

HOW BEST TO EVALUATE MOBILITY MANAGEMENT PROJECTS: CAN PSYCHOLOGICAL THEORY HELP?

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ABSTRACT

In order to persuade both policy makers and practitioners to adopt mobility management (MM) strategies there is a need for these decision makers to accept, understand and be able to predict (with confidence) their likely effectiveness. To satisfy these requirements there is a need for a greater understanding of how MM interventions affect individuals' modal choice decisions and robust evaluation techniques that will allow any behavioural changes to be observed. This paper considers three key questions, namely; [1] *Do mobility management type interventions work?*, [2] *How do MM interventions work?* and [3] *How best to measure their effects?* The paper then suggests practical solutions as to how these issues can be addressed, in the form of a new standardised evaluation resource: MaxSUMO, which contains advice on the use of more robust evaluation methods (e.g. randomised controlled type designs) and the inclusion of theoretical diagnostic procedures based on a new theoretical behavioural change model (MaxSEM) to measure individuals' stage positions (their susceptibility to change behaviour) and stage movement (progression towards actual behavioural change). To illustrate the benefits of including psychological-based attitudinal and perceptual measurement questions in MM interventions, an overview of a theoretical-based randomised controlled personalised travel planning intervention study conducted in Hammersmith, UK, is also presented.

Mobility Management; Behavioural change; Evaluation methods; Modal choice

INTRODUCTION

Interest in mobility management (MM) type projects¹ has been growing worldwide as a potential solution to global environmental problems (e.g. Cairns *et al.*, 2004). However, despite the widespread uptake of such interventions more recently questions have been asked in relation to the actual impact that MM can achieve. This paper first considers three key questions, namely; [1] Do mobility management (MM) type interventions work?; [2] How do MM interventions work?; and [3] How best to measure their effects?. It then offers potential solutions in the form of a new behavioural change model, MaxSEM, and its associated attitudinal/perceptual diagnostic measurement questions, and a new theoretical-based evaluation resource: MaxSUMO. To illustrate the benefits of including psychological-based attitudinal and perceptual measurement questions in MM interventions, an overview of a theoretical-based randomised controlled personalised travel planning intervention study conducted in Hammersmith, UK, is also presented.

DO MM INTERVENTIONS WORK? (DO THEY CHANGE INDIVIDUALS' MODAL CHOICE BEHAVIOURS AND IF YES TO WHAT EXTENT?)

Evidence to support the effectiveness of mobility management strategies is increasingly well documented (e.g. Rye, 2002; Cairns *et al.* 2002; Steer Davies Gleave, 2003; Cairns *et al.*, 2004; GORS, 2005; Parker *et al.*, 2007), although there remain some inconsistencies in the actual extent of changes in behaviour reported (Möser & Bamberg, 2008).

In one of the most recent and comprehensive reviews of UK and international evidence (Cairns *et al.*, 2004) concluded that if MM (or 'soft transport policy') measures were given greater policy priority in the UK than at present, they had the 'potential' to achieve a reduction in peak urban traffic of about 21% (off peak 13%), and a UK nationwide reduction of all traffic of about 11%. The report also considered the potential impacts of individual MM measures and suggests that at a local level individual MM measures such as workplace travel plans have the potential to achieve between a 10-30% reduction in solo car use, school travel plans between 8-15%, and personalised travel planning initiatives between 7-15% (see Parker *et al.*, 2007; Brög, *et al.*, 2009 for a later review of personalised travel planning initiatives).

However a later meta-analytical review of 141 studies pertaining to the three types of MM measures cited above (including those documented by Cairns *et al.*, 2004; Steer Davies

¹ Also known as 'Smarter choices' or 'Soft policy measures' in the UK, and 'Travel feedback programmes' in Japan. See the EPOMM website for a comprehensive definition of mobility management and associated measures (www.epomm.org/)

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CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla Gleave, 2003; and GORS, 2005) suggested a much lower potential of 7% (Möser and Bamberg, 2008).

Similarly for the three individual types of measures lower effect estimates of 12% for workplace travel plans, 5% for personalised travel planning² were suggested and for school travel plans the authors were unable to provide any conclusive estimates of their effects. More recent work (DfT, 2009) has also cast doubt on the robustness of the assumptions made by Cairns *et al.* (2004).

Möser and Bamberg concluded that this inconsistency is due in part to the typical methods used to evaluate interventions, which are lacking in 'empirical vigour' and more recently, similar concerns have been raised by other authors, which although made in the context of personalised travel planning type interventions apply to all other MM measure types. These include;

- The use of one-group pre-post test evaluations designs which restrict the ability to establish 'cause and effect', primarily due to the lack of control over external influences (Möser and Bamberg, 2008) and seasonality effects (Bonsall, 2009);
- Weak analytical techniques to synthesize the data obtained, for example the use of less objective narrative-style analysis (Möser and Bamberg, 2008) or failure to provide detail on the analytical procedures used (Goulias, 2001);
- Sample sizes too small to allow statistical effects to be established (e.g. Richardson, 2002; Stopher & Greaves, 2004; Morton & Mees, 2005; Möser and Bamberg, 2008);
- Related to the above, the use of unrepresentative samples (Bonsall, 2009);
- A tendency to report only 'good practice' case studies (Möser and Bamberg, 2008);
- Over reliance on self-reported travel behaviour (Stopher & Bullock, 2003; Bonsall, 2009) which can lead to 'measurement error' in terms of under or over reporting of trips (Stopher *et al.*, 2009) which may in part be due to 'halo effects', i.e. respondents wishing to appear more 'greener' than they actually are in terms of travel mode choices, and/or as complying to the studies aims or wider (e.g. Morton & Mees, 2005); and
- The lack of robust corroborative data to confirm self-reported measures such as the use of odometers readings (Seethaler & Rose, 2009) bus patronage data (Parker *et al.* 2007), or GPS readings (Stopher *et al.*, 2007).

More detailed discussion of these issues are available in Möser and Bamberg (2008) and Bonsall (2009).

² A joint rebuttal to the conclusions made by Möser and Bamberg in relation to personal travel planning has been prepared by SUSTRANS and SOCIALDATA, although not yet published at this time.

HOW DO THEY WORK?

