

Chapter 10

Navigating the Shift: Strategies Beyond “Build It and They Will Come” for Sustainable Mobility in Quebec



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Abstract Passenger transport is an important contributor to unsustainable urban systems. To achieve the necessary socio-ecological transition will require overcoming the entrenched system of automobility. Composed of several mutually reinforcing components, this system has conferred psychosocial dimensions to car ownership and use that leads to important institutional, political, and individual resistance to change both car-centric transportation infrastructure and individual travel behaviour. For this reason, a growing consensus suggests that transitioning to a sustainable mobility system requires a more holistic approach that applies a synergistic integration of “hard” supply-side measures and “soft” demand-side solutions. This means increasing non-automobile accessibility and supporting such change with soft travel behaviour change solutions that target social-psychological barriers to change. While such approaches have demonstrated their effectiveness around the world, this second category of interventions remains underutilized, particularly in North America. Drawing from social psychology and a North American case study, this chapter proposes a theory-to-practice guide for practitioners to designing effective voluntary travel behaviour change interventions based on the Stage Model of Self-Regulated Behaviour Change (SSBC). A four-level integration framework for intervention design based on the SSBC is proposed. The framework proposes intervention approaches from using the model as a simple diagnostic tool to a complete integration to deliver a fully individualized and stage-tailored intervention. Stage-specific messages and strategies are described to shift people away from car use towards active, collective, and shared mobility options. The chapter concludes on suggestions for collaborative efforts between researchers and practitioners to design,

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evaluate, and enhance the effectiveness of these interventions, thus moving beyond infrastructure-only solutions to foster a successful transition to sustainable mobility in Québec.

Keywords Sustainable transport · Travel behaviour change · Soft intervention · Stage model of change · SSBC · Car dependency · Automobility · Travel demand management

1 Introduction

One imperative of the socio-ecological transition needed to avert the worst consequences of climate change is the transformation of our mobility systems. In the province of Québec, the transportation sector produces an outsized share of the province's carbon emission: 43% for the entire sector and 22% for the road passenger subsector (Gouvernement du Québec, 2022). Contrary to all the other sectors except agriculture, transport emissions have been increasing substantially in the last decades (+20.6% vs. -22.9% for all other sectors combined between 1990 and 2021).¹ Despite a strong push for transportation electrification (Gouvernement du Québec, 2023), it is increasingly clear that a successful socio-ecological transition requires a paradigm shift in mobility that moves us away from car dependency (Laviolette et al., 2020). The “system of automobility”, or car dependency, is described as a transportation system that favours car travel and speed over alternative modes of transport. A system in which the car is considered a key satisfier of human needs for most of the population (Mattioli, 2016). The complexity of this system stems from several interlinked components that reinforce each other (e.g., Mattioli et al., 2020; Sheller & Urry, 2000), making any major shift in the system excessively challenging and politically difficult to accomplish. Furthermore, its well-documented consequences extend far beyond carbon emissions: put shortly, the automobility system poses a massive threat to public health, quality of life and well-being, equity and social justice (i.e., who bears the burden of car harms), climate change and the environment more broadly (e.g., Gärling & Steg, 2007; Glazener et al., 2021; Miner et al., 2024). Most of these will not be solved by simply switching to electric vehicles (Miner et al., 2024) and are too often overlooked when considering transportation solutions.

Most solutions proposed and discussed in the public sphere to reduce car dependency focus on improving accessibility by redesigning built environments, expanding public transit and active travel infrastructure, enhancing sustainable transport level-of-service, and offering shared mobility alternatives. However, there is a growing consensus that these “hard” infrastructure changes alone may not be enough (e.g., Banister, 2008; Handy, 2017; Javaid et al., 2020; Mattioli et al., 2020;

¹ Calculation by the authors based on the report by Gouvernement du Québec (2022).

Soza-Parra & Cats, 2024). This is because some of the institutional, political, and individual resistance to change is rooted in a car-centric mobility culture that reinforces the psychosocial dimensions of car travel, a core aspect of the automobility system (Mattioli et al., 2020; Sheller & Urry, 2000).

Based on this premise that “hard supply-side” solutions are not enough, a crucial question arises: how can strategically designed interventions effectively support behaviour change? To answer this question, this chapter serves two objectives. First, drawing insights from social psychology literature, we explore key elements of behaviour change theories, notably the Stage Model of Self-Regulated Behaviour Change (SSBC; Bamberg, 2013b), the role of habits and habit disruption, and the role of other psychological constructs such as norms, attitudes and beliefs. Second, we propose an integrated approach to guide practitioners in conducting a diagnostic of the issues, identify the potential for change within the targeted population and then provide a comprehensive framework for designing theory-driven, context-oriented, personalized behaviour change interventions to foster a successful transition to sustainable mobility in Québec.

1.1 Why We Need a Holistic and Interdisciplinary Approach for a Paradigm Shift in Mobility

Transportation and urban planning researchers have produced an extensive amount of evidence on what type of built environments, street design and provision of mobility options are associated with a reduced share of trips and distance travelled by car and lower car ownership needs (e.g., Ewing & Cervero, 2010; Javaid et al., 2020; Mishra et al., 2023). As Handy (2017) explains, “the built environment plays a role in determining the *choices available* to the individuals. [...] But it doesn’t mean that [it] determines the *choices made* by the individuals”. It gives them *the possibility* to choose those options, which is an essential first step. These supply-side solutions (also called “hard” measures) are well known and widely discussed beyond academic circles. In already built-up cities, the policy challenge for those “hard” measures resides more in retrofitting. Indeed, many of those changes require shifting priorities and funding away from components of the system of automobility (Gössling, 2020). As such, a lot of the challenge of overcoming car dependency is political (Gallez & Dupuy, 2018) as is our local case in Québec (Laviolette et al., 2020). We argue that challenging and overcoming the system of automobility requires a more holistic approach that includes activating various levers to change the culture of mobility including encouraging, fostering, and supporting behaviour change away from the private car.

Many motivations exist for using cars (see Mattioli et al. (2020), Schwanen and Lucas (2011) and Javaid et al. (2020) for more comprehensive overviews). We highlight three reasons we believe are important here: habits, the normative aspect of automobile culture, and the affective and symbolic associations to cars. Habits such

as travel mode choice (e.g., Gärling & Axhausen, 2003) arise from routine and once established are hard to change. Even with new infrastructure supporting new behaviours, car habits will resist change. New residents or young people might establish behaviours based on the new context, but those with established habits will need additional interventions.

A second reason is the presence of a strong automobility culture which imposes a normativity around cars where their ownership and use are perceived as the normal practice that every “normal” person does. Such social norms are strong explanatory factors of behaviour, though we often underestimate their influence (Nolan et al., 2008). The higher the rate of car ownership and the higher the modal share of cars, the stronger this barrier is likely to be.

A third reason is the perceived affective and symbolic benefits of the car (e.g., Sheller, 2004; Steg, 2005). Cars provide a way for individuals to communicate their social status and identity. Affective aspects are related to feelings of pleasure, excitement, dominance, freedom, and independence. These elements can become intertwined with personal, social, and even national identities (Edensor, 2004; Mattioli et al., 2020; Schwanen & Lucas, 2011). In short, someone for whom these perceived benefits are important and whose lifestyle and identity are highly linked to the car and the access it provides is less likely to adopt other modes even if those modes exist and are improved (e.g., Piras et al., 2022; Soza-Parra & Cats, 2024).

