THE EFFECTIVENESS OF INITIATIVES TO REDUCE CHILDREN'S CAR USE

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1. INTRODUCTION

There is increasing recognition of the needs of children in the transport field and a desire to involve them in decision-making processes (Department for Transport, 2003). This recognition is timely because car use by children is increasing, and is likely to increase further (Mackett et al, 2002, Mackett, 2002). There have been a number of interventions to reduce children's car use to school (see, for example, Department for Transport, 2000, 2001). However, there have not been many systematic evaluations of the initiatives. This is largely because they are 'soft' initiatives that do not fit into the conventional framework used for the evaluation of large transport schemes, they are often very cheap and have wide, diffuse impacts that may be difficult to quantify. However, there is growing awareness that such initiatives may be cost-effective in reducing car use: this can only be established if they are evaluated systematically, and so there is scope for developing a frameworks within which this can be done.

Whilst there are reasons for reducing car use by children which apply to trips by any users (reducing environmental pollution, reducing congestion, and so on), there are other reasons for encouraging children to walk and cycle, mainly to do with their health. Increased physical activity by children can bring various health benefits either in childhood or in later life, including reduced risk of heart disease, stroke, obesity and osteoporosis, and enhanced mental health and quality of life (Health Education Authority, 1997, Sustrans, undated).

The purpose of this paper is to explore these themes within the context of a research project entitled 'Reducing children's car use: the health and potential car dependency impacts' being carried out in the Centre for Transport Studies at University College London in collaboration with others including Hertfordshire County Council, with fieldwork being carried out in Hertfordshire, an area immediately north of London. The project has been described in more detail elsewhere (Mackett et al, 2002, Mackett et al, 2003a). In the next section the key aspects of the methodology that underlie the findings in this paper will be outlined. Then the results will be presented.

2. METHODOLOGY

The project on children's car use has a number of sub-projects within it. Two of these are:

a) Development of a framework for the evaluation of travel-to-school initiatives, using walking buses as a case study;

b) Analysis of children's activity patterns using portable motion sensors.

One of the objectives of the project is to develop a framework for the systematic evaluation of interventions to improve children's welfare in the fields of travel and physical activity. To do this, a specific case has to be used so that the ideas can be tested in a practical context. The chosen case study is the 'walking bus'. A walking bus is a group of children who walk to school along a set route, collecting other children along the way at 'bus stops', escorted by several adult volunteers, one of whom is at the front (the 'driver') and one is at the back (the 'conductor'). All the children using the walking bus are registered with it and all the volunteers have undergone training and police checks (or Criminal Record Disclosures which replaced police checks in April 2002).

Five walking buses in Hertfordshire are being studied in depth over a year in order to collect data to incorporate into the evaluation framework (Mackett et al 2003b). Use of the evaluation framework involves the identification of all the parties that are active participants and then the collection of data from each of them about the their role and what they see as the outcomes, both positive and negative. The participants involved are the headteacher, the walking bus co-ordinator, the parents, the children and the volunteers (who are usually parents of children using the walking bus). Children who have ceased to use the walking bus (and their parents) are interviewed as well as those still using it. Information is also collected about the walking bus route and where the children live to see how far they walk. This can be compared with their previous journeys in terms of mode used and distance travelled. This is done in a table of the form shown in Table 1. From this summary information a judgement can be made about the success, or otherwise, of a walking bus.

To complement that work by providing evidence across a wider spectrum of situations, and to find out about schools which have not set up walking buses, a postal survey has been conducted. This has covered all the schools in Hertfordshire which have or could have set up a walking bus (Mackett et al, 2003c). Questionnaires were sent to the 41 schools that had asked Hertfordshire County Council (HCC) to check potential walking bus routes for suitability and safety, as at January 2002. The questionnaires sent to the headteachers were in two parts: Part A to be completed by him or her, and Part B to be passed on to the co-ordinator of each walking bus. Twenty-six completed Part A's were received back, and Part B's for 26 walking buses at 23 schools (some schools have more than one walking bus). Of the 26 walking buses, 14 were still active at the time of the survey (May 2002). Of the 26 schools taking part in the postal survey, four were included in the in-depth study (the walking bus at the fifth school was set up later than the others and was not included on the list of 41 schools provided by HCC).