In order to successfully change people's travel behaviour, it is essential for practitioners and policy makers to understand the underlying processes necessary for behavioural change to occur, and to use this knowledge in both the design and evaluation of MM projects. Most relevant to the evaluation of MM projects are two key facts, as follows:

Firstly, in any given population some people are more susceptible, or ready to change their travel behaviour than others (Curtis & Headicar, 1997; Anderson & Stradling 2004; Anable, 2005). This partly relates to more subjective factors such as peoples' attitudes, perceptions and level of confidence towards their current travel mode choices, and towards alternative travel choices, as well as their wish to actually change their travel mode behaviour. In this context, if people currently have negative perceptions and attitudes towards alternative modes, little or no confidence in using other modes, or see no reason to change modes they will be unlikely to do so. The role of MM interventions should be to attempt to change these attitudes and perceptions, and instil confidence in a positive way in order to motivate people to try out, and ultimately adopt new travel mode behaviours.

For other people the barriers to modal shift are more objective: for example, if there is no bus service operating on the route for their journey they could not switch to local buses for that journey, or if they have a mobility-impairment that prevents them from switching car trips to traditional bus services, cycling or walking. In this instance MM interventions alone would be unlikely to change people's travel behaviour, and 'harder' more infrastructural measures would have to be implemented first or simultaneously (such as the addition of new bus services, or Demand Responsive Services for mobility-impaired people). The role of MM would be more supplementary in ways such as increasing awareness of these new services (via travel awareness campaigns), or provision of free tickets to entice people to try new services.

Secondly, it is increasingly acknowledged that in many instances behavioural change does not occur as a one-step process and can instead be viewed as a series of transitional stages (or steps) which individuals progress through in order to reach the final stage of behavioural change (e.g. Prochaska & DiClemente, 1984; Gatersleben & Appleton, 2007; Bamberg, 2007).

Accordingly, the implications are that any MM intervention is likely to affect people in different ways based on their susceptibility to change behaviour and stage position within the behavioural change process. Further, evaluations that focus on behavioural change *per se*, would not detect any of the more subtle attitudinal and perceptual changes that would also occur as people progress to later stages of readiness to change (Carreno & Welsch, 2009).

However, despite knowledge of these facts there remains no consensual theoretical framework that explains the behavioural change process involved in modal shift (see Anable *et al.*, 2006; Darnton, 2008; MAX-SUCCESS, 2008a for recent reviews). Previously, researchers have attempted to 'explain' modal choice decisions using a range of pre-existing theoretical frameworks, including the Theory of Planned Behaviour (Heath & Gifford, 2002; Bamberg *et al.*, 2003); Norm Activation Model (Hunecke *et al.*, 2001); Transtheoretical Model (Gatersleben & Appleton (2007); and Model of Action Phases (Bamberg (2007).

The lack of consensus as to which framework is the most appropriate remains due to the lack of validation studies that have applied these theoretical principles in actual modal choice studies. The relatively few studies that have attempted to test theoretical based interventions typically focus on individual behavioural change model constructs, such as Goal setting (Fujii & Taniguchi, 2005); Attitudes towards non-car modes (Beale & Bonsall, 2006; Fujii, 2007); Goal feasibility (Oja *et al.*, 1998); Implementation intention (Bamberg, 2000), rather than actual behavioural change process models as a whole.

HOW BEST TO MEASURE THEIR EFFECTS?

As part of the wider MAX project³, a state-of-the-art (SoA) review noted that at present there remains a lack of any standardized advice and 'practical' tools to allow MM type interventions to be evaluated (MAX, 2008b). Although, earlier European funded research projects (e.g. TAPESTRY, MOST) have made recommendations and suggested data collection techniques, such as MOST-MET (The monitoring and evaluation toolkit of the MOST Project) and CAG (The Campaign Assessment guidance of the TAPESTRY Project) the take up of these outputs is not widespread. Additionally, UK developed methods such as iTRACE (<http://itrace.org.uk/>) and SAM (Standard Assessment Monitoring-<http://www.trics.org/sam/default.html>) have been developed, although are designed to be measure-specific (i.e. focused on workplace/school travel plans) and are limited (as with CAG) to their application to the full range of MM measures.

The MAX report concluded that there remains a need for such guidance and advice that is both user-friendly enough to facilitate its uptake, but detailed enough to allow the required quality of data to be collected (to address the methodological weakness identified earlier), and also to incorporate a theoretical underpinning (to address the theoretical considerations discussed in the previous section) to allow the evaluation of all types of MM projects. After reviewing available methods, the SoA review suggested that the Swedish designed SUMO tool⁴ as the most suitable for further development. However, it would have to address three key issues;

³ MAX-SUCCESS was the EU's latest FP6 framework research project on Mobility Management and Travel Awareness in transport. Full details of the project are available at <http://www.max-success.eu/>.

⁴ SUMO (System for the evaluation of Mobility Projects) is a 'user friendlier' version of MOST-MET (the evaluation toolkit evolving from the MOST project) that has been adopted by the Swedish Road Administration (SRA) for the evaluation of SRA co-financed travel behaviour projects.

[1] How to ensure that the measurement incorporates the full range of attitudinal and perceptual constructs that are known to be important in affecting behavioural change?

[2] How to measure such changes in attitudes and perceptions in an objective way?

[3] How to ensure that more robust evaluations are performed?

MaxSEM and its associated stage diagnostic questions (see next section) allows the first of these two issues to be addressed and MaxSUMO (see later) provides an evaluation framework based on robust methodological principles to address the third.

MAXSEM (MAX-SELF REGULATION MODEL)

MaxSEM is a newly developed theoretical model designed to explain individual's modal choice decisions. MaxSEM has evolved following an extensive literature review of existing theoretical models (MAX, 2008b) and independent research of one of this papers co-authors (Sebastian Bamberg) which resulted in the identification of the most important aspects (constructs) that are relevant in explaining individuals' modal choice decisions and the underlying process that are involved in switching from car-use to more sustainable transport choices. MaxSEM has subsequently been extensively validated, first in a cross-cultural survey involving seven European countries and then as part of a large scale real-life intervention study conducted in Munich (see MAX-SUCCESS, 2009 for details), and pilot study in Hammersmith (Carreno *et al.*, 2010). MaxSEM provides a theoretical framework describing the behavioural change process and explains individuals' readiness to change travel mode by categorising them in one of four stages:

Stage 1: Pre-contemplative stage. Individuals in this stage typically make most of their trips by car, are quite happy with the way they currently travel (i.e. as car drivers) and at the moment have no wish, or desire to change to another mode, or feel that it would be impossible for them to do so at the present time, whether this be through subjective or objective reasons (see earlier).