It is thus critical to understand and act on the psychosocial factors and obstacles hindering change at both societal and individual levels. As previously described, modern life has been mostly reorganized around the ownership and use of cars, and so the shift to sustainable mobility requires substantial changes in daily practices and lifestyles. In short, changing behaviour is a highly complex process and while providing alternatives to the car is essential for change to be possible, it is often insufficient on its own to prompt rapid behaviour change across diverse segments of the population.

Travel Demand Management (or Mobility Management) is a category of strategies that apply social psychology to help with travel behaviour change (Bamberg et al., 2011). While a large variety of approaches fit within the broader TDM and supply side categories, this chapter focuses on *personalized travel behaviour change* strategies. We present how an important model of change, the Stage model of behaviour change (SSBC; Bamberg, 2013b) can be applied by practitioners to enhance the effectiveness of such interventions.

2 A Theory of Change

2.1 The Stage Model of Self-Regulated Behaviour Change

Many models of behaviour change exist. One of the most famous and extensively used is the Transtheoretical Model of Change (TTM; Prochaska & DiClemente, 1982; Prochaska et al., 1997; Prochaska & Velicer, 1997) originally developed to

modify health-related behaviour such as smoking cessation or increasing physical activity. It has since been used repeatedly in a variety of behavioural change contexts. More recently, Bamberg (2013b) proposed the Stage Model of Self-Regulated Behaviour change (SSBC) specifically designed to encourage pro-environmental behaviour, including a shift towards low-carbon transport modes.

Both models conceptualize the process of behavioural change as a non-linear progression through a sequence of distinct stages, with the possibility of stagnation or relapse to earlier stages. While the TTM postulates five different stages of behaviour change (i.e., Precontemplation, Contemplation, Preparation, Action, and Maintenance), the SSBC, proposes four. These reflect the process of becoming aware of an issue (Predecision), deciding to act (Preaction), implementing behavioural changes (Action), and maintaining the new behaviour over time (Postaction).

In the TTM, Stage 1 (Precontemplation) is characterized by amotivation, which can manifest itself either as a lack of desire to change or as seeing no reason to change at all. Contrastingly, Stage 2 (Contemplation) denotes the emergence of a certain degree of motivation for change, albeit accompanied by the belief that change is unattainable. In the SSBC, this resistance to change and low motivation are amalgamated into the initial predecision stage (1). Reflecting on this difference, Olsson et al. (2018) introduced the terms *predecisional denial* (1.a) and *predecisional inhibition* (1.b) to differentiate between types of resistance. *Predecisional denial* stems from perceiving no reason to change, while *predecisional inhibition* is associated with the belief that change would be beneficial but impossible to achieve. We shall use this distinction for the remainder of the chapter as we believe these substages are conceptually and psychologically different, thus requiring different strategies to facilitate progression towards higher stages.

Another distinction between the TTM and the SSBC is the time-specific component of TTM stages that is absent from the SSBC. For example, in Stage 2, the TTM specifies that individuals intend to take action within the next 6 months (Prochaska & Velicer, 1997). However, some have criticized these timeframes, notably describing them as arbitrary (e.g., Sutton, 2000). Another distinction is that, unlike the TTM, the SSBC proposes three *transition points*, representing the formation of three types of intention: goal, behavioural, and implementation intentions. A final yet crucial distinction that fortifies the theoretical underpinnings of the SSBC is its integration of the constitutive variables of the Norm activation model (NAM; Schwartz, 1977) and the Theory of planned behaviour (TPB; Ajzen, 1985, 1991). Specifically, the SSBC has the advantage of explicitly outlining the social, cognitive, and affective factors that differentially influence the three types of intention and thus promote stage transition. These psychological mechanisms underlying the progression through the stages are described below.

Because the SSBC is specifically designed for sustainable behaviour, including the transition to low-carbon transportation modes, and because it specifies the psychological mechanisms underlying self-regulated change, this chapter focuses on this model.

2.2 *Psychological Mechanisms That Support Moving from One Stage to the Next*

Change is a multifaceted process, characterized by its gradual, dynamic, and non-linear nature, where setbacks and relapses are not uncommon. Importantly, not everyone initiates change simultaneously or progresses through its stages at the same pace. Furthermore, within each individual, a complex interplay of socio-cognitive factors influences their willingness to change in interaction with external factors such as structural, economic, social, and political conditions. The very nature of the behaviour, along with the perceived or objective degree of difficulty, also plays an important role. Complementary behaviours aimed at the same problem often exist (e.g., reducing one's GHG emissions). For instance, while someone may be contemplating a transition to a vegetarian diet, they may simultaneously be at a more advanced stage when it comes to reducing their reliance on cars. Each stage of change is qualitatively distinct, comprising unique motivations and cognitive processes that shape how individuals perceive information and make decisions. As individuals navigate through these stages, they may find themselves shifting their focus, modifying their priorities, and reevaluating their strategies, all in pursuit of meaningful and sustainable change. The proposed sets of stage-specific socio-psychological variables in the SSBC determine the formation of intentions or transition points (Bamberg, 2013b). The model is presented in Fig. 10.1, including Olsson et al.'s (2018) proposed distinction between predecisional *denial* and *inhibition*.

2.2.1 Stage 1: The Why

While the *predecisional denial* stage (1.a) of the SSBC is characterized by the lack of recognition of the need to change, the *predecisional inhibition* stage (1.b) begins when the individuals become aware of the problem's significance, its impact on themselves (or society), and their personal role in it. For instance, they might think, "the number of cars on the roads is unsustainable. This causes many problems. I use my car too much." When individuals see a discrepancy between their actions (contributing to the problem) and their broader life goals (protecting the environment, staying healthy, spending less, contributing to the common good, etc.), they experience discomfort and unpleasant emotions (guilt, sadness, surprise, questioning). They can start comparing themselves to others (social norms) and feel a growing moral obligation to act (personal norms). In some cases, comparing oneself to others can hinder change if the norm is problematic such as driving a car in our car-dependent societies. At this point, subjective social norms, meaning the judgments of significant people close to us, become important. A positive influence of subjective social norms would be having a network of friends and family that value other modes of transportation over cars. The idea of changing their habits appears increasingly feasible and appealing. They know they would feel better about themselves if

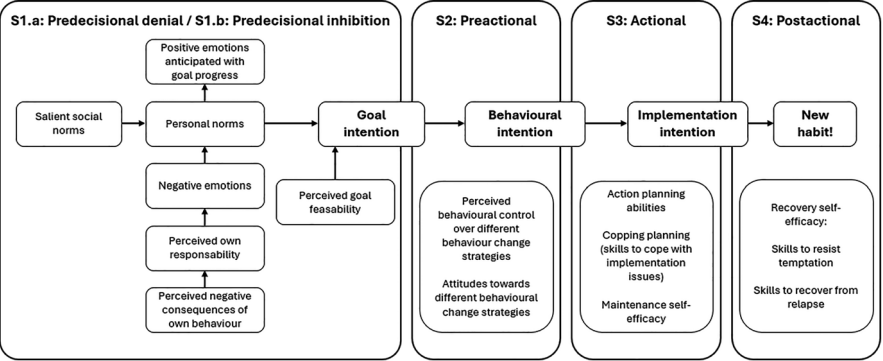


Fig. 10.1 The stage model of self-regulated behavioural change (adapted with permission from Bamberg, 2013b; Bamberg & Schulte, 2018) with the Stage 1 modification suggested by Olsson et al. (2018)

they made changes in their life (anticipated positive emotions). By the end of this phase, they know they want to improve their behaviour (goal intention). They might say at this point, “I would like to reduce my car dependence.” However, they are unsure at this stage what behaviour(s) to adopt to achieve this new goal. It still seems very difficult to them.

