

SUSTAINABLE TRANSPORTATION*

– A Psychological Perspective –

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This paper discusses possible contributions of psychologists to sustainable transportation. It is argued that in order to reach sustainable transportation, among others, behaviour changes of individual car users are needed. As transport policies will be more effective if they target important antecedents of travel behaviour, first, factors influencing such behaviour are discussed. It is argued that car use is very attractive and sometimes even necessary for many different reasons. This implies that a combination of policies is called for, each targeting different factors that support car use and hinder the use of more sustainable modes of transport. Next, the paper elaborates on policy strategies that may be employed to achieve sustainable transportation by changing car use. It was concluded that increasing the attractiveness of sustainable transport modes by means of pull measures is not sufficient to reduce the level of car use. Besides, car use should be made less attractive by means of push measures to force drivers to reconsider their travel behaviour. The acceptability of such policies may be increased by clearly communicating the aim of these policies, and the expected positive consequences (e.g., less congestion, improved environmental quality). Moreover, possible negative effects for individual freedom may be compensated by implementing additional policies aimed at facilitating the use of sustainable transport modes.

Key Words: Sustainable transportation, Travel behaviour, Car use, Psychology, Motivations, Behaviour change

1. SUSTAINABLE TRANSPORTATION: A PSYCHOLOGICAL PERSPECTIVE

It is widely acknowledged that the current transportation system is not sustainable¹. The increasing use of private cars has generated various environmental, social and economic problems. Emissions of toxic and harmful substances contribute to global warming, local air pollution (e.g., emissions of particles in urban areas), and smog, thereby threatening ecosystems and human health². Moreover, car use threatens urban quality of life, e.g., because it is noisy and yields traffic accidents^{3,4}. Furthermore, the accessibility of economic important destinations is endangered.

Technological solutions aimed to reduce the negative impact per car and per kilometre driven (e.g., energy-efficient cars) do not appear to sufficiently reduce these problems of car use, so as to make it compatible with sustainability¹. The mitigating effects of new technologies

tend to be overshadowed by the continuing growth of car use, and by the increase in the number of heavier cars that are less energy efficient (such as SUV's). Moreover, drivers might be tempted to use their energy-efficient cars more often because they are cheaper on fuel and more environmentally friendly, a phenomenon known as the rebound effect⁵ or the Jevons principle¹. Therefore, behaviour changes of individual car users are needed as well.

Various types of behaviour change may help to achieve sustainable transportation⁶. First, people may adopt more energy-efficient driving styles (e.g., drive at steady speed, shifting gears early). Second, people may change their car use, i.e., combine trips, use different (i.e., shorter) routes, change the time of travel to avoid traffic jams, visit other destinations to reduce travel distance, suppress certain car trips, or travel with other modes of transport, such as public transport, cycling, walking or carpooling. Third, people may replace their car by an energy efficient car or dispose of their car. Fourth, people may move residence, or look for another job location to reduce travel needs and distances.

Psychologists can contribute to sustainable transportation by studying how such behaviour changes may

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be achieved. Two questions need to be addressed. First, we need to understand which factors cause travel behaviour. After all, policy strategies will be more effective if they target important antecedents of behaviour. Second, we need to examine which policies may be effective in promoting sustainable transportation. More specifically, we need to understand which policies may be effective, acceptable and feasible to change travel behaviour. In this paper, both questions will be addressed. We do not aim to provide an extensive overview on these topics. Rather, we summarise some of the main issues involved. Section 2 discusses factors that influence car use. Section 3 elaborates on policy strategies that may be employed to achieve sustainable transportation by changing car use. The final section summarises the main conclusions.

2. FACTORS INFLUENCING CAR USE

Why do so many people drive their car? This question has been addressed in many studies. This section reviews important societal and psychological factors that promote the use of a private car.

2.1 Societal factors

Car use has been stimulated by various societal developments^{7,8}. For example, reliable motor vehicles and the corresponding infrastructure of roads, petrol stations, traffic regulation and the like became widely available. Increases in spending capacity have led more and more people to own and use cars. Urban sprawl has increased the need to travel. In many countries around the world, infrastructural and societal organisation is tuned towards the wide-spread availability and the regular use of cars⁹. These (and other) developments have made the use of private cars attractive and in some cases even necessary⁸. Indeed, many people claim they need a car in order to undertake their daily activities. But people also presume the availability of a car when making choices on where to live, work, shop, or how to spend their leisure time. As a consequence, many people became dependent of their car^{10,11}; car use turned into a socio-economic necessity.