Stage 2: Contemplative stage. Individuals in this stage also typically make most of their trips by car, but are not as content with their current travel behaviour (as pre-contemplators). They would like to reduce their level of car use and change to another way of travelling, but at the moment are unsure of which mode to switch to, or perhaps don't have enough confidence to do so. They are not really sure which alternative mode [s] they could use, or when they will begin replacing their car trips.

Stage 3: Preparation/Action stage. Individuals in this stage also typically make most of their trips by car, but have decided which replacement mode they intend to switch some or all of their car trips to, have the confidence to do so and may have already tried this new mode for some of their trips.

Stage 4: Maintenance stage. Individuals in this stage typically make most or all of their trips by non-car alternatives (public transport, walking, cycling etc.). These can either be people who do not own or have access to a car for their trips (and therefore dependent on non-car modes for travelling), or people who do own/have access to cars but for various reasons use them very infrequently, or not at all.

These stages can be viewed as a series of steps, leading up to the final step of actual behavioural change. Although the steps are fundamentally different from each other and follow on from each other in a logical way, it is possible for some stages to be missed (e.g. pre-contemplators could move directly to preparations/action or maintenance stages) or backward movement (stage regression) to occur.

In order for people to progress from earlier to later stages, key **threshold** points (shaded orange in Fig. 1) have to be 'satisfied'. So for pre-contemplators to become contemplators the key is the formation of a '**Goal Intention**' (i.e. they have to recognise their current level of car use is 'problematic' and want to reduce it). For people to form a goal intention, several factors (or constructs- shown by grey-shaded boxes in Fig 1.) are known to be important, although the importance of each construct will differ on an individual basis. For example, for some people

the key factor may be for them to 'feel bad' about their current level of car use (Negative affect) and for others they may feel that to reduce their car use at the current time is not a realistic option (goal feasibility) etc. Once in the contemplative stage, they then have to identify which would be the most suitable option (which mode) for them to reduce their car use, and feel sufficiently positive towards (Attitudes towards different behavioural change strategies) and/or confident (Perceived behavioural control) to use this alternative non-car mode and a **Behavioural Intention** is formed. The transition into the final Maintenance Stage involves individuals making definite plans and/or possibly trying out the new mode choice, which is conceptualised by an **Implementation intention**, and ultimately this new behaviour becomes their new normal dominant mode behaviour.

MaxSEM's stage diagnostic questions

In order to objectively measure individuals' stage positions within MaxSEM, MAX researchers have developed a set of six simple questions. The questions have evolved from a series of validation studies conducted across Europe within the MAX project (see MAX, 2009 for details). The questions (shown in Table 1) require respondents to indicate which **one** of the six statements best reflects their current attitudes towards their current level of car use and intentions towards future car use. According to the answers given (which box did

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CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla they tick), respondents can then be grouped into one of MaxSEM's four stages (see final column).

Table 1: Standardised stage diagnostic questions and allocated stage position

Question: Which of the following statement best describes how you currently feel about your level of car use for*.....and whether you have any plans to try and reduce any of these car trips? Please tick only one box.		Stage allocation
At the moment I use the car for most of my trips. I am happy with my current level of car use and see no reason why I should change it.	<input type="checkbox"/>	Pre-contemplative
At the moment I do use the car for most of my trips. I would like to reduce my current level of car use, but feel at the moment it would be impossible for me to do so.	<input type="checkbox"/>	
At the moment I do use the car for most of my trips. I am currently thinking about changing some or all of these trips to non-car modes, but at the moment I am unsure how I can.	<input type="checkbox"/>	Contemplative
At the moment I use the car for most of my trips, but it is my aim to reduce my current level of car use. I already know which trips I will replace and which alternative transport mode I will use, but as yet have not actually put this into practice.	<input type="checkbox"/>	Preparation/testing
As I do not own/have access to a car, reducing my level of car use is not currently an issue for me.	<input type="checkbox"/>	Maintenance
As I am aware of the many problems associated with car use, I already try to use non-car modes as much as possible. I will maintain or even reduce my already low level of car use in the future.	<input type="checkbox"/>	

***The question can be changed for specific trip types (e.g. shopping, commuting) or for everyday car use. In this study example, the question related for trips into Hammersmith.**