2.2.2 Stage 2: The What

The individual knows that their behaviour is problematic, but they do not yet know what avenues of change are possible. They will therefore pay attention to information about different solutions and actions they could take. For example, taking the bus, cycling more, and moving to a neighbourhood that favours utilitarian trips on foot. At this stage, direct changes in travel behaviour might not be evident, but actions such as supporting progressive sustainable mobility policies could reduce the internal conflict. They will evaluate the pros and cons of behavioural changes for themselves, as well as their feasibility: “Is it difficult for me to make this change? Do I have the means, control, time, knowledge, and resources? Are the necessary services and infrastructure available in my area? What are the benefits for me? How will they impact the problem I’m trying to address?” By the end of this stage, a behavioural intention forms: the individuals know which action(s) to try in order to reduce their car dependency.

2.2.3 Stage 3: The How

Here, individuals understand why changing their habits is important and have chosen a way to do it. They are now figuring out how to implement their plan. They think about the specifics: how, when, where, and with whom? Planning skills are

crucial in this stage. The more they can elaborate and anticipate obstacles, the easier the action will seem to them when they implement it. For example, one could think, “If I want to take public transport to work, I need to wake up at X time, walk to the bus stop located here, and get off at the right stop/station. If the bus is late, I have a backup plan.” At this stage, they are attentive to information that supports their self-efficacy (the belief in oneself that they can undertake an action) and helps them plan their action, like guides, apps for route planning, or friends who can accompany them. By the end of this phase, they start trying out the new behaviour. Practising this behaviour at a non-crucial time (e.g., on a day when it does not matter) can be helpful as they can gain experience without the stress of arriving on time in a situation of uncertainty.

2.2.4 Stage 4: Keep Going

Maintaining the new behaviour over time is challenging. There are many reasons to revert to old travel habits: lack of motivation, rushed mornings, bad weather, family obligations, errands, or route changes. At this stage, individuals must resist the temptation to revert to their old ways, which is not easy. Maintaining the new behaviour is a *process* that involves setbacks, mistakes, hesitations, and failures. This is normal and expected. The ability to recover from these relapses is thus important. Just because the new behaviour is not applied every day does not mean they should stop trying to improve. The quality of motivation to maintain this lifestyle change is also essential. Thus, a person who is internally (intrinsically) motivated will be more likely to succeed and will recover from relapses more easily (Pope et al., 2018). External support can also be important at this stage such as friends or colleagues with similar habits, feedback and encouragement systems, and adequate services and infrastructure that support the new behaviour.

In summary, a deep understanding of these mechanisms is crucial to fostering and supporting the changes we wish to see in our society. As explained below, proposed programs, interventions, and solutions must be tailored to the specific stage of change.

2.3 The Importance of Message Framing

Framing in communication refers to the way information is presented or “framed” to influence how it is perceived by the audience. It involves selecting and emphasizing certain aspects of an issue or topic while downplaying or omitting others. It can significantly impact how people interpret information, make decisions, and form opinions. By framing information in a particular way, communicators can shape the audience’s understanding, attitudes, and behaviours related to the topic at hand. There are various types of framing, including risk framing, economic framing, health framing, gain vs. loss framing.

An individual who is doing a desirable behaviour and an individual who sees no reason to do such a behaviour do not need the same information. In fact, giving reasons to do a behaviour and expecting behaviour change is asking too much of that information. As described in the previous section, a stage-based approach can help practitioners know what type of information is required to help individuals move towards the desired behaviour (Bamberg, 2013b; Pope et al., 2018; Waygood et al., 2012). One common problem that people fall into, is believing that “if only others knew what I know they would do as I do”. People have different motivations and ways of viewing problems. It is critical to create messaging that captures people’s attention (i.e., that individuals “attend to” that information) and that speaks to them. Furthermore, messaging that relates to an individual’s self-determined motives will be more effective in the long term (Pope et al., 2018).

Consideration to what intrinsically motivates people should be applied. For example, some individuals might be highly motivated by the environment, while for others, this might be reducing cost or other social factors such as improving health (Waygood et al., 2012). How this information is itself framed can impact how effective it is in influencing choices (Daziano et al., 2021; Wang et al., 2023). If this occurs, they will search for possible actions that they could take.

This final point is crucial: how information is framed will have a considerable influence on how much influence it has on different populations (Wang et al., 2023). It is not possible to go into great detail here, but examples of information framing for climate change emissions could help inform framing decisions. As an example, loss framing is generally found to be more influential than neutral or positive framing (Waygood & Avineri, 2018). Framing information with respect to societal goals can be more effective overall, though economic impacts can be highly influential for certain parts of the population (Daziano et al., 2021).

2.4 Efficacy of Personalized Travel Planning and Model-Based Behaviour Change Interventions

In our view, and based on the scientific literature, *personalized behaviour change programs* based on the models of behaviour change represent a promising avenue for achieving the desired changes in travel behaviour. But before describing how to design this kind of program, it is important to explain what they are and why they are effective at changing travel behaviour. To achieve this, recent and robust reviews on the matter are examined. Additionally, studies that specifically investigate the limited applications of Stage models of behaviour change (SSBC or TTM) to improve travel behaviour change interventions are also explored.

2.4.1 What Is a “Personalized Behaviour Change Intervention”?

Various types exist, but in general, a personalized behaviour change or individualized marketing program directly targets individuals either at work, at school or in their neighbourhood to offer them information, assistance, motivation and incentive to support them in *voluntarily* altering their travel choices (Bamberg & Rees, 2017). When targeted at work or school, the objective is usually to reduce solo driving for commuting. When neighbourhoods are targeted, people or households are encouraged to adopt active travel, public transit, and shared mobility options for their daily trips more broadly.

Taking the neighbourhood example, the idea is that an organization or a municipality will target a specific sector of a city and distribute by mail to all homes within the area a travel information package or bundle. The package provides area-specific information about surrounding walking, cycling, public transit, and shared mobility options available. This can include practical information such as the location of transit stops, bikesharing stations, or bike paths, as well as information about *how* to subscribe and pay for those services. It can also contain motivational messages, information on the benefits of using sustainable mobility, social norms in the neighbourhoods regarding each mode, and information about local neighbourhood groups and events such as exploratory walks. It can also include direct incentives such as free public transport tickets or an invitation to go online to order further incentives and goodies for specific modes (free public transit or bikesharing tickets, bike lights, etc.). Registering to receive those incentives and/or goodies can include commitments to change and to set goals. The ordered incentives can be delivered to one’s door by a travel ambassador or agent that can further assist in trying out a new mode of transport. This simplified example based loosely on the Portland (Oregon) SmartTrips program² can be adapted to any context, any mode available and can make use of a wide range of persuasion technique, message framing and more. In the next section, further explanation will be provided on the Portland program as an illustration of a long-running large-scale North American case study and describe how the program could be upgraded by incorporating elements of the stage models of behaviour change.

