GREENING COMMUTER MODE CHOICE THROUGH WORKPLACE INTERVENTION: COMPARATIVE EFFECTIVENESS OF THREE BEHAVIOUR CHANGE STRATEGIES AND IMPLICATIONS FOR REDUCING CAR DEPENDENCY IN PERTH, WESTERN AUSTRALIA

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ABSTRACT

The TravelSmart Workplace program aims to 'green' commuter mode choice through workplace intervention. Increasing the use of alternatives to the single occupant vehicle by commuters will reduce vehicle emissions and traffic congestion in Perth, the capital city of Western Australia. In this study three intervention types were implemented in a workplace situation which varied in the level of employee involvement, environmental leadership, and method of information distribution. A mixed methodology is employed to examine the relative effectiveness of the three education strategies in light of qualitative and quantitative data. Changes in knowledge, attitude, efficacy and behaviour were noted in all programs, but the data indicates the third intervention, the most involving, achieved the best outcome. These findings have implications for the way in which achieving sustainable transport in metropolitan areas is approached.

INTRODUCTION

Air Quality and Commuter Behaviour in Perth

In recent times air pollution in Perth and one of its main causes, traffic congestion and motor vehicle dependency, have become the focus of much attention by the Western Australian Government (Transport, 1995). The State Governments response to the Select Committee on Perth's Air Quality (1998) recognised the need for co-ordinated action across a number of government agencies and the community to avoid significant decline in air quality (Government, 1998).

Despite a relatively small population, air pollution is becoming a serious issue in Perth (Department of Environmental Protection, 2000). In summer the city suffers high levels of photochemical smog, and in winter high levels of haze are common. Photochemical smog is considered one of the most significant problems facing many cities around the world. It is characterised by high concentrations of ground level ozone. Ozone is formed when oxides of nitrogen (NOx) and reactive organic compounds (ROCs) react together under the influence of sunlight (Department of Environmental Protection, 1997).

Motor vehicle emissions are the source of up to 50% of these photochemical smog forming reactants in Perth.

Although a relatively small city by international standards with an estimated daytime population of 100 000 (City of Perth, 2001), Perth is heavily car dependent. Department of Transport (1995) figures indicate that on average, trips in private or company cars represent 75% of all commute trips made in Perth. Interestingly it is the shorter trips (=30 minutes) which show the highest proportion of car use, as shown in table 1 below (Australian Bureau of Statistics, 1995). While non-commute trips also impact on air quality and congestion the work trip is the longest journey made by individuals on a regular basis and occurs predominantly in the peak period, thus creating the greatest pressure on the urban environment (Transport, 1995).

Table 1: Average journey time to work

Duration of work trip	Proportion of commuters	
	Public Transport	Car
To 19 minutes	6.0%	50.6%
20 to 29 minutes	11.0%	24.0%
30 to 59 minutes	68.0%	24.1%
60 minutes and more	15.0%	1.3%

Source: Australian Bureau of Statistics, Travel to work and school, greater Perth region, October 1994.

The Perth Photochemical Smog study (Department of Environmental Protection, 1996) highlighted the need to address these trends in order to achieve a realistic management plan for Perth's air quality.

Behaviour Change Approaches
With the increasing economic, social and environmental costs associated with car dependency there is an emerging focus on changing the behaviour of motorists. Many studies reported have tried different ways of changing peoples knowledge, attitude, and behaviour (Baudains, 2002). These have ranged from didactic style methods that involve simply telling people, to reward based methods where the required behaviour can be rewarded either by tangible incentives or social praise. In more recent times social change theories have been developed which focus on levels of efficacy and self regulation as important factors in determining a transition between positive attitudes and actions (Baudains, et al., 2001).