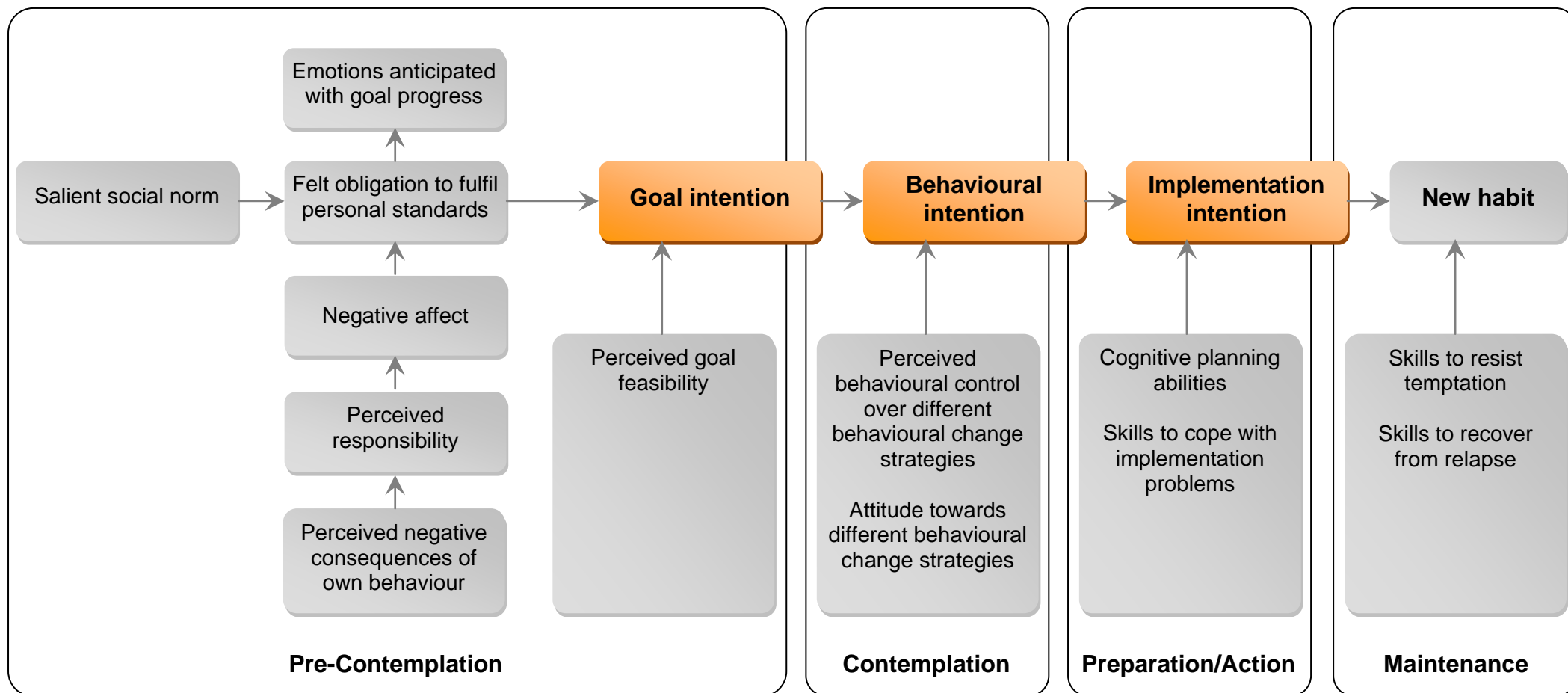


Fig 1: Overview of MaxSem

MAXSUMO

Evolving from the review of available evaluation methods (MAX-SUCCESS, 2008b) the Swedish developed SUMO evaluation tool was identified as the most suitable resource for future development, and following major revisions evolved into MaxSUMO.

MaxSUMO like its predecessor SUMO allows evaluation of a range of MM type projects and the online guide provides step-by-step guidance for users to effectively plan, monitor and evaluate MM projects. The design of MaxSUMO is simple and the methods included are not significantly different from other guidelines for transport and public policy evaluations. However, MaxSUMO is unusual in how its targets, indicators and results can be specified at different levels (see Fig 2), which allow changes to be observed at various stages of the MM project process, related to the type and details of the MM project implemented (services provided), the new travel behaviour the MM intervention is aiming to promote (mobility option provided), and also the impact of the MM intervention at both an individual and system level (overall effects)- see . Most importantly although simple to apply, it is based on the MaxSEM theoretical framework and incorporates this knowledge into the evaluation process via the inclusion of the stage diagnostic questions. To address methodological issues it also contains a chapter discussing ‘cause and effect’ issues and guidance on robust evaluation methods, along with sample survey instruments (see Hyllenius *et al.*, 2009).

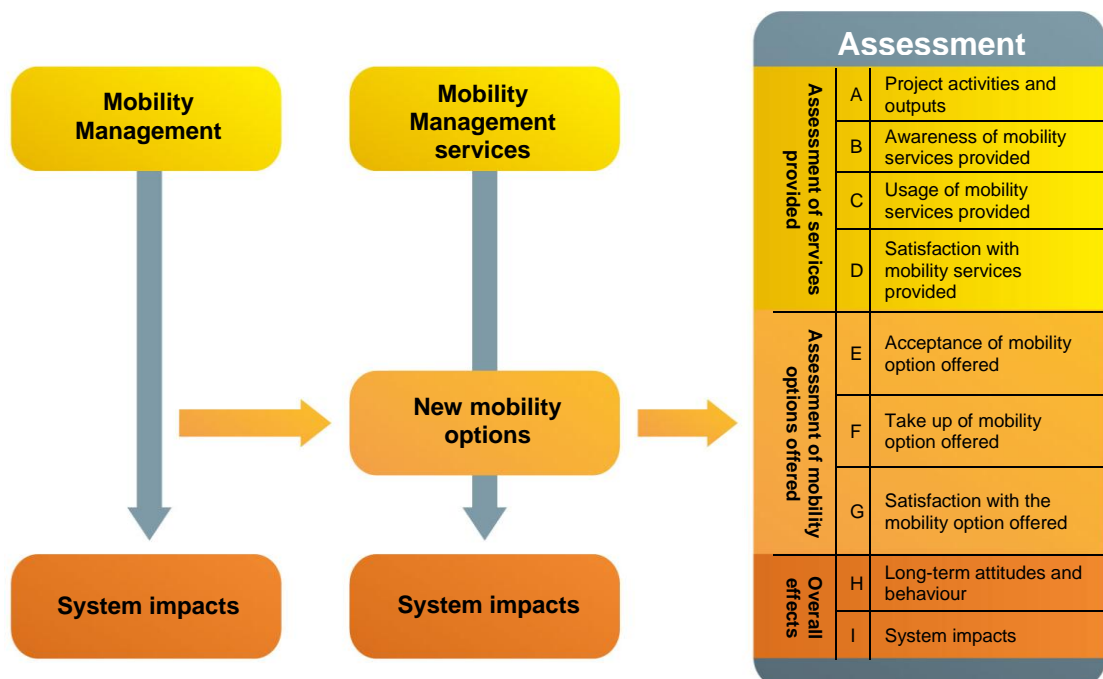


Fig. 2: Overview

Figure 2. Overview of MaxSUMO levels

PUTTING THEORY INTO PRACTICE

To illustrate the benefits of including MaxSEM-based attitudinal and perceptual measurement questions in MM interventions, an overview of a theoretical-based randomised controlled personalised travel planning⁵ intervention study conducted in the London Borough of Hammersmith and Fulham, UK, is presented below. For full details of the study see Carreno *et al.*, 2010.

Most relevant to this paper, the main aims of the study were to investigate whether theoretical-based awareness materials are more effective than ‘traditional’ (non-theoretical based) materials in facilitating modal shift, and in addition to measuring overt behavioural change, explore more subtle attitudinal/perceptual changes (i.e. changes in MaxSEM stage position).