2.4.2 Does It Work? What Are the Evidence?

For a municipality or non-profit organization, building such a program from “scratch” can seem like a daunting task. Thus, a critical question is: is it worth the trouble? These types of programs have been tested in various contexts since the late 1990s with numerous studies on their efficacy. Those studies include narrative or systematic reviews (Chatterjee, 2009; Graham-Rowe et al., 2011; Petrunoff et al.,

² See <https://www.portland.gov/transportation/news/2018/12/26/news-blog-moving-portland-new-year-pbts-here-help-you-find-your-way> for a short overview of the current program.

2016; Scheepers et al., 2014; Zarabi et al., 2024) as well as meta-analyses (Arnott et al., 2014; Bamberg & Rees, 2017; Fujii et al., 2009; Möser & Bamberg, 2008; Semenescu et al., 2020). The consensus is that “yes, they work”, though improvements can be made to increase their impact (Laviolette, 2020, p. 38). Four meta-analyses found that the overall effect was a 5–7% reduction in driving mode share (Bamberg & Rees, 2017; Fujii et al., 2009; Möser & Bamberg, 2008; Semenescu et al., 2020).

Is a 5–7% modal share reduction of car use a significant achievement? It’s all about perspective. If travel behaviour change programs are extended to entire neighbourhoods or cities, reaching tens of thousands of participants annually, a 5–7% decrease in modal share could noticeably impact the city-wide modal share. Because developing a program from scratch entails an important start-up cost, a report on individualized marketing to practitioners in the United States recommends going big and planning for a minimum of 10,000 households per year (Alta Planning + Design & Transit Center, 2017). Results from larger scale projects in the UK, Australia, Europe and Portland (OR), although harder to evaluate with the highest quality design due to the high cost of such evaluation, indicate that similar results of 5–10% reduction in car use can be achieved among the targeted populations (AGO, 2006; Chatterjee, 2009; Dill & Mohr, 2010; Sloman et al., 2010). The cost of such programs is typically orders of magnitude cheaper than the hard (infrastructure) interventions and should be a popular complement to such changes.

2.4.3 Behaviour Change Programs Based on Models of Behaviour Change

In the field of transport, two reviews looked at this question. Friman et al. (2017) conducted an integrative review of the application of the Transtheoretical Model of Change (TTM). Analysing 13 intervention-based studies, they concluded that interventions based on the TTM processes were successful in triggering a behaviour change (reduction in car use or an increased in sustainable mode use). However, due to large variability in measured outcomes, it was not possible to provide clear numbers on those changes. To the authors’ surprise, only three of the 13 studies measured the progression to higher stages, which is baffling considering that one strength of stage-based model is to provide more information on the steps between not even considering change (stage 1.a) and fully integrating the change in one’s life (stage 5). Overall, the review concluded that more research is needed to determine how the specific processes of the TTM lead to travel behaviour change.

A second review by Keller et al. (2019) focused on ten studies applying Bamberg’s Stage Model of Self-Regulated Behavioural Change (SSBC). From these, only three were intervention studies and two were related to travel behaviour: one by Bamberg (2013a) applying a stage-tailored telephone campaign and one by Sunio et al. (2018) where the stage-based intervention was delivered using a mobile

app. Both studies as well as the non-travel one (related to beef consumption) showed that the tailored interventions were effective in moving people towards higher stages and performed better than the mismatch-information interventions or the no-information interventions.

In summary, both reviews conclude on promising results, although with many caveats, and suggests more robust, and optimally, longitudinal studies to improve our understanding of how each aspect of a tailored intervention is effective in moving people up the stages towards the desired behaviour.

3 Translating the Theory into Practice

3.1 Conditions for Maximizing Success

The extensive literature evaluating the effectiveness of soft interventions, including personalized behaviour change programs, can provide guidance on how to design interventions to maximize their effectiveness at changing behaviour away from driving. We outline four conditions of success that, in our opinion, practitioners should consider when developing their own interventions.

3.1.1 Don't Copy Paste: Adapt Each Intervention to the Mobility Context of the Targeted Area

This might sound trivial, but promoting and encouraging people to use a product that does not exist, does not meet people's needs, or does not satisfy the basic conditions for safety and convenience is unlikely to work. This does not mean that practitioners have to "wait" for their city to have world-class cycling and/or transit infrastructure to start implementing travel behaviour change programs. A lot comes down to managing expectation: do not oversell something that you cannot deliver. As we will argue later, travel behaviour change interventions can contribute to a positive loop of promoting a sustainable mobility culture that will make it easier to implement and improve the structural conditions which in turn will further strengthen the sustainable mobility culture. Practitioners should start with the low-hanging fruit—individuals who are at Stage 2 and up. They should plan their interventions, first for neighbourhoods which are best served by transit, active travel infrastructure and shared mobility options so that infrastructure barriers are minimized. This should be done in parallel with improvements to infrastructure and services in other neighbourhoods to reduce inequalities and eventually make alternative modes of transport accessible to the entire population. However, evidence from Australia suggests that both neighbourhood behaviour change programs (Ma et al., 2017) and workplace programs (Petrunoff et al., 2016) can work in suburban

areas, although, according to Ma et al. (2017) such programs will have higher, longer-lasting effects, in more walkable neighbourhoods. In addition to area targeting, this also means focusing on the promotion of modes that already offer good conditions. If a neighbourhood is well served by public transit but has no protected cycling infrastructure, then the focus should be on the former not the latter. If a small town has a vibrant “core” with local shops and walkable streets, then the focus should be made on promoting walking for people’s regular errands. What might motivate individuals to do so? Examine how social, environmental, health, and other messages resonate with your target population. These internal motivators are essential to start. This could be combined with designated parking lots to encourage residents living further away to park and walk the last hundred or so meters to their destination, thus reducing congestion and car nuisance on the commercial street and enhancing its appeal to pedestrians. This latter example brings up the next condition.

3.1.2 Combine Structural and Soft Intervention for Maximum Effectiveness

A company launching a new product is unlikely to be successful if no one knows about it, if its benefits are unclear, or if people do not know how it works. The same principle can be applied to new mobility options. This is critical when: there is a lack of social norms associated with the use of the mode (e.g., bikes, e-bikes); the mode is a new “system” that people are unfamiliar with (e.g., bikesharing or car-sharing); the new option improves an aspect of an existing system but is not very visible (e.g., a new express bus line, a new bikesharing or carsharing station). The “build it and they will come” adage in transportation can be true, but to a certain extent only, and can vary drastically by context. A new mass transit rail line, like the Réseau express métropolitain (REM) in Montréal, is highly visible (both physically and in the media environment), but its construction requires considerable capital and cost billions of dollars. Due to its high cost, it can be highly beneficial for the operator, but also for society more broadly, to “catalyse” the adoption curve of the new transit line and boost ridership early on to maximize the “return on investment” by attracting new users and not just existing transit users. In a very similar example, Piras et al. (2022) evaluated the impacts on motorists of a light rail extension in Cagliari, Italy. They tested whether adding personalized travel planning (PTP) interventions to the hard measure was more effective at changing the behaviour of drivers to adopt the rail line than just having the hard intervention. Using a longitudinal survey design, they found that 46% of drivers who received the PTP opted for the light rail compared to 34% in the control group. As a critique to the existing literature, very few studies have specifically investigated the combination of hard and soft interventions. Furthermore, it has to be demonstrated that it can work in a North American context.