A variety of programs have been developed and implemented across the globe which aim to decrease the use of single occupant vehicles (SOV) in favour of alternatives through raising awareness amongst the community about environmental problems associated with car use (Victoria Transport Policy Institute, 2002). A comparison of the strategies used and the indicators of effectiveness for a range of these programs is useful in clarifying the currently disparate work in the field. Collection of literature evaluating a range of these programs revealed that the average program, generally run by government organizations, extended over three years or less (Baudains, 2002). Programs evaluations have reported success in achieving set goals of

reducing car trips and/or increasing use of walking, cycling, carpooling and public transport. In Western Australia, research comparing levels of empowerment in similar situations has shown empowerment to be a significant factor in bringing about change. By contrast, other international programs have found incentive based and information based programs have also met with success (Jacobs, et al., 1982;Studenmund and Connor, 1982). The variety of strategies employed by transport behaviour change programs can be examined in light of educational theory.

Learning Theory and Behaviour Change Strategies.
A common assumption in adult education is that increasing awareness or knowledge of an issue will automatically increase the occurrence of a desired behaviour. As a result it is often assumed that achieving behaviour change in the general population is as simple as distribution of information (Iozzo, 1989). As a result distribution of information about an issue through brochure or television advertising is a commonly employed strategy for environmental education (McKenzie-Mohr, et al., 1999). These popular forms of education have been used despite a lack of evidence that this medium is effective in achieving an overt learning outcomes such as behaviour change. Recent evaluations in cases such as the '10 Tips to minimise waste' campaign, and the clean air campaign conducted by the Western Australian State government in 2000 have been shown this assumption to be flawed (Baudains, 2001;White, 1999).

Education theorists are well aware of the limited success of information based education, and the literature demonstrates this thoroughly. Education principles for student centred learning practices suggest that information alone does not result in a positive learning outcome (Boulton-Lewis, et al., 1996). Usually what is recommended is some direction or facilitation by another individual acting as teacher or educator. The more the learning strategies are focussed on involving and empowering the learner the more effective they are expected to be (Merriam and Caffarella, 1991). In the case of environmental outcomes it has been suggested that effectiveness of achieving outcomes can be improved by modelling the behaviour through a facilitator or mentor. This has been shown to be effective in some cases (McKenzie-Mohr, et al., 1999).

There has long been a recognised inconsistency between behavioural intention and actual behaviour. Individuals with high positive environmental attitudes who indicate they intend to participate or complete a particular activity, often report a lower level of actual behaviour (Andrich and Styles, 1998;Styles, 1993). While links do exist between levels of attitude, knowledge and behaviour, an increase in one does not necessarily result in an increase in another (Styles, 1993). One explanation of this phenomenon is the higher level of difficulty associated with action as opposed to professed attitude (Andrich and Styles, 1998;Styles, 1993). No matter how positive an individual is about particular behaviours, if there are significant external and or internal barriers to completing the behaviour, its incidence will be lower than the individual may expected.

Learning (behaviour change) is known to be more effective if the learner is self regulated, that is, aware and in control of their own learning (Boulton-Lewis, et al., 1996). Self regulated learning has been described as "the way learners select and articulate their goals for learning and understand and manage the learning process in order to achieve these, and includes motivational, attitudinal, strategic, and metacognitive components," (Radloff, 1997). A characteristic of adults who are self regulated learners is that they make a conscious effort to address the situation and attempt to reduce the influence of those barriers on their behaviour. They can be very determined to achieve their goals. They are able to assess circumstances, isolate the areas they can have some influence on, and remove themselves from the influence of some barriers. It has been observed that few adults are self regulated learners (Radloff, 1997). As a result, they need to be provided with opportunities to reflect on their beliefs, goals and knowledge in order to develop new understandings which may result in changed behaviour. This perspective on adult learning and behaviour can be utilised in a workplace situation where the aim is to educate for behaviour change.

This research aimed to determine if interventions which stimulate a deeper level of learning, and encourage self regulated learning and reflective practice will be more likely to achieve positive behaviour change. The focus was specifically on transport behaviour and air pollution. In addition, the study included a clarification of the relationships between the dependent variables of attitude, knowledge, self efficacy and behaviour through focus on participants as self regulated learners.