Respondents were recruited for the baseline part of the project over a one month period, from 20/03/09 until 20/04/09, using an intercept style survey approach. Potential respondents were approached as they left the main Hammersmith car park (Kings Mall) by one of a team of 6-8 surveyors. They were asked if they had driven into Hammersmith that day, and if yes provided with a brief introduction to the study and asked if they could either; spare 10 minutes to fill out a questionnaire there and then; take a questionnaire and return it later (to surveyors at car park); or take a questionnaire away and return via a pre-paid postal envelope. The questionnaire included amongst other items, the MaxSEM stage diagnosis questions, reasons for car use, potential for mode shift and frequency of car trips into Hammersmith.

Returned questionnaires were grouped according to stage position (Pre-contemplator or Contemplator) and the one mode they had indicated would be the ‘best’ option for them to switch some or all of their future car trips into Hammersmith. Respondents were then randomly allocated (on a semi-stratified basis according to total sub-group size, i.e. contemplators who indicated car sharing would be their best option, etc.) into MaxSEM, standard, or to control Groups - see Table 2 below.

⁵ Note: This was not a ‘true’ personalised travel planning type intervention, and more a hybrid type, as contact with respondents was primarily postal-based.

Table 2: Overview of study design

Recruitment	Respondents recruited at Hammersmith's Kings Mall car park and completion of baseline questionnaires		
Group allocation	Respondents randomly allocated into one of 3 main groups (MaxSEM, Standard or Control Group), according to their baseline stage position		
Group details	MaxSEM Group: sub-divided by pre-contemplators and contemplators.	Standard Group: sub-divided by pre-contemplators and contemplators.	Control group: Half pre-contemplators and half contemplators.
Intervention booklet type	Receiving theory based construct specific message based on best mode ⁶		All receiving non-theoretical, mode and stage specific booklets
	Targeting pre-contemplative constructs	Targeting contemplative constructs	
Final measurement	All respondents sent final measurement questionnaire 10 days after receipt of information booklets sent to MaxSEM and Standard group respondents.		

Intervention materials

The intervention materials used in the study comprised of printed information booklets, supplemented by maps and information guides where appropriate. In total 11⁷ booklet versions were created, 5 for pre-contemplators and 5 for contemplators, subdivided by the one mode respondents indicated would be the 'best option' for them to switch their car trips to, and a non-theory, non-mode version was created (for the Standard group). Information booklets were posted to MaxSEM and standard group respondents at the end of the baseline data collection period. Pre-contemplative booklets were specifically designed to target the 8 MaxSEM Pre-contemplative associated constructs, and Contemplative booklets were specifically designed to target the 3 MaxSEM contemplative associated constructs - See Figure 1 earlier. Non-theory booklets contained publically available information (similar to pre-contemplative and contemplative information although not enhanced with any theoretical (emotional or rational) messages or photographs) about current Transport for London travel awareness campaigns and information resources covering the Hammersmith area.

⁶ The study also examined the whether emotional vs. rational based theoretical messages were more effective, although not discussed here (see Carreno *et al.*, 2010), and for the purposes of this paper the MaxSEM emotional and rational groups were combined and treated as one (MaxSEM) group.

⁷ In the main study, 21 booklet versions were used, i.e. 5 emotional and 5 rational pre-contemplative and contemplative types.

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Need some help finding people to carshare with?




Londonliftshare is a London wide carsharing scheme that allows you to match your journeys with others travelling to the same places. It allows you to benefit from the convenience of the car, whilst cutting congestion and pollution and reducing costs.

Joining is easy. Just visit the website at: <https://london.liftshare.com/> and in three simple steps:

1. Register yourself;
2. Register your journeys; and
3. Search for suitable sharers.

Think of the benefits

You can still enjoy the convenience of the car but can save money when making the same trips.

It's cheaper

- You can keep the convenience of the car but reduce the costs;
- Share your car journey with someone else and half your costs: it's as simple as that;
- Sharing a daily commute saves many car sharing members over £1,000 a year.

It's greener

- Reduces the number of cars on the roads, resulting in less congestion, less pollution and fewer parking problems.

It's quicker

- Less cars on the road = less congestion and shorter journeys due to fewer cars being on the road;
- Increased chance of finding a parking space, because fewer cars means less competition for spaces.

The more people who care share the better it is for everyone

Figure 2. Excerpt of information booklet designed to target contemplative construct's perceived behavioural control and attitudes towards behavioural alternatives, targeting potential car sharers.

Have you thought about not driving for some of your trips?

Have you visited Transport for London's Journey Planning website? journeyplanner.tfl.gov.uk

Simply put in your starting point and destination (place, postcode) and find out how easy it can be to travel by bus, tube, walking or cycling.

Or phone: **020 7222 1234** (24 hours) for general travel advice.

It's a lot easier than you think...



If your journey to Hammersmith is less than 5 km, why not cycle rather than take the car?

For more information visit the Transport for London website: <http://www.tfl.gov.uk/roadusers/cycling/11598.aspx> to see how easy it could be

And see how less stressful it can be by not using your car



Figure 3. Excerpt from information booklet designed to target pre-contemplative construct perceived goal feasibility, targeting potential cyclists.