3.1.3 Leverage the Habit Discontinuity Hypothesis

Travel behaviour, including mode choice, is often conducted in a stable context, and thus can be initiated by environmental cues without much deliberation or thinking (Gärling & Axhausen, 2003). Over time, this becomes a habitual response, a behaviour performed repeatedly without much conscious effort. Someone commuting to the same workplace by car does not reassess every day if the car is still the “optimal” (or even simply the “good enough”) option, even if some small elements of the environment change such as a new protected bike lanes, a new, faster, bus service or if traffic conditions deteriorate slowly over the years. Habits have been acknowledged as a major barrier to behaviour change because it weakens the link between intention and the behaviour (Javaid et al., 2020). It also limits the extent to which people acquire and process new information about alternative transport choices (Verplanken & Roy, 2016).

The *habit discontinuity hypothesis* states that when a major change to individual context happens, habits are broken, at least temporarily. This provides a “window of opportunity” for change where the individual is more open and ready to acquire and process new information about a new behaviour (Verplanken & Roy, 2016). It also makes the choice process more deliberate; that is the pros and cons are reevaluated to determine if the past option is still the best option. Various changes could be leveraged such as starting work/school at a new location (e.g., Ralph & Brown, 2019; Thøgersen, 2012; Walker et al., 2015) or temporary closures of major car infrastructure (e.g., Fujii et al., 2001). However, the most studied context change in transport is residential relocation (e.g., Ampt et al., 2006; Bamberg, 2006; Ralph & Brown, 2019; Verplanken & Roy, 2016). Verplanken and Roy (2016) estimated empirically that the opportunity window lasts about 3 months after a relocation. Targeting recent movers has also been done in large-scale travel behaviour change programs such as the SEGMENT project in Europe (Intelligent Energy Europe, 2015) and the Portland SmartTrips program since 2014 (Dill & Mohr, 2010). Targeting individuals who recently moved might not be easy. SmartTrips Portland for example bought an inexpensive mailing list based on the U.S. Postal Service’s National change of address database. Bamberg and Rees (2017) were provided a list of addresses by the Munich municipal office where new residents must register.

In the authors’ local context of Québec, several options could be explored. At the provincial level, Hydro-Québec, the state electricity provider, have a database of people who have changed their home address. The *Société de l’assurance automobile du Québec* (SAAQ) is also notified when someone with a driver’s license moves to a new address, despite some delay. At the municipal level, any new homeowner must register their new address for real estate and “welcome” tax purposes. However, this does not cover renters. Another possibility is to target those who request a residential parking permit. To get the permit for the correct zone, they must supply their home address. It would be a great opportunity to reach out to motorists who are about to pay to park their vehicle in the public domain.³

³We would like to thank Pascal Priori from the non-profit Solon for this idea.

3.1.4 Personalize Interventions to Target the Right People with the Right Psychological Mechanisms

A one-size-fits-all approach rarely works best. In addition to geographical segmentation described in section 3.1.1, it is also recommended to plan the behaviour change programs with interventions for various segments of the population (Davies, 2012). A basic approach is to segment the targeted audience based on sociodemographic and household-level characteristics such as age, gender, household composition or occupation status. Students in their 20s, a young family with a child, or a retired couple all have very different mobility needs but also different barriers to change. Preparing for this in the development of a program is a step forward to a more personalized approach that could deliver better results. Over the last decade or so, there has been an increased interest in developing interventions based on psychographic segmentation built on a set of psychological variables (e.g., Gousse-Lessard & Laviolette, 2022; Hausteine & Hunecke, 2013). A large-scale travel behaviour change program called SEGMENT was tested for 3 years in several European cities from 2010 to 2013 (Intelligent Energy Europe, 2015). A classification algorithm based on 12 “golden questions” asked in a pre-intervention questionnaire was developed (Anable & Wright, 2013). This allowed the identification of eight psychographic segments which could then be targeted with segment-specific information, recommendation, incentives and more.

In this chapter, we argue for a simpler segmentation approach that simply classifies the targeted population based on their current stage of change, either away from car use or towards specific transport modes. This approach builds on the theoretical constructs supporting changes at each stage as described in section 0. Furthermore, within each stage of change, the strategies and information delivered can be further targeted towards specific demographics. For example, a mother of young children in Stage 1.a could be more receptive than a young man in his 20s to information designed to raise awareness about the need to collectively reduce road violence and traffic-related risks for children by reducing car traffic in their neighbourhoods. We provide examples of psychological mechanisms to target at each stage of change through specific message framing and incentives in 0 below.

3.2 A Level-Based Approach in Integrating the Stage-Based Model in Travel Behaviour Interventions

To facilitate the development of behaviour change interventions, we propose a framework containing four levels of integration of stage-based models. The higher the level, the more complete the integration, but also the more complex and resource-intensive to both develop and deliver. Each level of integration needs to incorporate the lower-level elements to be effective. For each level of integration, and for illustration purpose, we suggest how the Portland SmartTrips program could be improved by using a stage-based model approach.

Portland's current SmartTrips program started in 2003, first as a pilot project before moving to full scale in 2004. The program was inspired by similar successful travel behaviour change programs in Europe and Australia based on the TravelSmart concept developed by Socialdata (see Dill & Mohr, 2010). It is one of the largest such programs in North America. In its first 10 years of full-scale existence (2004–2014), the program targeted roughly 20,000 households in one specific Portland neighbourhood each year. In 2014, the program was transformed to target specifically 10–15% of households having recently moved to or within Portland (Boddy & Kassirer, 2013).

3.2.1 Level 1: An Effective Diagnostic Tool

In this first level of integration, the stage of change models is only used to classify or segment the population based on their current behaviour and readiness to change. This can be done by including one or more stage assessment question into a pre-intervention survey administered to the targeted population. Due to its strong impact on the potential to change, it is essential to also assess the quality of alternatives available. This means mapping out active travel infrastructure and assessing the transit level-of-service (not simply if a bus stop exists). Optimally, this should be done by identifying and calculating accessibility indicators using various modes for the targeted neighbourhood or city or to compute accessibility to a specific destination like a workplace or school/university where the intervention is planned. For further guidance on measuring accessibility see Boisjoly (2023).

As described by Keller et al. (2019) in their review of SSBC applications, there are two approaches in designing stage-based evaluation and interventions. The first is to focus on moving people *away* from their current problematic behaviour. For sustainable transport, this generally means reducing single-occupancy car use. The second approach is to focus on modelling change *towards* a specific desirable behaviour like walking, taking public transport, or cycling. The first approach might work better when several alternatives to the car are available as it leaves participants the freedom to choose. The second approach likely works best when the entire intervention promotes a specific mode. Furthermore, because each mode has its own benefits and barriers, this can help develop even more tailored interventions addressing mode-specific barriers at each stage of change. Finally, both approaches can be combined. This means assessing stages of change in reducing car use combined with either stage-assessment questions for specific modes or, more broadly, willingness to use specific modes for daily trips.