2.2 Psychological factors

Many studies revealed that people like driving. In general, the car is much more attractive than other modes of transport, particularly compared to travelling on public transport. The car outperforms public transport in many respects, e.g., the car is more convenient, flexible, comfortable, fast, independent, reliable and pleasurable than

public transport¹²⁻¹⁵. Especially travelling by bus is evaluated rather negatively¹⁶. Judgements about walking and cycling are generally more positive^{16,17}. However, these modes of transport are feasible only for short distances.

2.2.1 Symbolic and affective motives for car use

What makes car use far more attractive than other modes of transport? For a long time, studies focused on the instrumental benefits of car use¹⁸. Also, transport policies typically target such instrumental factors, for example by increasing prices of car use (e.g., tolls, parking fees) or reducing accessibility (e.g., prohibiting cars from entering certain areas). In most cases, such policies have not resulted in significant changes in car use, suggesting that other factors influence the level of car use as well.

Recently, it has been acknowledged that the private car is not only very attractive because of its functional properties, such as its speed, flexibility and convenience. Besides, other motives seem to play an important role, such as feelings of sensation, power, superiority, arousal and pleasure¹⁸⁻²⁰. Such symbolic and affective aspects are emphasised in many car advertisements, e.g., pictures of cars in spectacular landscapes. Moreover, the way people talk about their car illustrates that for many, the car is a symbol for status and success and a way to express yourself (e.g., people may talk about a 'typical BMW driver'). Based on this, it has been argued that car use fulfils three different functions²¹: an instrumental (i.e., it enables activities), a symbolic (i.e., the car is a means to express yourself or your social position) and an affective function (i.e., driving is pleasurable and arousing). A study by Steg²¹ revealed that commuter car use in the Netherlands is especially related to symbolic and affective motives, and hardly to instrumental aspects. This implies that differences in car use are especially related to the extent to which people evaluate symbolic and affective aspects positively, and not to the evaluation of instrumental aspects. Symbolic and affective motives may even play a more important role when considering mode choice for types of trips that are less functional, such as recreational trips. Some authors argued that driving may be desired for its own sake (and not be derived demand only), as it emerges from the fact that people take their car for a spin without having any goal to drive to²². Symbolic and affective motives seem to be especially valued by young and male drivers²¹. Thus, people do not only drive because they need to do so, but also because they love to do so. This may be one of the reasons why attempts to change car use have not been very successful, and it might explain the vast resistance against (effective)

policies aimed at changing or reducing car use. This implies that policies should not only target the instrumental costs and benefits of car use, but also its symbolic and affective qualities.

2.2.2 Habits

Another process that strengthens the increasing use of cars is the formation of habits. When behaviour has positive consequences over and over again, habits are formed. As car use has many advantages over other modes of transport, it is very likely to turn into a habit. Indeed, various studies revealed that car use is to a large extent habitual²³⁻²⁵. When habits are formed, behaviour is guided by automated cognitive processes, rather than being preceded by elaborate decision processes. That is, people will no longer make conscious decisions, but use the same mode again and again without even thinking about it²⁵. Habits may be even generalised across situations. For example, a person who has a habit to commute by car may use the car for many other trips as well, without considering whether this is indeed the best way to travel²⁶.

Habits are highly functional to cope with daily life. People do not have the cognitive capacity nor the time to think through every single choice they make. Fortunately, it is not necessary to make conscious decisions on how to act time and again, since in many cases the choice circumstances will not be changed, and a person would have come to the same decision anyway. However, habits may not always yield optimal outcomes. In some cases the circumstances may have changed. For example, a new bus route may have become available which makes the bus highly attractive compared to the car. Such changes will generally not be noticed when habits are formed. Habits result in selective attention: people tend to focus their attention on information that confirms their choices, and tend to neglect information that is not in line with their behaviour. As a result, people know little about the qualities (such as travel time and costs) of the modes of transport they hardly use²⁷. Habits may also result in misperceptions, e.g., people tend to overestimate the costs of travelling by public transport, while costs of car use are underestimated. This is partly due to the fact that people overlook fixed car costs, such as insurance and maintenance costs.