Table 1 Example of an overall summary table

Numbers providing information about the walking bus	Children: Parents who are volunteers: Parents who are not volunteers: Other volunteers:
Net change in km by children each week	Walk: Car: Bus: Bicycle:
Net change in time spent travelling by children	Walk: Car: Bus: Bicycle:
Change in number of car trips per week	
Net change in time spent taking children to school	Parents who are volunteers: Parents who are not volunteers: Organiser: Other volunteers:
Monetary costs:	Setting up scheme: Running costs per week:
Outcomes reported by children	Positive: Negative:
Outcomes reported by parents for their children	Positive: Negative:
Outcomes reported by parents for themselves	Positive: Negative:
Objectives of the headteacher	Objectives met: Objectives not met: Other positive outcomes observed: Other negative outcomes observed:
Objectives of the co-ordinator	Objectives met: Objectives not met: Other positive outcomes observed: Other negative outcomes observed:

The other main strand of the project forming the basis of this paper is the assessment of the travel and activity patterns using the RT3 portable motion sensors. The RT3 is a tri-axial accelerometer, manufactured by Stayhealthy, USA. It measures movement in three directions and is worn in a belt around the waist. An example is shown in Figure 1.

Figure 1 The RT3 motion sensor

The RT3s combine the movements in three directions to produce total activity counts in units of vector magnitude (VM). These can be converted to activity calories using formula programmed into the equipment using data on the age, gender, weight and height of the child. (Activity calories are calories used in undertaking physical activity. The RT3s can also convert activity calories to total calories, i.e. including the calories that are used by the body to function and develop even when the person is passive, by adding on a constant based on the physical characteristics of the person. Activity calories are used in this work).

The RT3s are the size of a small pager and are worn around the waist in a purpose-made holster on a belt. It can be worn for all activities except those which would make it wet. They were set to record movements on a minute-by-minute basis. An example of the output is shown in Figure 2. In this study the volunteers were asked to were the monitor from a Wednesday to a Monday, with data being collected for the four days Thursday, Friday, Saturday and Sunday. These days were chosen so that both school days and weekend days were included.

The children were asked to keep a travel and activity diary for the four days. An example extract from the diary is shown in Figure 3. The events from the diary have been mapped on the output traces from the RT3s so that the activity levels associated with each event or trip can be identified. (This was done in consultation with the children in order to reduce the number of possible miscodings).