Although standardized methods do not exist (e.g., Adams & White, 2005), one method to capture the stage of an individual is through self-assessment. Reviewing the literature applying the SSBC or the TTM to travel behaviour change, we suggest the following set of statements based on Bamberg (2013a, 2013b) and further adapted by Olsson et al. (2018). For a French-speaking example applicable in Québec, see Chouinard et al. (2021). The first set is to identify the stage of change *away* from car use. We provide an example specific for commuting to work in

Table 10.1 based on Olsson et al. (2018). Follow-up questions can capture whether those not driving intend to start (are they captive non-driver aspiring to drive or not driving by choice?) The second set is to identify the stages *towards* alternative modes for daily trips in general (Table 10.2). In both cases, the stage name or number should not be included in the questionnaire.

There are two ways this could be integrated in a program like Portland SmartTrips. The first is to simply include the relevant behaviour change question within a pre-intervention questionnaire distributed in the targeted neighbourhoods. The second is to ask this self-assessment question to people who visit the online portal to order incentive and material. The question could be made mandatory to order the free material.

3.2.2 Level 2: A More Complete Evaluation of Change

This second level of integration goes one step further by incorporating the stage-assessment question in a post-evaluation survey, in addition to the pre-intervention survey. Whether or not the intervention itself is based on the stage-based model of change, measuring pre- and post-intervention stage membership offers the benefits of capturing more information than simply assessing behaviour before and after. This can be very useful to understand if the targeted population has been successfully moved to higher stages of change, even if that does not mean an observable change in behaviour. An example would be to evaluate the effect of an awareness campaign designed to motivate people who *want* to reduce their car use, thus moving them from the *predecisional inhibition* stage (S1.a, seeing no reason to change) to stage 1.b or 2 (Tables 10.1 and 10.2). The next efforts for those individuals would be to facilitate a change. In short, a behaviour change program could have some success even if it doesn’t lead yet to observable behaviour change as people in

Table 10.1 Examples of a car-use reduction stage of change question for commuting to work

#	SSBC Stage name	Question: Which of those statements best describe your intention and use of the car to go to work? Statements:
S1.a	Predecisional denial	I mostly drive alone to go to work. I am pleased with this and see no reason to reduce my car use
S1.b	Predecisional inhibition	I mostly drive alone to go to work. I would like to reduce my car use but feel it is impossible
S2	Preactional	I mostly drive alone to go to work. I am thinking about reducing my car use but I’m not sure how or when to do this
S3	Actional	I mostly drive to go to work. My aim is to reduce my current car use. I know which journey to replace, and which mode to use, but I have not started to do so on a regular basis
S4	Postactional	I will maintain or reduce my already low car use to go to work in the coming months. I try to use other modes than the car as much as possible
	Not applicable	As I do not drive or have access to a car, this question does not apply

Table 10.2 Examples of sustainable mode stage of change question for daily trips

#	SSBC Stage name	Question: Which of those statements best describe your intention and use of [walking/cycling/taking public transit] for your daily trips? Statements:
S1.a	Predecisional denial	I don't do any trips [on foot^a/by bike/by public transit] . I am satisfied with this and see no reason to start
S1.b	Predecisional inhibition	I don't do any trips [on foot^a/by bike/by public transit] . I would like to start but feel it is impossible
S2	Preactional	I don't do any trips [on foot^a/by bike/by public transit] . I would like to start but I'm not sure how or when to do this
S3	Actional	I rarely do trips [on foot/by bike/by public transit] . My aim is to start doing more soon. I know which trips to replace, which itinerary to take, but have not started to do so on a regular basis
S4	Postactional	I regularly travel [on foot/by bike/by public transit] , I will maintain or increase the trips I do [on foot/by bike/by public transit] in the coming months

^aBecause not walking at all for transportation can be rare, the statements for S1.a, S1.b, and S2 can be modified to "I do few or no trips on foot [...]"

stages 1.b, 2 and 3 might have slowly developed a higher intrinsic motivation to change which would make them more ready to change when future interventions (infrastructural or soft) are implemented. Furthermore, those at higher stages of change are more likely to be more supportive of transport policies that would allow them to operationalize those changes (Gousse-Lessard & Laviolette, 2022; Kirschner & Lanzendorf, 2020), although more research is needed to validate this hypothesis.

There are two ways of conducting a pre- and post-evaluation of a target population. The first is by using repeated cross-sectional surveys. A first survey is distributed within the targeted population before the intervention and then another at one or more point in time after the intervention (e.g., 1 and 6 months). In that first approach, a different sample of respondents is recruited for the pre- and post-surveys. A critique formulated by Bamberg and Rees (2017) is that this approach of evaluation is too often used in transportation while it does not allow analysis of intra-personal changes resulting from the interventions. For this reason, researchers should consider a longitudinal design where the same individuals are surveyed two or more times to test the effectiveness of interventions. A second critique formulated is that the effect of behaviour change interventions is often not evaluated in the long run (Bamberg & Rees, 2017), leading to the question: are the changes "permanent" or long-lasting? However, there are evidences that behaviour change following well-designed interventions is maintained in time (Semenescu et al., 2020), including in the case of Portland's SmartTrips (Dill & Mohr, 2010).

In summary, from a practitioner's perspective, it is likely sufficient to know whether the population is moving in the desired direction of change (by using repeated cross-sectional surveys). If the budget allows it, practitioners should consider a third evaluation 1–2 years later to see if the changes are maintained in time. See Alta Planning + Design and Transit Center (2017)'s report for practitioners for

further recommendations of evaluations. Linking this level to the Portland SmartTrips program, this would mean integrating one or more stage of change questions in the post-intervention surveys and measure the progress from the pre-surveys.

3.2.3 Level 3: Stage-Specific Intervention Design

In this third level of integration, interventions are designed to target people at specific stages of change. Due to the difficulties of tailoring and delivering the information to each individual based on their own stage of change, the goal is to design interventions more broadly to appeal to people in specific stages. Considering that programs are often designed around limited budgets, a first approach would be to design the messages and strategies, such as incentives, to appeal to those individual “ripe” for change: people in Stage 2, early Stage 3 (people have only started to try out the new behaviour) and to a lower extent, Stage 1.b. A second approach can also be to vary the targeted stages based on geographical location. For example, if a sector has a strong majority of people in Stage 1.a and another a larger share of people in Stage 1.b or 2, than the first sector could receive an intervention designed for people in Stage 1.a (to bring them to consider change) and the second sector should apply an intervention with Stage 1.b and 2 in mind even if in each sector there will be people in the other stages. A third possibility when it is impossible to know in which stages targeted individuals find themselves is to use a menu-based approach on a website where people can choose the information and interventions that best fit their current readiness to change (Abraham, 2008). Such approach can be enhanced with a few quick self-assessment questions, such as the stage-of-change questions (Tables 10.1 and 10.2) to then direct the individuals to a reduced set of messages and interventions to choose from. Drawing from various works (Alta Planning + Design & Transit Center, 2017; Bamberg, 2013a, 2013b; Pope et al., 2018; Sunio et al., 2018; Waygood et al., 2012), Table 10.3 presents strategies and message framing for each stage.