In general, habits are reconsidered only when the choice situation has changed significantly. Indeed, Fujii and colleagues found that regulations that temporarily forced car users to use alternative travel modes induced lasting changes in car use^{24,28}. The impacts of such temporary changes were particularly strong for habitual

car users who had little or no previous experience of using other travel modes, suggesting that these habitual drivers had inaccurate perceptions about the pros and cons of these modes.

2.2.3 Car use as a commons dilemma

The societal and individual factors discussed above have made car use very attractive to many people. As indicated in the Introduction section, car use has also various negative consequences, among which environmental and safety problems, and those associated with reduced livability and accessibility of cities. These problems are acknowledged by car drivers as well⁸. This implies that individuals perceive a conflict between the individual benefits of car use and the collective problems caused by car travel. This conflict between individual and collective interests may be typified as a commons dilemma. A commons dilemma is a situation of conflict between aggregate collective interests and numerous individual interests. In pursuing their own personal interests, individuals tend to shift the (mostly limited) negative impact of their behaviour onto their common environment. The cumulative effect of these numerous small impacts may result in serious deterioration of collective (environmental) qualities. In a commons dilemma, people are tempted to act in their own interests, especially because individual contributions to the problems and their solution seem futile. Moreover, some problems are uncertain, and only visible in the long term (e.g., global warming). In contrast, acting in one's own interests yields certain positive outcomes in the short term. For most people, the many advantages of car use outweigh the negative consequences. Consequently, people do not restrict their car use. However, people do not always act in their own interest. Some use their car as little as possible to safeguard collective qualities, even though this might be less comfortable for them. Indeed, car use appears to be correlated to environmental considerations, i.e., high environmental concern, high awareness of problems of car use, and strong ecological norms are associated with less car use, although correlations are typically not strong^{8,29-31}.

3. CHANGING CAR USE

The previous section revealed that many factors have made car use very attractive. The car outperforms other modes of transport, most particularly public transport, in many different respects. Consequently, many factors could and should be targeted in order to successfully change car use and to reach sustainable transportation.

We indicated that car use is influenced by individual motivations and perceptions as well as by the situational context. This implies that car use may be changed by changing individual motivations and perceptions, or by changing the context in which decisions are made. The former may be referred to as psychological strategies, while the latter may be labelled as structural strategies for behaviour change.

3.1 Psychological strategies

Psychological strategies are aimed at changing individual perceptions, beliefs, attitudes, values and norms. Information may be provided to heighten people's awareness of the problems of car use, to increase people's knowledge about possible alternatives for driving, or about the behaviour of others. The underlying assumption is that people behave in a reasoned way and that behaviour can be modified by altering the perceived costs and benefits associated with particular choices. However, this assumption is not invariably true. First, feasible alternatives should be available before providing information can have any effect. Second, information provision is not very effective when habits are formed. In that case, people may not reconsider their initial choices or not even notice the information because of selective attention. Third, in some cases information may be counter effective. For example, a study by Tertoolen and colleagues³² revealed that information about the negative environmental effects of car use resulted in a reduction of the awareness of environmental consequences of car use. Apparently, in this study, car users experienced a discrepancy between their environmental attitude and their actual behaviour. Such a discrepancy causes an unpleasant psychological tension, a phenomenon called cognitive dissonance. People are motivated to reduce this tension. The easiest way to do so is changing their attitudes (rather than their behaviour). However, information proved to be quite effective in some cases. Most notably, individualised social marketing approaches, in which information is tailored to the needs, wants and perceived barriers of individual segments of consumers, have resulted in significant changes in car use³³. Another important reason for the success of such approaches is the use of various techniques for catching attention to the offerings³³. The provision of information is an important prerequisite for implementing other, more stringent measures as well. Public support for such measures may be increased by informing people about the need for and possible consequences of such measures.