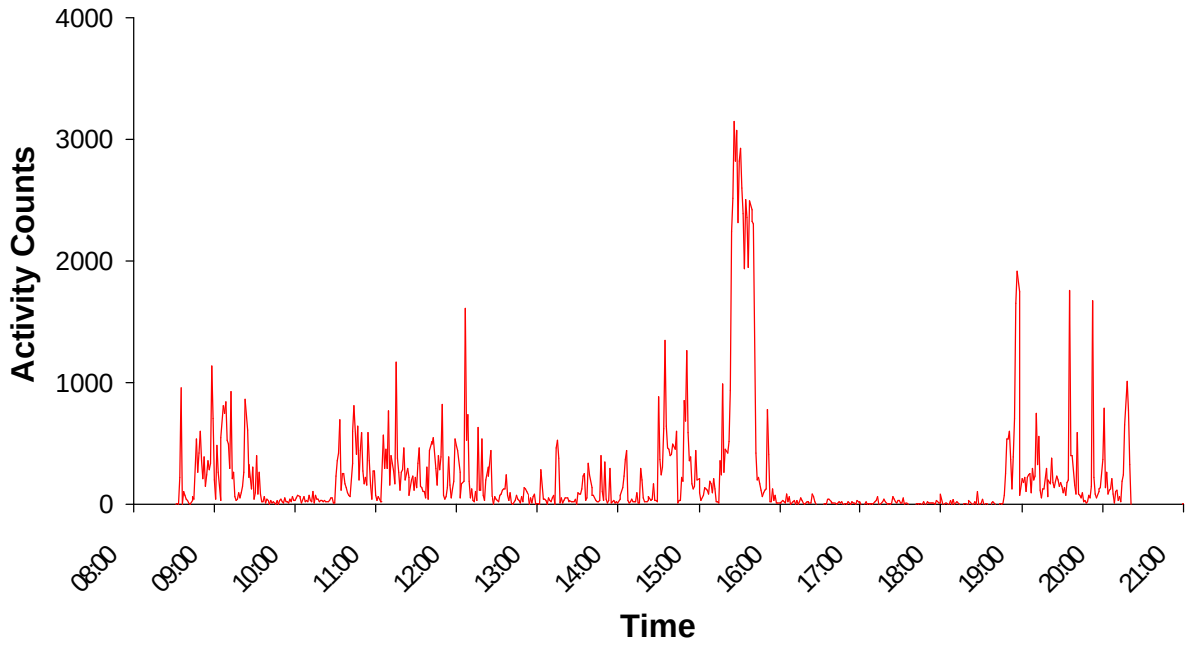

Figure 2 An example of the output from an RT3 motion sensor

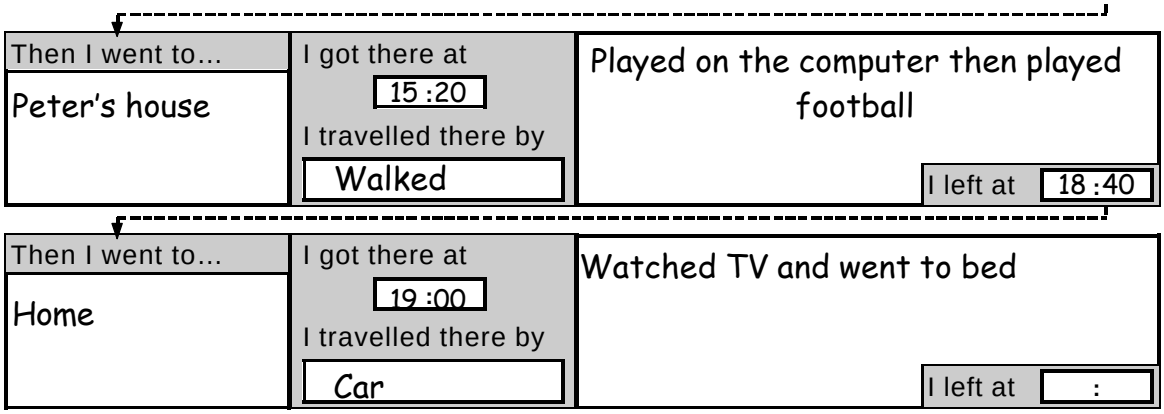

Figure 3 An example extract from a travel and activity diary

3. THE IMPACTS OF WALKING BUSES

3.1 The objectives of setting up walking buses

In this section the impacts of walking buses will be considered. Potentially they have a wide range of possible impacts because if they reduce the number of car trips to school, they should have consequential impacts on congestion, air pollution, road accidents and so on, assuming that the cars removed are not replaced by others. However, it would be very expensive to monitor all such changes, and they are likely to be too small to be discernible from the day-to-day variation in traffic flow. The reduction in car trips can be measured directly by collecting information from the participants.

It is also useful to consider the perceptions of the changes by the participants, because decisions are often made on the basis of perceptions.

The perceptions of the headteachers in the postal survey about the impacts of walking buses are shown in Table 2. This is based on 22 responses from schools that have set up walking buses. The table shows the objectives behind setting up the walking buses and the extent to which they have been met. The most popular objective was 'to reduce congestion at the school entrance', mentioned by twenty schools. The second most popular objective, with twelve schools mentioning it, was 'to give children more exercise', followed by the general desire to increase walking to school, cited by seven schools. Two schools mentioned reducing car use to school, and two others cited ensuring that children reach school on time.