3.2.4 Level 4: The Right Intervention to the Right Person

The “ultimate” level of integration of a stage-based approach consists of a program that delivers stage-tailored information and (dis)incentives to individuals based on their current stage. As discussed in section 0, this approach ticks all the benefits of using stage-based individual-tailored approach of a behaviour change intervention. It requires greater effort, though the benefits should be greater. The complexity of delivering such individual-tailored interventions might explain why there are only a few transport-related studies in the literature reaching this level of integration (Bamberg, 2013a). Furthermore, to the best of our knowledge, no large-scale program in transportation has ever been implemented at this level of integration.

Table 10.3 Intervention strategies recommended for each stage of change

Stage	Intervention strategy
1.a Predecisional denial	Raise awareness about the consequences of car use: a diversity of information is required as people are motivated in different ways; individual negative impacts such as cost, health, stress; negative societal impacts (environment, climate, road violence, etc.); attention should be given to framing (see section 0)
	Make injunctive social norms more salient: Make it clear that a majority of people think that overuse of cars in our cities is problematic. Make the link with societal objectives (e.g., increasing road safety for all) and the current problematic behaviour particularly those that are irrefutable
	Ascription of responsibility: Consequences (for self and others) should be linked to the individual's own action and that they can alleviate those consequences through a new behaviour
	State the inconveniences related to car use: Make people think and say what bothers them when using their private car, and for which daily trip(s) do these disadvantages apply particularly. Those that relate to negative emotions are likely strong motivations to change
1.b Predecisional inhibition	Make descriptive social norms more salient: Ideally, this should be done based on real, credible, statistics and emphasize the behaviour to be performed (new mode) and not the behaviour to change (car use). For example, a message crafted based on results from a pre-intervention survey could state that a majority of people in the neighbourhood are either already or planning to walk/cycle/take public transit for some of their trips
	Promote goal formation to change while preventing reactance: This could be done by asking the person to think of a regular trip that they could do on foot, by bike, or by using transit. Asking for a small step, stating that even small steps matter, while recognizing that this can be difficult and asking what barriers they see in using their preferred alternative mode can reduce reactance (Bamberg, 2013a)
	Highlight advantages of modal shift: The objective is to increase positive attitudes and emotions towards change so that the idea to carry out the new behaviour will outweigh the perceived difficulty of trying something new. People might be motivated by different benefits for the same mode. For some, the physical and mental health argument of walking, cycling and even using transit might work well, others might be more convinced by practical, economic or environmental arguments

(continued)

Table 10.3 (continued)

Stage	Intervention strategy
2. Preactional	Highlight advantages of alternatives: At this stage, the advantages of the specific changes the person is considering should be highlighted. Again, the advantages should (as far as possible) be linked to the individual’s motivations. If not possible, a diversity of information is recommended Increase perceived behavioural control: The idea is to lower the perceived barriers to using alternative modes of travel. Provide quick tips on how to use other modes (e.g., where are the bus/bikesharing/carsharing access points, illustrate how to easily pay for mobility services, suggest downloading the <i>app</i> to unlock a shared bike, etc.), provide tools to plan itinerary by bicycle or transit, etc. incentives could also work well to increase PBC at this stage, see below for tips Highlight social norms or trends that are supportive: If available, provide relevant examples of the desired behaviour among peer social groups (neighbours, coworkers, classmates). Use inspiring images of people from various demographics doing the desired behaviour Offer incentives to try possible alternatives: This is the stage where the incentives will be the most efficient. The idea is to increase perceived behavioural control and allow them to test an alternative at a low cost and with minimal risks. Someone is interested in transit? Offer them a free daily, weekly or monthly pass (see Zarabi et al., 2024 for a review). Interested in cycling? Do they have a bike? Does it need a tune-up? Offer a rebate on tune-ups or on a new bike at a local bike shop. Have they ever tried bikesharing? Offer them a free pass or discount code on the app. The same can work for carsharing. Programs such as Équiterre’s Vélovolt that allows workers to try out an e-bike for 2–4 weeks for free also produced great results (Chevalier et al., 2024) Establish social relationships that will be a critical source of support and information: Providing social support can seem time-consuming but might be critical in providing the confidence, the support, and the motivation to start the new behaviour. Let the individual know that others are also trying, offer direct support (accompany the person on their first transit or bike trip), link them to neighbourhood groups, invite them to discovery walks or rides in their neighbourhood, ask if they have someone they know that is already performing the behaviour and could help them

(continued)

Table 10.3 (continued)

Stage	Intervention strategy
3. Actional	Provide practical information on alternative mode use: This is the “what, when and how”. Bring the person to think about which mode should be used, when and which trip should be replaced and how is the behaviour going to be operationalized. As described before, this should be specific to the context (geographic <i>and</i> individual). Offer information on how to plan their itinerary, how to dress for uncertain weather, how to pay, where are located the nearest bus stops, bikesharing/carsharing stations, protected bike lanes, etc. Offer incentives: Incentives could also be very useful here to bring people to try out their selected alternative Acknowledge the person’s goals (why they want to change): At this stage, they have positively committed to changing. They might even have already tried the new behaviour. Thank them for their commitment, congratulate them for trying out Action planning and commitment: Do they have a plan to enact the behaviour? Bring them to commit: when and where are they going to try the new mode, for which trip? Do they have everything needed? Contingency management for when problems will occur: Provide help on how to plan if something goes wrong. Ask them what their plan is if the bus is late, if they were planning to cycle and it rains, what to do if they need to hurry back home for an urgent matter. Guidance can be provided with a quick “how to” guide to the most common problems with each mode Restate the benefits of the chosen alternative: Get them to increase positive anticipation of the new mode of transport by reminding them of their benefits and why it matters to them. Overall, information should be as temporally close as possible (i.e., the feedback should be given as close to the behaviour as possible)

(continued)

Table 10.3 (continued)

Stage	Intervention strategy
4. Postactional (maintenance)	Provide positive feedback after the new behaviour has been accomplished: Positive, non-criticizing and non-controlling feedback help people feel more competent. If it's possible to follow people's progress throughout the intervention (through an app-based intervention for example, see next section), providing information on how far they have come by recognizing the challenge that this represented could strengthen their determination to keep going. For example, one might say: “You've made great progress, how do you feel about the next step? Here's some information that might help you with your goals. Feel free to use it as you see fit. I noticed you have been working hard on this. Is there anything you think would help you improve more?” Help them prevent and recover from relapses: Share information on how to persist in the face of adversity: State obstacles experienced and help people set a coping plan that includes detailed solutions for each barrier; Provide resources into which people can keep track of their progression, goals and difficulties (e.g., log book, calendar, apps); Encourage people to visualize their trips, possible challenges, and successes, as well as to practise self-compassion (positive self-talk) in their efforts (Pope et al., 2018) Acknowledge their behaviour that contributes positively to society: Thank them for contributing to reducing excessive car use and its consequences on society. Remind them that they are making an important contribution to society's goals (e.g., reduce GHG emission, to transition to a healthier society, or to increase safety and quality of life for all) by reducing car traffic in their neighbourhood Help them plan to maintain sustainable mobility behaviours through life course changes: A next step is to provide them with tips and guidance on how to maintain their low car use through important life transitions such as having a new job in a location not as well served by sustainable mobility options, expecting a child, or relocating to a new home. In short, help them think of what they can do to preserve their high-quality and low-car lifestyle, by providing examples for life transitions that might apply to them Helping others: Finally, the ultimate step is to help them contribute more broadly to society shifting away from car dependency. This can be done by suggesting that they help people in their social networks to use active travel and public transit. Providing them with “group” incentives such as public transit/bikesharing tickets that would allow them to bring their friends and family to free, thus helping their close ones try out new behaviour. Going one step further is to suggest ways to get involved at the local level to ask for better active travel and transit infrastructure and safer streets. Suggests a list of local organizations that they can volunteer with to further help their community embrace a fair transition away from car dependency