METHODOLOGY

This study attempted to move outside the traditional information based government education campaign in order to examine the role of education strategies which focus on adults as self regulated learners. A mixed methodology approach was adopted to improve the strength of the research (Bowen, 1996;Trochim, 1999;Yin, 1994). The study compared the effectiveness of three educational strategies employed in a workplace situation to achieve voluntary behaviour change in the case of Perth Central Business District (PCBD) commuter transport behaviour.

The underlying theory in the design of these education programs was that as the level of self regulation and self efficacy increased the participants would become more self motivated learners and any learning that occurred would be higher impact and longer lasting due to the intrinsic development of that learning. Table 2 below summarises this research design. The three program types had the same basic structure, which was built on in subsequent programs. The third intervention was timed differently in some workplaces due to decisions made by the workplace steering committee.

The sample population comprised of 4000 employees from 10 workplaces located in the Perth central business area. Participation in the program was voluntary and initiated in all cases by the workplace accepting an invitation to participate in the program.

Table 2: Research Design

	Intervention Group	Treatment Given	Treatment Characteristics
Least Complex Surface Learning Top down motivation	1) Information	Poster Display Brochures Newsletters Lunchtime Speakers	Impersonal No Ownership
	2) Environmental Leadership	Group 1 plus Environmental Leader in the workplace	Personal No Ownership
Most Complex Deep learning Bottom up motivation	3) Involvement (Green Transport Plan)	Group 2 plus Workplace steering committee engaged in problem solving	Personal Ownership
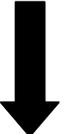
The methodology for evaluation of program effectiveness focussed not only on measurement of trip reduction, but the more 'holistic' impact on the participants. Participants knowledge of car use and air pollution issues, attitudes, efficacy, and behaviour were measured quantitatively using a benchmark survey distributed prior to the intervention beginning, and a follow up survey distributed at the conclusion of the nine month program. In addition to these quantitative measures, workplace policy change, implementation of transport initiatives, and participants sense of success were used as qualitative indicators of program effectiveness.

RESULTS & DISCUSSION

Overall an interesting pattern emerged when the significant differences observed across all the intervention types and all variables are compared. Table 3 below shows the p value for the paired sample t-test of each of the matched variables, and the average percentage SOV trip reduction for each of the intervention types.

Table 3: Significant increases in knowledge, attitude and behaviour, and average percentage trip reduction across three interventions.

Program :	Type A	Type B	Type C
Knowledge	.024	.000	.001
Attitude (Air quality & car use)	-	-	.007
Attitude 2 (general environment)	-	-	-
Efficacy	-	-	.068
mean SOV % change	-2.12	-6.39	-3.25

The type A and B programs achieved a significant change in knowledge, while the type C program achieved significant change in 3 variables, knowledge, attitude to air quality and car use, and efficacy. This suggests that the type C

program had the most significant impact on the participants. It is notable that general environmental attitudes were not influenced, supporting the idea that the level of involvement in the type C program resulted in an increase in the target attitudes. If this increase was due to another environmental issue or general community awareness it would be expected that both attitude types would be influenced.

The overall average level of trip reduction was not statistically significant, however, all 10 participating workplaces achieved a reduction in SOV use while two workplaces reached the target of 10% reduction in SOV trips. Table 4 below shows the trip behaviour change in six of the participant workplaces, one engineering (e) and one government (g) in each intervention. The trip reduction in engineering workplaces increases with each intervention, while the government workplace in the type C intervention does not continue the upward trend in trip reduction.

Table 4: Trip reduction in 6 Perth workplaces

	Type A		Type B		Type C	
	W1 (e)	W7 (g)	W3 (e)	W2 (g)	W9 (e)	W11 (g)
SOV% T1	46.2	38.3	12.1	33.1	29.26	44.3
SOV% T2	46.9	33.3	9.7	22.6	22.4	43
% Change	0.7	-4.9	-2.3	-10.5	-6.9	-1.3
Trips reduced/wk:	-27.3	123.3	69.2	418.2	209.1	80.48
Employees (n)	400	250	300	400	600	600

A more significant reduction in SOV trips was expected in the type C participants due to qualitative data suggesting a more radical change had taken place. It is important to note here that the type C program had not been completed at the time of the second survey due to the extra time needed for the planning process and the restriction of nine months in each workplace. It was thought that the approval of the green transport plans by management and the implementation of the strategies would have a continued influence on trip behaviour. A further longitudinal study would be required to confirm this.