Table 2 Achievement of objectives by walking buses as perceived by headteachers in the postal survey

Objective	Number of schools with this objective	Objective achieved?			Success rate (%)
		Yes	Partially	No	
To reduce congestion at the school entrance	20	10	4	6	60
To give the children more exercise	12	9	1	2	79
To increase walking to school	7	3	1	3	50
To reduce car use to school	2	2	-	-	100
To ensure children reach school on time	2	1	1	-	75
To improve the children's road safety skills	1	1	-	-	100
To create safer routes to school	1	1	-	-	100
To increase social interaction between the children	1	1	-	-	100
To be environmentally friendly	1	-	1	-	50
To slow down the traffic	1	-	1	-	50
To escort children who currently walk unsupervised	1	-	-	1	0
To reduce the need to bring younger siblings to school	1	-	-	1	0
Total	50	28	9	13	65

Source: The walking bus postal survey.
Note: This table is based on 22 responses from schools which have set up walking buses. Some respondents provided multiple answers. The success rate has been calculated by dividing the number of schools achieving the objective plus half the number achieving partial success by the number of schools setting that objective.

Table 2 also shows whether the objective was achieved. In some cases they were achieved partially. A success rate has been calculated by summing the number of schools achieving the objective, plus half those partially achieving the objective, and dividing by the number of schools which set that objective. Overall, 65% of the objectives were achieved. Of the three main objectives (in terms of the number of schools setting them), giving the children more exercise had a success rate of 79%, followed by reducing congestion at the school entrance at 60%, and increasing walking to school at 50%. Most of the other objectives were achieved. Overall, it can be argued that walking buses are seen as fairly successful by headteachers.

More detailed information was gathered from the headteachers and walking bus co-ordinators of five of the schools in the interviews, as shown in Table 3. The objectives of setting up the walking buses were broadly in line with those in Table 2, with reducing traffic and parking outside the school as the main objective. The second objective was to encourage more children to walk to school. Several other objectives were also mentioned. Table 3 also shows whether or not the outcome matched the objective. The respondents reported that the reduction in car use had been very small with no noticeable reduction in congestion or parking near the school entrance. They did not perceive a large increase in walking, because many of the children walked previously. This will be examined below, as will the amount of exercise being taken. The sense of community was increased and one of the schools managed to get onto the County Council's Safe Routes to School programme.

It may look as if there is a contradiction between the two surveys about the perceptions of the headteachers of the effects of walking buses on congestion at the school entrance. In the postal survey, of the four schools that were also interviewed, one did not mention reducing congestion as an objective. Of the other three, one said that the objective of reducing congestion had been partly met, while the other two said it had not. Hence there is not a large difference between the two surveys in this matter, it is simply that the schools interviewed tended to be in the group that did not observe a reduction in congestion.

Table 3 Summary of the achievement of objectives by the walking buses as perceived by the headteachers and walking bus co-ordinators

Objective	Outcome
To reduce congestion around the school entrance	No noticeable reduction
To increase the amount of walking to school	Not much change because most children walked anyway
To increase the fitness of the children	Achieved in that the children are undertaking more exercise
To increase the sense of community	Achieved
To stop children being dropped off early at school	Not achieved
To get onto the Safe Routes to School programme	Achieved
To obtain funding for improvements to the road crossing	Not achieved

Source: The walking bus interviews

3.2 The perceptions of children and their parents

Before considering whether there has been a decrease in the number of cars, it is useful to examine the perceptions of two important groups – the parents and the children. Tables 4 and 5 show the perceived outcomes. These include the perceptions of parents both for themselves and for their children. The latter can be compared with the perceptions of the children. The main positive outcomes for the children are the social aspects, the pleasure of walking and the increase in exercise. For the parents it is the exercise and the increase in flexibility (classified under 'other'). The main disadvantages are the loss of flexibility for some parents, particularly the volunteers, and for the children, the social aspects (having to walk with people they do not like) and having to walk at all.

Table 4 Perceived positive outcomes of walking buses

	Outcome for			Total
	Children	Children as perceived by	Parents	
	Children	Parents	Parents	
Social aspects	61	33	2	96
More exercise	10	20	7	37
Enjoyment of walking	19			19
Independence for child from parent (and seeing it)		11	3	14
Child settles more quickly at school or is more alert		10		10
Other	3	9	9	21
None	12	6	14	32
Total	105	89	35	229

Source: The walking bus interviews

Table 5 Perceived negative outcomes of walking buses

	Outcome for			Total
	Children	Children as perceived by	Parents	
	Children	Parents	Parents	
Loss of flexibility in time		4	22	26
Social aspects	15	10		25
Poor weather	8	8	1	17
Embarrassment	7	7		14
Loss of parent-child interaction	2	7	5	14
Do not like walking	10			10
Other	8	2	10	20
None	47	17	21	85
Total	97	55	59	211