3.2 Structural strategies

Structural strategies are aimed at changing the relative attractiveness or feasibility of behavioural options by changing the external context. The assumption is that behaviour is strongly influenced by the context in which decisions are made. In the long term, attitudes and preferences may change as well, in line with the behaviour.

Three types of structural strategies may be distinguished: financial measures, legal regulations and physical changes. Financial measures are aimed at changing the prices of behavioural options. Car use can be made more expensive (e.g., by increasing or introducing car taxes, tolls, kilometre charges) or the use of (sustainable) transport modes may be made cheaper (e.g., subsidising public transport, tax discounts). The basic assumption underlying this strategy is that prices steer behaviour, and that people will choose the option with the highest utility against lowest costs. However, this is not always the case³⁴. First, feasible alternatives to car use should be available. Second, financial considerations are not the main determinant of car use. Many other considerations may play a more important role, such as comfort, speed, and flexibility, and people may be prepared to pay for these qualities. Third, if habits are formed, small price increases may not be notified. Fourth, people may not be well-informed about prices of different modes of transport. As argued earlier, people generally underestimate costs of car use, suggesting that significant price increases are needed before people reconsider their car use.

Legal regulations may be effective as far as laws and regulations are internalised by those affected. However, people may resist, or elude, the laws and regulations. If they do so on a large scale, legislation will be discredited and the practical effect of it will be virtually nil. Effective regulation and enforcement are crucially dependent on majority public support, or at least compliance. Legal regulations require adequate organisation for supervision, monitoring and enforcement. On the positive side, applying a regulation and enforcement strategy may help to increase people's trust in the cooperation of others, as far as there is a guarantee that one's own willingness to comply is not exploited by others, viz., that others will adapt their behaviour to the laws and regulations as well³⁵.

Physical changes are directed at changing urban form and available technical apparatus. Traffic can be directed via certain routes, geographical relationships between destinations may be changed, and technological innovations may be introduced. The underlying assumption behind such measures is that behaviour is shaped by

the circumstances. However, individual preferences may be opposed to such changes, e.g., people may not want to live in compact cities with mixed land use that would reduce their need to travel. Moreover, urban planning is typically effective in the long term only; current land use patterns shape the possibilities for exhaustive geographical reorganisations. Technological innovations aimed at making cars more energy-efficient (and thus less polluting) are very important to reduce emissions. Unfortunately, such solutions tend not to be sufficient to manage the problems of car use, because their effects tend to be overtaken by the continuing growth of car use. Technological solutions also may not solve the problems of car use completely: for example, energy-efficient cars may help control environmental problems, but will hardly solve accessibility problems³⁶. Drivers might even be tempted to use their energy-efficient car more often because it is cheaper and more environmentally friendly (the rebound effect; see Introduction section). Moreover, technological innovations may have unwanted effects. For example, the more people favour technological solutions, the less they are willing to reduce car use and the more they reject policies aimed at this objective³². Also, some technological innovations are not easily implemented. For example, the introduction of electric or hydrogen cars requires a widespread adaptation or expansion of the infrastructure needed to keep them in service.

3.3 Push and pull measures

Structural strategies may be aimed at making car use less attractive or feasible via so-called push measures (i.e., ‘penalties’), while the use of more sustainable transport modes may be stimulated by means of pull measures (i.e., ‘rewards’)³⁷. Table 1 lists important merits and demerits of push and pull measures. Push measures are more likely to restrict people’s freedom of choice, while

pull measures typically increase the (quality of) available behavioural alternatives. Geller³⁸ argued that pull measures are generally more effective in changing behaviour, because in case of rewards, behaviour changes are associated with positive affect, feelings and attitudes, increasing the probability that the desired behaviour will become a social norm. In contrast, penalties may be accompanied with negative affect and attitudes, and may threaten individual freedom, which may result in behaviour contrary to compliance with a mandate³⁹. However, pull measures will be effective only when they succeed in making car use less attractive than more sustainable choices. Given the many advantages of car use, this will not be easy to accomplish. In this vein, it has been argued that pull measures are generally less effective in changing car use because they are likely to fail to make car use less attractive. Moreover, they are less successful in activating goals to change car use and to facilitate the implementation of such goals⁴⁰. Indeed, in the transport domain, push measures have been more successful than pull measures. For example, increasing prices of car use (e.g., by introducing tolls) was effective in reducing car use in some cities (such as Singapore, London), whereas decreasing prices of bus use did increase bus ridership, but did not result in reductions in car use⁶. However, push measures are generally not easily implemented because of lack of public support. Public support may increase if people believe policies will be effective in reducing the problems caused by car use, and if the policies do not seriously threaten individual freedom of choice. Moreover, policies are more acceptable when policies are believed to be fair and when people trust the good intentions of the government implementing the policies⁶.