One workplace (W9), as a result of implementing their green transport plan, provided the results of further journey to work surveys conducted as part of the ongoing self-evaluation process. This data, when added to the two surveys already conducted for this research, show a definite trend towards continued trip reduction as shown in figure 1 below. The intervention in W9 concluded in September 2000 with a trip reduction of 6.9%, but a year later a survey conducted by the workplace revealed a further 2.9% reduction in SOV trips. The small increase in trips over December is likely to be due to the extreme heat of Perth summer and the arrival of the Christmas season involving an increase in social engagements and shopping. This data supports the idea that the type C intervention involving the green transport planning process is able not only to sustain any trip reduction achieved, but continue to decrease the use of the SOV. While quantitative data of this nature was not available for type A and B workplaces, post intervention

interviews suggested the interventions had little or no long term impact on the workplace as a whole, and in places had been completely forgotten.
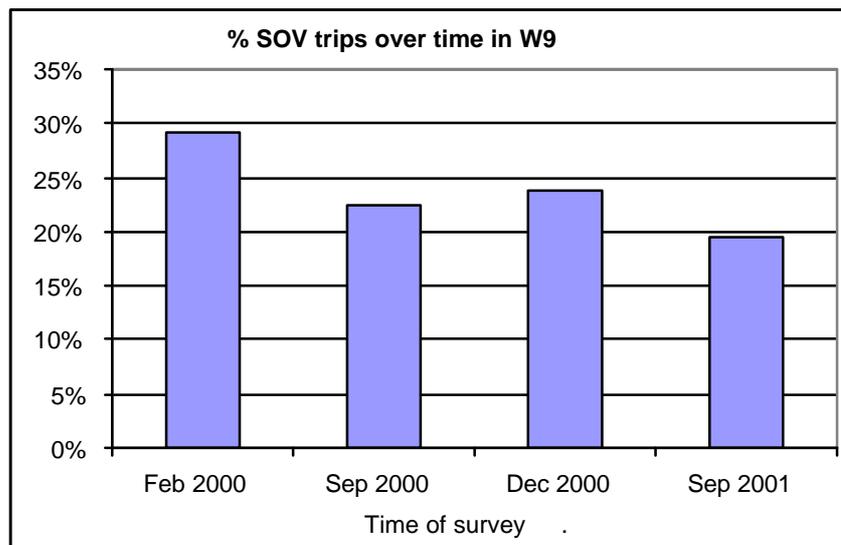

Figure 1: % SOV trips over time in W9.

When the changes in transport behaviour were examined in terms of both negative and positive change some interesting observations were made. Figure 2 below shows the proportions of each sample group which changed their behaviour by either reducing SOV trips (change +), increasing SOV trips (change -), or did not change their behaviour at all (no change). The 'no change' sample may have changed their behaviour from one green transport to another, but their overall number of 'green' trips remained the same from the first survey to the second. As can be seen from the figure up to 22% of participants in each sample group changed their behaviour positively, but there was a similar proportion of participants who reverted to SOV use.