In his first application of the SSBC, Bamberg (2013a) developed a phone-based module with scripts designed for each of the four stages. The intervention had three steps: (1) People were recruited for the behaviour change campaign via invitation letters sent by mail. To participate, they had to mail back a prestamped postcard which contained a stage-diagnosis question and a phone number where they could be contacted. (2) The main intervention happened when they were contacted by phone by the research team who used the stage-tailored messages. (3) At the end of the phone call, participants were asked if they were interested in receiving material and incentive to help them try out the new behaviour. If a phone-based only approach today (in 2024) might not go as far as when Bamberg conducted his study, the idea of a direct contact, recommended in community-based social-marketing approach (McKenzie-Mohr, 2011), should be considered within a larger program to have a significant impact on a small number of people's behaviour change process (Davies, 2012). Such one-on-one conversations could be conducted through a door-to-door campaign or through local "mobility ambassadors".

More recently, the idea of using information and communication technology (ICT) has been suggested and tested as a means to deliver highly tailored behaviour change interventions (e.g., Ahmed et al., 2020; Briant et al., 2023; Bucher et al., 2019; Sunio et al., 2018). All four levels of integration described so far can be implemented within a web-based or smartphone app. For example, both Ahmed et al. (2020) and Sunio et al. (2018) developed smartphone apps and web tools with the potential to deliver such tailored intervention. Their apps were used to conduct detailed pre and post interventions mobility diagnosis (behaviour, stage-of-change, etc.). While their interventions were personalized to each individual by recommending, for example, realistic alternatives for specific trips taken, neither study appeared to take full advantage of their app to deliver stage-tailored messaging to participants. While they report positive results in shifting people to higher stages, this classifies their interventions as a level 3 integration that also includes the first two levels. However, the potential exists to add this next level of tailoring. Sunio et al. (2018) demonstrated that a technology-based intervention, even when non-tailored to specific stages, seems particularly effective in helping people translate intention into action by supporting self-efficacy, confirming previous research in the health domain (Dallery et al., 2015). However, it seems less effective in changing entrenched beliefs and attitudes (about cars and alternatives for example), thus less likely to bring "unconvinced" individuals to form a goal and behavioural intention to reduce their car use (moving from S1.a to higher stages). It thus remains to be tested if a true level 4 integration with stage-tailored intervention delivered through a phone app would be more effective in moving people at all stages to higher stages. But as described by Briant et al. (2023) in a comprehensive report on using Mobility as a Service (Maas) to support behaviour change, an important challenge with such app-based approach is to bring people to download the app and then to come back to it and keep using it. This might be a particular challenge for motorists in lower stages which might not see any benefits in using a multimodal trip planning app. In such cases, more subtle techniques may be required that nudge people gradually

towards more desirable behaviours and tie rewards to such shifts in both behaviour and beliefs.

Finally, a simpler and cost-effective way for a large behaviour change program such as Portland’s SmartTrips to deliver stage-tailored intervention would be to integrate a quick self-assessment question on the website where people are invited to order incentives. Based on their stage of change, participants would then be redirected to different pages containing information and incentives tailored to their respective stage (Table 10.3) before being able to order their incentive. While relatively low cost to implement, this approach would have the downside of only reaching people who take the step of ordering incentives (about 10% in the Portland program). These are likely to be people in higher stages. An approach worth considering to attract more people from lower stages (S1 and S2) to the program’s website would be to include in the mail-in mobility package an invitation to complete a short online survey about their general travel behaviour (that would include stages of change questions) to be eligible to a lottery to win cash prizes. After survey completion, respondent would then be redirected to stage-tailored information and incentive pages.

4 Conclusion

Changing behaviour is a highly complex process and while providing alternatives to the car is essential, it is often insufficient on its own to prompt rapid behaviour change across diverse segments of the population. In this chapter, we argued that personalized behaviour change strategies should be more systematically included in policy packages to further leverage the impact of increasing the quantity and quality of sustainable transportation option while facilitating public acceptance and demand for structural changes away from cars. In a North American context, we see this as an essential component of a holistic approach to a socio-ecological transition in the transport sector away from car dependency. Unfortunately, too few large-scale applications voluntary travel behaviour change programs have been implemented in North America. Their application typically brings about a 5–7% reduction in car use among participants, which if applied yearly will help cities make great strides towards sustainable transport goals. This chapter was structured as a guide to practitioners who wish to develop such behaviour change programs. To enhance the effectiveness of transport behaviour change interventions, we recommend integrating components of the Stage model of self-regulated behaviour change (SSBC). We propose a four-level integration framework: (1) using the self-assessment question of the SSBC to enhance diagnosis of the targeted audience and measure its readiness to reduce car use or switch to alternative modes; (2) reuse the self-assessment question in post-intervention surveys to measure its effect on behaviour, intention and motivation; (3) developed stage-specific strategies and messages to be delivered, relying on either a “menu-based” approach or the most likely stages of the targeted population; (4) fully integrate the model by delivering individual

stage-tailored strategies and messages using one-on-one methods (e.g., door-to-door) or a technology-based approach. The latter remains to be tested in large-scale experiments in a North American context to evaluate its efficacy over simpler interventions.

To help achieve the greatest success, practitioners should: (1) carefully adapt the intervention to the structural context by first prioritizing the individuals most likely to change (stage 2 and up) within the neighbourhoods with the best alternative to the car, and thus the least structural barriers; (2) “advertise” structural changes by combining them with simple behaviour change programs to enhance the benefits of new infrastructure and transport options; (3) use the potential of the habit discontinuity hypothesis to target individuals who have recently undergone important life changes; (4) tailor the programs to individuals as much as possible based on geographic context, socio-demographics and, of course, their current stage of change.

Beyond contributing to reducing car use, such program can also contribute to enhancing a sustainable mobility culture that relies on higher social norms and attitudes towards active travel, public transit and shared mobility and bringing people to fully embrace more multimodal and less car-dependent lifestyles. We hypothesize that this should increase support among the population for more pro-transit and pro-active travel including the politically difficult structural changes that often require taking space and funding away from car infrastructure. In doing so, this contributes to a positive feedback loop of increasing demand for sustainable mobility policies that would further reduce car use and so on. In areas offering the best non-automobile accessibility, such program could even go one step further by helping household voluntarily maintain low car ownership or reduce the number of cars they own.

Finally, from a research perspective, better collaboration is needed between practitioners and researchers from various disciplines to both develop theoretically driven interventions and evaluate them through robust methods to enhance our collective understanding of the pathways leading to sustained changes in travel behaviour.

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