantly more likely to consider using car-sharing in the future.

In addition, the **importance of communication was stressed,** to increase visibility but also accessibility of mobility hubs. In this regard, having a few well designed large hubs combined with many smaller ones is a meaningful strategy to combine proper visibility with good accessibility. Interestingly, car-sharing users in Hamburg consider the **functionality and convenience of mobility hubs** more important than their aesthetics, noting that design matters but is not a decisive factor on its own.

The evaluation also shows that car-sharing is **a necessary but not a sufficient component of mobility hubs.** Almost a third of residents living near a mobility hub indicated the addition of bike-sharing options as an important complement to the hub.

There are also a few **common problems** that have been identified across mobility hubs in Hamburg, significantly reducing the effect of mobility hubs on private car ownership:

- Insufficient availability of car-sharing vehicles
- Occupied car-sharing parking spaces, exacerbated by parking violators
- Small "effective" catchment areas (≈ 200 metres)
- The strong focus on car-sharing services reduces acceptance by non-car-sharing members.

The main conclusions drawn from the evaluation can be summarised as below:

- Mobility hubs with car-sharing services increase the attractiveness of car-sharing services and their impact on car ownership
  - Car-sharing should be a core element of mobility hubs
  - However, limiting mobility hubs to car-sharing alone is not advisable
- Expect (neighbourhood) mobility hubs to have small catchment areas
  - Many small hubs are better than a few large ones
  - However, a network of mobility hubs of different sizes and with varying ranges of features is important (different hubs for different roles)
- Mobility hubs should be placed in highly visible locations (e.g. in public spaces)
  - However, hubs on public streets must be effectively protected against misuse by unauthorised vehicles. Enforcement is key.

Key takeaways

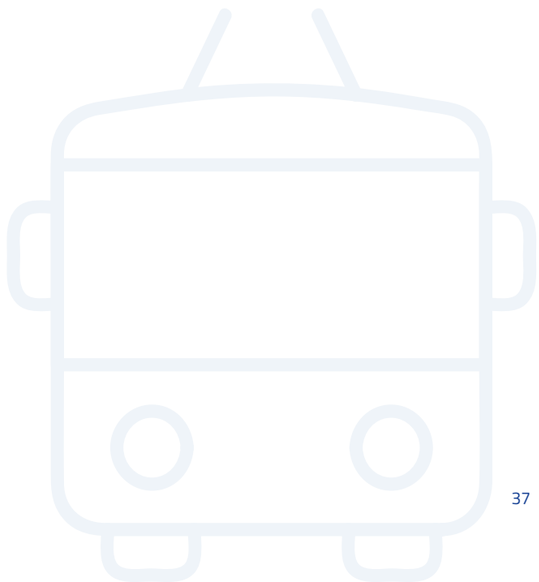
- Behaviour change strategies need to be tailored to individuals but should aim at reaching a tipping point within a target group – typically when about 25% of a group adopt the new behaviour – so the rest is incentivised to adopt it too.
- Actioning a range of push and pull factors at different moments in the action cycle is key to draw people toward a new situation. Importantly, the success of push and pull measures is target-group dependent.
- Nudging is a popular technique to motivate people to change without imposing any restrictions. Understanding the context is key to the effectiveness of nudges, as well as combining relevant nudges with other complementary measures.
- Structural enablers are crucial for behaviour change. Without the right framework conditions (e.g. infrastructure, regulation) combined with relevant psychological levers, a long-term shift toward more sustainable mobility options is unlikely.

Conclusion and recommendations

Promoting sustainable mobility behaviour is an essential component of the transition to better mobility systems. Next to the provision of adequate infrastructure and a coherent regulatory and policy framework, interventions focused on leveraging psychological factors impacting mobility behaviour show great positive impact. In particular, the following recommendations can support private and public sector decision-makers in efforts to stimulate sustainable mobility habits:

- **Be aware of cognitive biases such as the status quo preference:** daily travel routines like commuting can become deeply ingrained habits. These are strongly influenced by the existing infrastructure and the incentives set at the mobility system level. People are usually reluctant to shift their behaviour away from these established reference points.
- **Human beings are savers of cognitive resources:** desired changes in people's mobility behaviour need to be perceived as simple and convenient, otherwise it is likely that the already established behaviour will prevail and change will not happen.
- **Mobility is a basic, goal-oriented, human behaviour:** it is key to keep in mind the end-goal people intend to reach when being mobile, and ensure the suggested mobility alternatives allow them to reach it in accordance to their needs.
- **Infrastructure is a major enabler:** whether expanding the existing bus and metro network or deploying (private/public) mobility hubs, the existing physical mobility infrastructure impacts how individuals can reach their mobility goals.
- **Successful mobility hubs have some common features:** they are highly visible and easily accessible, include car sharing and other shared modes, and form a citywide network of hubs with catchment areas of 200 metres or less.
- **Timing is key:** sustainable behaviour change takes time. Change in an individual's context, for instance starting a new job, getting children, or relocating, are moments when previously stable behaviour like commuting become unstable. Such points in time should be leveraged to incentivise people to take on new mobility habits.

- **Focus on rewarding experience:** while the importance of practical and theoretical information in changing mobility behaviour is debated, positive and enjoyable experiences are essential to foster new mobility habits.
- **Deploy targeted and individualised interventions:** drawing on various behaviour change strategies and interventions like push and pull measures, group dynamics, and nudges, organisations should design incentives tailored to the needs and context of individuals, to optimise the relevance of their offer. Digital nudges has proven to be a scalable, cost-efficient, and user-centred policy instrument that enables this.
- **Combine psychological nudging with supportive regulation and infrastructure:** structural factors like public transport offer, access restriction, user-pay principle, combined with psychological interventions lead to outcome optimisation. Bottom-up processes like co-creation and agreeing on common objectives through a joint, negotiated narrative support behaviour change processes.
- **Evaluate impact:** any deployed intervention should be assessed against its costs and effort. This allows to understand what worked and what failed, and to identify "low-hanging fruit" interventions that may not be very costly but still yield substantial results. This understanding is a key prerequisite for replicating measures based on identified success factors.



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