3.4 Factors influencing the effectiveness of rewards and penalties

Three factors affect the effectiveness of rewards and penalties. First, the most powerful motivating consequences are “certain” and “soon”³⁸. This increases the likelihood that people associate the reward or penalties with their previous behaviour, which in turn increases the salience of the reinforcement and the likelihood that it will play a significant role in the choices made. Second, rewards or penalties should target factors that are deemed to be important to people, i.e., factors that significantly affect the particular behaviour. For example, transport pricing will hardly be effective if travel costs are not an important determinant of car use. In that case, people will just pay the price and keep on driving. Third, the contingency should be strong enough to get the desired behav-

Table 1 Pros and cons of push and pull measures

Push	Pull
Restrictive	Enlarge behaviour options
Makes car use less attractive	Does not make car use less attractive in an absolute sense
May elicit reactance	Does not elicit reactance
Associated with negative affect and attitudes	Associated with positive affect and attitudes
More effective in activating car use reduction goals	Less effective in activating car use reduction goals
Lack of public support	Public support high

behaviour started³⁸, otherwise people may not notify the reward or punishment, especially when habits are formed. However, contingencies should not be too strong, because people will strongly react to such policies. Moreover, strong reinforcements may reduce intrinsic motivation to contribute to the solution of traffic problems^{41,42}. This will especially occur when people can attribute their behaviour change to the reward or penalty. This may be problematic, because research has shown that intrinsic motivation may more strongly affect behaviour than do extrinsic motivators such as financial incentives⁴³. In such cases, extrinsic motivators should be at least as strong as to compensate for the reduction in intrinsic motivation. Moreover, powerful external consequences may improve behaviour only temporarily, as long as the behavioural intervention is in place³⁸.

3.5 Intervention planning

In general, intervention will be more effective if they are systematically planned, implemented and evaluated. Geller³⁸ proposed a general behavioural analysis method which may assist policy makers to do so. This so-called DO IT process comprises of four stages. The process starts by defining the target behaviour (Define). Interventions could best target behaviour that significantly contributes to the solution of the problems at stake, and aim at behaviour changes that are feasible and acceptable to the public. Next, a baseline level of the behaviour should be obtained by observing how often the target behaviour occurs under natural conditions, and which conditions hinder sustainable behaviour or support unsustainable behaviour (Observe). This reveals which factors may best be targeted to change behaviour, and provides a baseline for assessing the effectiveness of the intervention later. Then, interventions should be developed and implemented that target important factors hindering or supporting behaviour (Intervene). As indicated earlier, interventions may be aimed at changing external conditions (structural strategies) or at changing perceptions and preferences (psychological strategies). Finally, the effects and side effects of the intervention should be evaluated (Test). Based on this, change agents can decide whether they need to refine or replace a behaviour change intervention. Moreover, feedback may be given to the target population as to inform them about the effectiveness of their efforts. This may strengthen their commitment to change their behaviour. In sum, successful interventions should start with a careful diagnosis of the particular behaviour, and end with an evaluation of effects. As different groups may have different reasons for (not) driving a car, interven-

tions may best be tailored to the needs, preferences and circumstances of different target groups.

4. SUMMARY AND CONCLUDING REMARKS

This paper was aimed at illustrating how psychologists can contribute to sustainable transportation by changing travel behaviour. It was argued that various types of behaviour change may be needed to achieve sustainable transportation, ranging from changes in driving styles, mode choices, car ownership to changes in location choices. These changes are associated with different behavioural costs, which may vary for different trip purposes. For example, for some trips (e.g., commuting), travelling by public transport instead of a car may be more feasible than for other trips (e.g., shopping), and it may be quite easy to change travel time for some trips, but not for others. In general, behaviour changes will proceed according to a general cost-minimization principle, with the less costly adaptation alternatives being selected first⁴⁴.