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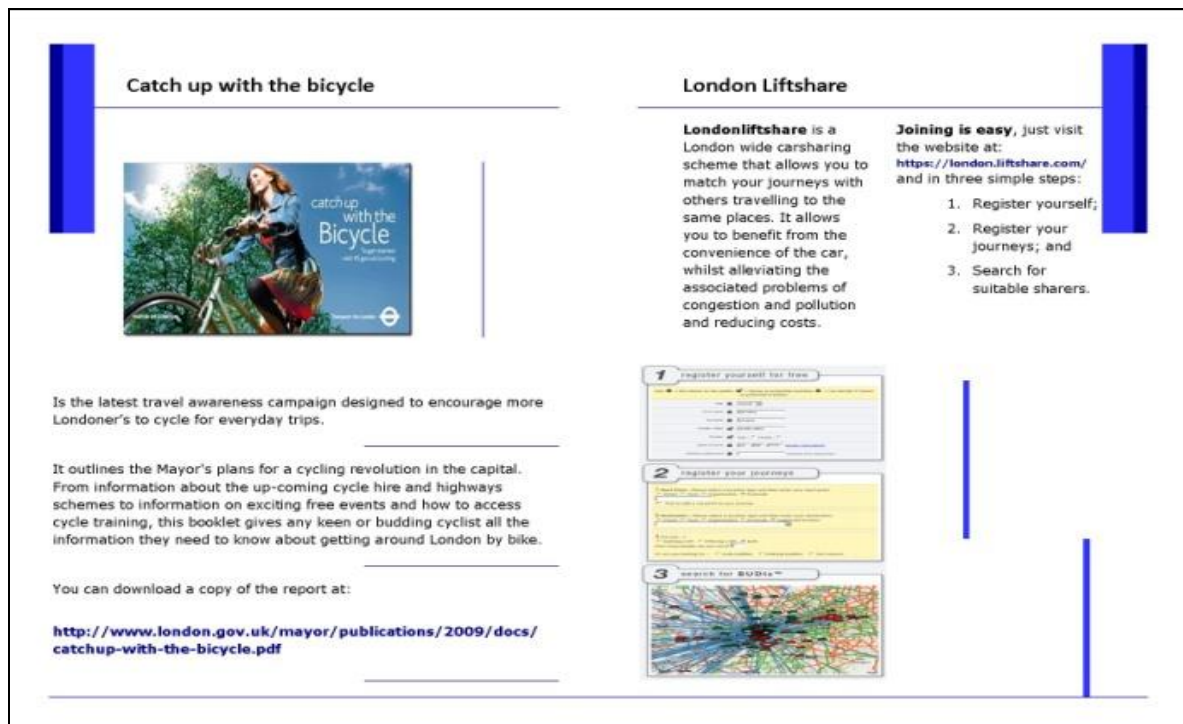


Figure 4: Excerpt from Non theory booklet pages designed for cyclists and car sharers: without theoretical enhancements.

Response rates

14 days after the information booklets were sent to both MaxSEM and standard group respondents, all respondents (including control group) were sent a second measurement questionnaire, identical to the baseline questionnaire, with additional questions for MaxSEM and standard group respondents asking them to evaluate the information booklets. All respondents were offered a £10 gift voucher if they completed and returned the questionnaires. From the initial baseline sample of 490, 148 usable after measurement returns were received. The average response rate was 30%, although varied between the respective experimental groups from between 17 to 40% (see Table 3).

Table 3: Summary of before and after sample response rates by group

Before stage	Pre-contemplator					Contemplator					Total
	211					279					
Preferred mode	CS	B	T	W	C	CS	B	T	W	C	490
		36	80	56	25	14	49	89	76	34	
Randomly allocated to groups below (stratified by stage and preferred mode sub-group size)											
	MaxSEM	Standard	Control	MaxSEM	Standard	Control					
Interventions sent	109	52	50	144	75	50	490				
Returns	44	19	10	45	13	17	148				
Response rate (%)	40	37	20	31	17	34	30				

CS = Car share; B = bus; T = Tube; W = Walk; C = Cycle.

Overt behavioural change (car trips into Hammersmith)

For the MaxSEM group, in total 15 people (representing approximately 17%) reported reductions in their use of cars for trips into Hammersmith, although 5 people reported an increase in car use. For the Standard group, in total 3 people (representing approximately 9%) reported reductions, although 2 people reported an increase, and for the Control group, in 1 person (representing approximately 4%) reported a reduction, although 1 person also reported an increase in car use.

Table 4: Before and after self-reported car driving trip frequency for trips to Hammersmith

Group	Before	After			Total
		Some	Often	V. Often	
MaxSEM	Often	3	44	5	52
	V. Often	2	10	25	37
	Total	5	54	30	89
Standard	Oft	1	23	2	24
	V. Oft	1	1	4	8
	Total	2	24	6	32
Control	Oft	1	16	1	18
	V. Oft	0	0	9	9
	Total	1	16	10	27

Green shading = reduction; red shading = increase

Stage movement

Of key importance to the study's aims, was to examine the effects of the intervention in terms of individual stage-movement, i.e. would the MaxSEM/theory-based information booklets be more likely (if at all) to progress individuals to later stage of change within MaxSEM, compared to both those in receipt of the standard non-theoretical booklets and control group respondents.

As can be seen in Table 5, in total, 34 respondents were observed to move to higher stages and one person from the control group regressed from contemplation to pre-contemplation. 26 of the 34 upwards 'movers' were MaxSEM group respondents (76 % of movers). In comparison, 5 respondents from the standard group reported stage progression (16 % of group) and 3 of the control group respondents (11 % of group).

Of those 26 that moved stage-position upwards within the MaxSEM group, 6 were pre-contemplators, 4 moving to the Contemplation stage, and 2 to the Preparation / action stage. The remaining 20 'movers' were contemplators, 18 moving to the Preparation / action stage and 2 to the Maintenance stage. Out of the standard group one mover was a pre-contemplator who reported a jump to the maintenance stage and the remaining 4 contemplators were moving to the Preparation / action stage. In the control group, one mover was a pre-contemplator moving to the Preparation / action stage and the remaining 2 were contemplators moving to the Preparation /action stage.

Table 5: Before and after MaxSEM stage position

Group	Before stage	After stage				Total	
		Pre	Con	Act	Main	N	% movers
MaxSEM Group	PC	38	4	2		44	14
	C		25	18	2	45	44
	Total	38	29	20	2	89	29
Standard Group	PC	18			1	19	5
	C		9	4		13	31
	Total	18	9	4	1	32	16
Control Group	PC	9		1		10	10
	C	1	14	2		17	12
	Total	10	14	3		27	11

PC = Pre-contemplation; Con = Contemplation; Act = Preparation / Action; Main = Maintenance Stage; **Green shading** = positive movement; **Red shading** = negative movement

Study discussion

Overall the evidence obtained from the analyses of behavioural change for trips into Hammersmith and stage movement offer comprehensive support for the use of theoretical-enhanced awareness materials, compared to non-theoretical materials.