It is possible to surmise that the percentage of participants who changed positively over the program were influenced by the program as the qualitative data supports this idea. The negative change group is thought to represent the proportion of the population that has either been restricted to the use of alternatives to the SOV or chosen to use alternatives previously and due to:
• a change of circumstances;
• negative experience of alternative transport;
• developing a sense their choice is not valued or not 'worth it' ; or
• dissatisfaction due to perceived or real lack of government support or infrastructure for alternative transports;
has returned to using the SOV. This would have been further complicated for the type C program as during the period of the study a particularly visible construction of a large freeway bridge across the river into the city was completed. These factors are only the major reasons for negative change, many more exist and further study of this group would aid in understanding the changed behaviour.
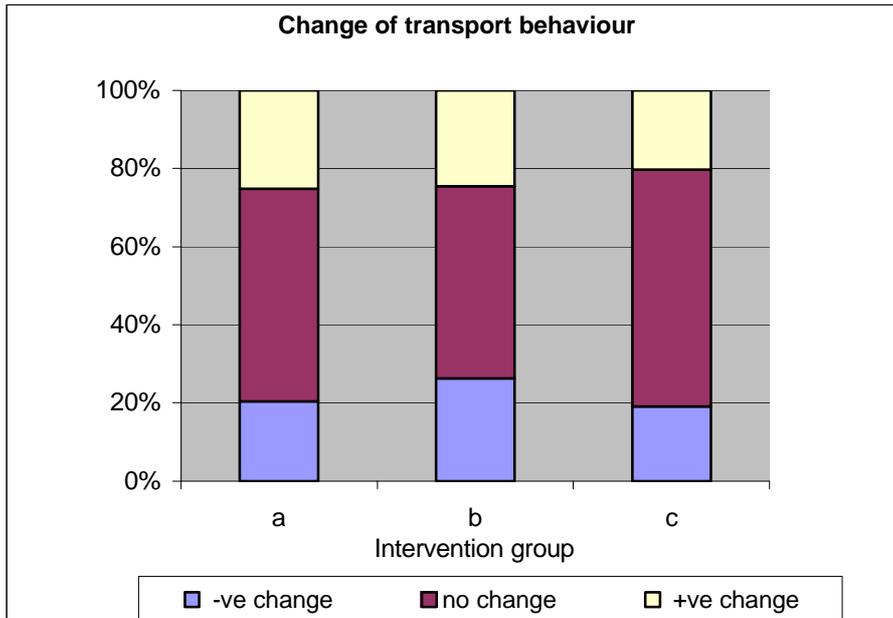
Figure 2: Change groups within intervention samples

Qualitative Effectiveness Indicators

Due to the mixed methodology research design a large quantity of qualitative data was collected in order to place quantitative results into context, and examine the breadth of perceptions regarding program efforts to reduce SOV use. The researcher and volunteers in each workplace recorded observations for the duration of the intervention, and post intervention interviews were conducted one year after completion of the intervention. From this data it is possible to identify a series of outcomes that are comparable across the three interventions. These outcomes, summarised in table 6 below, show a trend of minimal achievement in the type A program to more substantial long term outcomes in the type C program.

Table 5: Summary of observations in participating workplaces

Type A	Type B	Type C
• No policy changes	• TravelSmart concepts incorporated into HR or HSE policy.	• Changes made to HR & HSE policy and generally implemented.
• No employee involvement	• Generally dependent on one employee coordinating workplace aspect of program.	• Progress driven by 2 to 15 or more employees: Less chance of stalling.
• No additional support or resources applied to program	• Generally no additional support or resources applied to program.	• Additional resources and support provided through GTP committee.
• No additional encouragement	• No longer term support	• Long term support provided through approval of GTP by management
• No effort to maintain program post intervention	• No continuation of program post intervention	• Continuation of program through implementation of green transport plan.

These observations, in conjunction with the trends visible in the quantitative data, suggest the educational theories may have a valid application in adult environmental education for transport behaviour change.

More generally, a number of factors were observed to contribute to successful trip reduction in participant workplaces. These were particularly obvious in the Type C workplaces, but had similar effects in both type A and B workplaces.

Workplace culture was observed by the volunteers and researcher as a significant impact on success across all intervention types. Workplaces with a strong Health, Safety and Environment (HSE) department, policy or programme appeared to be the best targets as they already have a workplace culture which valued these areas in addition to the usual focus on economic based productivity. As one intervention C interviewee noted:
"There is a management lean towards cost effectiveness, but empowering your employees does not cost you any money. It makes sense. My experience is that it is very easy." (HWW9)