In order to achieve behavioural changes, two questions need to be addressed. First, we need to understand which factors cause behaviour. After all, policies will be more effective if they target important antecedents of behaviour. Second, we need to examine which policies may be effective, acceptable and feasible.

This paper first reviewed the rich literature on factors influencing the level of private car use. Car use is very attractive and sometimes even necessary for many different reasons. Many societies have been tuned towards the regular use of a car. Moreover, car use has many advantages over alternative means of transport, not only because its instrumental function (i.e., a means to travel from A to B), but also because of its symbolic and affective values (i.e., the car is a symbol for status and success and a way to express yourself, and driving is pleasurable and exciting). Empirical evidence for the significance of these different motives for car use and the use of other modes of transport for different types of trips is still limited, and needs to be studied further.

Because of its many advantages, car use is likely to become habitual, making it more difficult to change. Car use became common practice, and many people became dependent on their car. That is, people presume the availability of a car when making choices in daily life, and as a consequence, they can no longer live without a car. Although many people acknowledge the negative consequences of car use (such as environmental problems, traffic noise, traffic unsafety, congestions), in gen-

eral, they do not act accordingly. That is, for many, the numerous individual advantages outweigh these collective problems. However, some people try to use their car use as little as possible out of environmental concern.

From the above, we may conclude that many factors may and should be targeted to reduce the attractiveness and necessity of car use. In order to effectively change car use, transport policies should not only be aimed at reducing the attractiveness of car use, but at increasing the attractiveness of other modes of transport as well. Since many different factors make car use attractive, it is unlikely that single policies targeting a few of these factors only will succeed in significantly changing car use. A combination of policies, each targeting different factors influencing car use (e.g., the available infrastructure, urban structure, the instrumental, symbolic and affective qualities of cars and other modes of transport, awareness of the problems of car use) is needed⁴⁰.

Second, the paper discussed various strategies for changing travel behaviour in order to safeguard collective qualities. A distinction was made between psychological strategies, aimed at changing individual perceptions and motivations, and structural strategies, aimed at changing external conditions as to make car use relatively less attractive or feasible, and the use of sustainable transport options more attractive and feasible. Psychological strategies are mostly not very successful in changing behaviour in isolation, although individualised social marketing approaches yielded promising results, probably because in this case information is tailored towards the needs, wants and perceived barriers of those involved. Structural strategies can either reward “good” behaviour or punish “bad” behaviour. In the transport domain, the latter (so-called push measures) seem to be more effective in changing car use than the former. However, push measures are less easily implemented because of lack of public support. Policy acceptability may be strengthened when expected (positive) effects of policies are clearly communicated. Moreover, anticipated negative effects for individual freedom may be compensated by implementing supportive policies aimed at facilitating the use of sustainable modes of transport. This again highlights that a combination of policies is called for.

Finally, we argued that interventions aimed at changing car use should be systematically planned, implemented and evaluated. Interventions should target important antecedents of car use (as described in section 2). Moreover, effects of interventions should be evaluated. This enables change agents to communicate these effects to those involved, which may strengthen their commit-

ment to contribute to the solution of the problems caused by car use. Moreover, it should be examined whether actual effects are in line with the expectations of change agents. Based on this, it can be decided whether a behaviour change intervention needs to be refined or replaced.

This paper provided a broad overview of psychology and sustainable transport. For the purpose of this paper, relevant topics could not be discussed in much depth. More detailed discussions of the relevant topics may be found in the literature listed in the references and in a recent volume on threats from car traffic to the quality of urban life, in which problems of car use, causes of these problems as well as possible solutions are discussed⁴⁵. Obviously, psychology focuses on some relevant aspects of the problems. Given the complexity of the problems, and the many factors involved, policy makers should also consider knowledge provided by other disciplines. A multidisciplinary perspective will provide a more comprehensive view of the factors causing the problems and possible solutions, and thus a richer basis for policy making. I hope this contributions has highlighted that psychologists have an important contribution to make in reaching sustainable transportation.

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