In terms of actual behavioural change the MaxSEM theoretical materials realized an approximate 16% self reported reduction in car use for trips into Hammersmith. This is in comparison to and 9% and 4% reported for car trips into Hammersmith for the Standard and Control group respondents, respectively. Although, some caution must be made due to small group sample sizes, the figure obtained for the MaxSEM groups are similar to the higher levels suggested by Cairns *et al.* (2004) for 'personalized travel planning' initiatives. The figures obtained for the Standard and Control Group are more akin to Cairns *et al.*'s lower estimates, although, slightly higher than those suggested by Möser and Bamberg (2008). However, some respondents in all groups reported increases in car use for Hammersmith trips, which are 'unlikely' to be as a result of the intervention materials (as also observed for control group respondents), but perhaps reflective of 'natural' fluctuations in individuals car use, perhaps due to seasonal (weather conditions) fluctuations, or perhaps changes in individual's personal circumstances (e.g. requirements for car at the time of the after survey). These increases in car use should be considered in evaluating the positive reductions in overall car use found.

In addition to the overt behavioural changes observed above, considerable positive MaxSEM stage movement was observed following the intervention materials. This was more so for the MaxSEM group whereby on average approximately 29% of respondents were observed to move stage, compared to the standard and control groups, where 16% and 11% respective stage change was observed. The greatest amount of change was observed for contemplators (for all groups) who were already considering reducing their car use (by stage definition), and the bulk of movement was to the preparation/action stage, suggesting the main impact of the intervention was to give this group a 'push' towards actual behavioural change, but at the time of the after survey not to actually change behaviour *per se*. Whether those people now in the Preparation/Action stage will naturally progress into the final Maintenance stage (i.e. change behaviour), or whether a further 'push' measures (perhaps free test travel tickets or other incentives) would be required cannot be established, due primarily to the short timescale (i.e. lack of follow up say after 6 months) of this present study.

The results obtained have two main implications for future awareness type campaigns. Firstly, the addition of theory-based messaging (with reinforcing photographs) is clearly shown to be able to enhance the effectiveness of transport relevant information provision. Secondly, as noted above the inclusion of the MaxSEM stage diagnostic questions has allowed a more detailed examination of the effects of the intervention, both in relation to stage movement and construct strength. Quite simply, if these additional measures were not

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CONCLUSIONS

This paper set out to address three key questions relating to how and to what extent MM type interventions work and also how to best measure their effects.

Firstly, there is considerable evidence that MM interventions do work, although, as noted by Möser and Bamberg (2008) the precise effects in terms of behavioral change remains unclear. Further, current understanding of the behavioral change process recognizes that MM type interventions are likely to affect many individuals in more subtle ways (than behavioral change), although the precise impacts of different MM measures in effecting such changes is yet unclear. To enhance current knowledge in these areas, a toolkit of useful resources has been produced within the MAX project, and MaxSEM, it's stage diagnostic questions and the MaxSUMO evaluation resource will in time help address these issues. However, further refinements/practical guidance specifically in relation to aspects such as the use of appropriate sample sizes (e.g. Richardson, 2002) and supplementary objective measures (e.g. Stopher *et al.*, 2009) is still required.

Although, only a pilot, rather than full intervention study (and thus some caution must be held) the study has provided an insight into the potential of enhancing 'travel awareness' messages with theoretical content. This was clearly demonstrated in the considerable differences observed in self-reported car use behaviour and observed stage movement, between those receiving the theoretical-based awareness booklets compared to the non-theoretical booklets, and for both those receiving theory and non-theory booklets to the control group respondents.

REFERENCES

- Anable, J. (2005) Complacent car addicts or aspiring environmentalists? Identifying travel behaviour segments using attitude theory. *Transport Policy*, 12, 65-78.
- Anable, J., Lane, B. & Kelay, T. (2006) An evidence base review of public attitudes to climate change and transport. HMSO, London.
- Anderson. S & Stradling, S. G. (2004) Attitudes towards car use and modal shift in Scotland. Scottish Executive Social Research, Edinburgh.

Applying psychological principles to enhance the evaluation of Mobility Management interventions

CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla

- Bamberg, S. (2000) The promotion of new behaviour by forming an implementation intention: results of a field experiment in the domain of travel mode choice. *Journal of Applied Social Psychology*, 30 (9), 1903-1922.
- Bamberg, S., Ajzen, I. & Schmidt, P. (2003) Choice of travel mode in the Theory of Planned Behaviour: the roles of past behaviour, habit and reasoned action. *Basic and Applied Social Psychology*, 25 (3), 175-187.
- Bamberg, S. (2007) Is a stage model a useful approach to explain car drivers' willingness to use public transportation? *Journal of Applied Social Psychology*, 37 (8), 1757-1783.
- Beale, J. R., & Bonsall, P.W. (2006) Marketing the bus industry: A psychological interpretation of some attitudinal and behavioural outcomes. *Transportation Research Part F: Traffic Psychology & Behaviour*, 10 (4), 271-287.
- Bonsall, P. (2009) Do we know whether personal travel planning really works? *Transport Policy*, 16 (6), 306-314.
- Brög, W., Erhard, E., Ker, I., Ryle, J., & Wall, R. (2009) Evaluation of voluntary travel behaviour change: Experiences from three continents. *Transport Policy*, 16 (6), 281-292.
- Cairns, S., Davies, A., Newson, C., & Swiderska, C (2002) Making travel plans work. Research Report (former) Department for transport, Local Government and the Regions (DTLR), London.
- Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbridge, A., & Goodwin, P. (2004) Smarter choices-changing the way we travel. Final report of the research project: The influence of soft factor interventions on travel demand. Research Report, Department of Transport, London. <http://www.dft.gov.uk/pgr/sustainable/smarterchoices/ctwwt/> . Retrieved 01/09/09.
- Carreno, M. & Welsch, J. (2009) MaxSem: Max Self Regulation Model: Applying theory to the design and evaluation of Mobility Management projects. Report prepared for the MAX-SUCCESS project. Available at <http://www.epomm.org/index.phtml?ID1=2360&id=2360>. Retrieved 01/01/10.
- Carreno, M., Rye, T., & Volk, B. (2010) Hammersmith Intervention Study: Main Report. Available at <http://www.tri-napier.org/members/tri-napier-members/profile-of-michael-carreno/page2.html>. Retrieved 01/01/10.