Management involvement was important to the level of success and the motivation of the employees, but it was the employees (more than one or two...) themselves who had to be involved, committed and empowered to drive the process within their workplace. This was initially a struggle as all those involved were uncertain of what would be required, or the relevance of their skills and understandings, but that was part of the process. As one interviewed participant reported so aptly:
"I guess in terms of the process, it was really largely us who set in the end how we developed them, which was probably the best way to do it but it meant that it went a bit slower. We had to come to the realisation that we had to pull it together, it was not quite so obvious that that was what was going to have to happen, so people were stumbling in the dark a little bit I guess...... it probably could come quicker, but whether it would be as effective I don't know.... " (CGW9)

The success in establishing a green transport planning committee in the participating workplaces which had either the full support of, or representation from senior management was a strong factor in success. The workplaces which formed a cohesive team to set and work towards achieving goals tended to achieve more and maintain their own momentum in the process. The workplace which most successfully achieved this is still maintaining the committee to implement and improve on the green transport plan (GTP). There is strong commitment from management now, and the GTP has been integrated into the business plan. In workplaces where an effective committee was not formed within the first few months the planning process was a far greater struggle and more dependent on the facilitators. Some of these workplaces have still managed to have their plan approved and are working towards implementing it, but progress is taking much longer which may be reflected in the trip reduction figures for intervention C.

Participants in all interventions felt that the support from an external body was essential in order to achieve change in transport behaviour. A number of

reasons were given including motivation to act (deadlines and competitions), someone empathetic to talk to about difficulties, and access to resources.

"I think the external support, like the resources from DEP, and people that know about green transport modes and can identify with the barriers that are there because of their knowledge of what the transport industry has.....

And in terms of access to information.... Like knowledge of where to get information from, who is out there whatever, it would have taken a lot more energy from someone within our workplace without the knowledge to go and chase up someone...its very time consuming if you don't know who exactly to chase up for particular information" (CGW9:)

IMPLICATIONS

The perception of effectiveness of these three strategies is dependent on the chosen measure for success. If value is placed on quantitative evaluation and measurement of short term trip reduction the second program would be considered more effective. If however, value is placed on the longer term influence of human learning for behaviour change then a need exists to recognise the importance of workplaces achieving the qualitatively measured goals of a green transport plan. The outcomes are longer lasting and continuous in effect even after intervention withdrawal from the workplace.

This suggests that in order to achieve a long term change in human behaviour for sustainable transport, a long term strategy must be employed. The benefits of continued reinforcement of the value placed on choosing sustainable transports, increasing levels of empowerment to act on sustainable transport issues, and moving the importance of transport choice to a higher priority for individuals, are not to be seen overnight. Despite the lack of 'instant' results, it will become increasingly important for transport planners to have the support of the people they are trying to move around. While this would require a long term commitment to such efforts, the positive aspect is that once the initial work is done, only minimal energy is required to maintain the change. In contrast, the short term change achieved by the Type B program would have a short term impact, which suggests that to maintain the level of trip reduction, the whole program would need to be repeated, a far higher cost than minimal maintenance & support.

The implications of this include: A need for policy and decision makers to clarify their preferred outcomes when considering their approach to the issue of sustainable transport. This includes: a need for consideration of the longevity of process required when setting goals; an awareness of the difference between long term impacts and short term impacts; a consideration of holistic approaches to achieving change as opposed to a single approach focused on a single outcome.

CONCLUSION

Significant increases in knowledge were noted in all three workplace interventions. The leadership program (intervention B) achieved the highest average trip reduction over the nine month period, and intervention C involving the green transport planning process achieved the greatest impact on participants with significant increase in attitude and efficacy in addition to knowledge.

Long term outcomes were also achieved through the more involving intervention C which results in the development and implementation of a green transport plan for participating workplaces. With further development and refining of techniques the program also has potential to increase the level of trip reduction, therefore increasing the already significant ratio of benefits to costs. In addition the positive and ongoing nature of the green transport plans already being implemented in some Perth workplaces provides an encouraging outlook for further efforts in this area.

Overall, the leadership program achieved the greatest trip reduction, but the empowerment program achieved the best long term outcomes and had the greatest impact on participants. These findings have implications for the way in which sustainable transport in metropolitan areas is approached if truly long term outcomes are to be achieved.

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