Applying psychological principles to enhance the evaluation of Mobility Management interventions

- CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla
Curtis, C. & Headicar, P. (1997) Targetting travel awareness campaigns: which individuals are more likely to switch from car to other transport for the journey to work? *Transport Policy*, 4 (1), 57-65.
- Darnton, A. (2008) *Practical Guide: An overview of behavioural change models and their uses*. London, HMT Publishing Unit-
http://www.gsr.gov.uk/downloads/resources/behaviour_change_review/practical_guide.pdf-
(Accessed 01/09/09)
- DfT (2009) *Low Carbon Transport: a Greener Future*. Department for Transport, London, UK. Currently (Oct 2009) available at
<http://www.dft.gov.uk/pgr/sustainable/carbonreduction/low-carbon.pdf>
- Fujii, S. & Taniguchi, A. (2005) Reducing family car-use by providing travel advice or requesting behavioural plans: An experimental analysis of travel feedback programs. *Transportation Research Part D*, 10, 385-393.
- Fujii, S. (2007) Communication with non-drivers for promoting long-term pro-environmental travel behaviour. *Transportation Research Part D*, 12, 99-102.
- Gatersleben, B. & Appleton, K. (2007) Contemplating cycling to work; attitudes and perceptions in different stages of change. *Transportation Research Part A: Policy and Practice*, 41, 302-312.
- GORS (2005) *Travelling to school initiative*. Annexes to the report on the finding of the initial evaluation. Operational Research Unit for Sustainable Travel Initiatives Branch (GORS).
- Goulias, K. (2001) *Audit of South Perth individualised marketing evaluation survey: Final Report*. Department of Transport, Perth, Western Australia. Available online at
http://www.dpi.wa.gov.au/mediafiles/ts_southperthaudit.pdf. Retrieved 01/01/10.
- Heath, Y., and Gifford, R. (2002). Extending the theory of planned behaviour: predicting the use of public transportation. *Journal of Applied Psychology*, 32 (10), 2154-2189.
- Hunecke, M., Blobaum, A., Matthies, E. & Hoyer, R. (2001) Responsibility and environment: ecological norm orientation and external factors in the domain of travel mode choice behaviour. *Environment and Behaviour*, 33, 830-852.
- Hyllenius, P., Smidfelt Rosqvist, L., Haustein, S., Welsch, J., Carreno, M. & Rye, T. (2009) *MaxSUMO: Guidance on how to plan, monitor and evaluate mobility projects*.

Applying psychological principles to enhance the evaluation of Mobility Management interventions

CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla

Available online at http://www.epomm.org/docs/MaxSumo_.pdf. Retrieved 01/01/10.

MAX-SUCCESS (2008 a & b) Work Package B State-of-the-Art-Report's. Available at http://www.max-success.eu/downloads/MAX_SoA_AnnexB1_1.pdf- Retrieved 01/01/10.

MAX-SUCCESS (2009) Work Package B Final Report. Available at http://www.max-success.eu/downloads/MAX_WPB_FinalReport.pdf. Retrieved 01/03/10.

Morton, A. & Mees, P. (2005) Too good to be true? An assessment of the Melbourne travel behaviour modification project. In, Proceedings of the 28th Australasian Transport Research Forum, Paper 108, Sydney, Australia, September, 2005. Available at [http://www.patrec.org/web_docs/atrf/papers/2005/Morton%20&%20Mees%20\(2005\).pdf](http://www.patrec.org/web_docs/atrf/papers/2005/Morton%20&%20Mees%20(2005).pdf). Retrieved 01/01/10.

Möser, G. & Bamberg, S. (2008) The effectiveness of soft transport policy measures: a critical assessment and meta-analysis of empirical evidence. *Journal of Environmental Psychology*, 28, 10-26.

Oja, P., Vuori, I., & Paronn, O. (1998) Daily walking and cycling to work: their utility as health-enhancing physical activity. *Patient Education and Counselling*, 33, 87-94.

Parker, J., Harris, L., Chatterjee, K., Cleary, J. & Goodwin, P. (2007) Making personal travel planning work: research report. Integrated Transport Planning Ltd. Report to Department for Transport. Available at <http://www.dft.gov.uk/pgr/sustainable/travelplans/ptp/makingptpworkresearch.pdf>. Retrieved 01/01/10.

Prochaska J. O. & DiClemente C. C. (1984). *The transtheoretical approach: crossing traditional boundaries of therapy*. Homewood, Ill:Dow-Jones-Irwin.

Richardson, A. J. (2002) Sample size design options for before & after surveys of transport programs. Report to Victoria Department of Infrastructure, TUTI Report 13, 2002. The Urban Transport Institute, Victoria.

Rye, T. (2002) Travel plans: do they work? *Transport Policy*, 9 (4), 287-298.

Seethaler, R. & Rose, G. (2009) Using odometer readings to assess VKT changes associates with a voluntary travel behaviour change programme. *Transport Policy*, 16 (6), 325-334.

Applying psychological principles to enhance the evaluation of Mobility Management interventions

CARRENO, Michael, BAMBERG, Sebastian, WELSCH, Janina, RYE, Tom & HYLLENIUS, Pernilla Steer Davies Gleave (2003) Evaluation of first yellow bus. Report for the Department for Transport, London.

Stopher, P. & Bullock, P. (2003) Travel behaviour modification: a critical appraisal. In Proceedings of the 26th Australasian Transport Research Forum, Wellington, New Zealand, 1st-3rd October, 2003.

Stopher, P. & Greaves, S. (2004) Sample size requirements for measuring a change in behaviour. In Proceedings of the 27th Australasian Transport Research Forum, Adelaide, Australia, 29th September – 1st October 2004, Paper 13. Available at [http://www.patrec.org/web_docs/atrf/papers/2004/Stopher%20&%20Greaves%20\(2004\).pdf](http://www.patrec.org/web_docs/atrf/papers/2004/Stopher%20&%20Greaves%20(2004).pdf). Retrieved 01/01/10.

Stopher, P., Xu, M. & FitzGerald, C. (2007) Assessing the accuracy of the Sydney household travel survey with GPS. *Transportation*, 34 (6), 723-741.

Stopher, P., Clifford, E., Swann, N. & Zhang, Y. (2009) Evaluating voluntary travel behavioural change: suggested guidelines and case studies. *Transport Policy*, 16 (6), 315-324.

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