Source: The walking bus interviews

3.3 The impacts on car use

A significant question about walking buses is the extent to which they reduce car use. Table 6 shows the reduction in car use for 11 of the walking buses in the postal survey. According to the walking bus co-ordinators 62% of the children using the walking buses used to travel by car, with a range from 32% to 100%. It should be recognised that the children who travelled by car previously may not have used the car everyday. Also, the car may not have been used solely to take the child to school. A parent may have previously dropped a child at school and now drops the child at the start of the walking bus and then travels onto work.

Table 6 Estimated shift from the car in the schools with active walking buses in the walking bus postal survey

Walking bus number	Number of children registered	Number of children who used to travel by car	Percentage of children who used to travel by car
1	12	7	58
2	5	2	40
3	15	7	47
4	5	3	60
5	13	4	31
6	13	6	46
7	14	7	50
8	28	9	32
9	18	18	100
10	41	39	95
11	8	5	63
Total (for schools providing data)	172	107	62

Source: The walking bus postal survey

There is some evidence on car use by those using the walking bus from the interviews about the five walking buses. Table 7 shows the mode used before they started using the walking bus by the 73 children interviewed. It also shows the mode used on days when the walking bus is not used. This suggests that about 26% (17 out of 66 for whom information is available) of the children previously used the car every day. If those using a mixture of car and walk are counted as 0.5 this increases to 36% (24 out of 66). This is lower than the figure of 62% in Table 6. However, if the schools in both surveys are examined, and the children who previously used a mix of walk and car are counted as 0.5, the mean from the postal survey is 42.4% (14 children out of 33) and the mean from the interviews is 42.5% (17 out of 40). (One of the four schools that was interviewed and responded to the postal survey, did not answer this question in the latter survey, so the comparison here is based on three schools). The surveys were done at different times, which may explain the difference between the total numbers. This comparison suggests that the differences between the two data collection exercises reflects the different sets of schools covered rather that a difference arising from the methods used. This partly arises from the small numbers providing this information, namely 172 children in this part of the postal survey and 66 in the interviews. It is recognised that these are small numbers, but walking buses are small-scale initiatives, and it is unusual to obtain data about the dynamics of modal shift from any sector of the population, let alone for young children.

Table 7 Number of children using modes of travel other than the walking bus in the walking bus interviews

	Walk	Car	Mixture of walk and car	Not known or not applicable	Total
Mode of travel used before walking bus was set up	35	17	14	7	73
Mode of travel used on days that the walking bus is not used	20	13	9	31	73

Source : The walking bus interviews

As shown in Table 7, quite a few children do not use the walking bus every day, and some use car on other days. This means that even if a child has switched from car to using the walking bus, they may not be making five fewer car trips to school each week. (It is worth noting that most walking buses only operate in the morning. This is usually because of the variation in the times that children leave school because of after-school activities).

Because of the relatively small numbers involved, and because some children did not previously go to school by car on five days a week, and because some do not use the walking bus every day, it is difficult to reach a firm estimate of the reduction in the number of car trips to school by children. (It is worth bearing in mind that the figures presented here are based on a survey of the whole of Hertfordshire, which is wider than many other travel surveys.

Potentially, every child on a walking bus in the county was covered and the response rate in the postal survey was well over 50%, which is very high for this type of survey sent out 'cold'). Given these caveats, the reduction in the number of children travelling by car seems to be about 50% of the number of children on the walking bus. A walking bus typically has 10 children using it and at January 2003 there were 26 active walking buses in Hertfordshire (Mackett et al, 2003c). Putting these figures together suggests that there are about 130 children on walking buses rather than using the car each day in Hertfordshire. This is not a huge reduction in the number of car trips in a county with a population of just over one million.

Just because a child has switched from using the car to going by walking bus, it does not mean that the car is not being used for a trip. For example, if a parent previously dropped a child off outside the school on the way to work and now drops the child off at the beginning of the walking bus, then there will not be a significant reduction in the number of cars on the road, but there could be a reduction in the amount of parking near the school entrance, which would be a small benefit on road safety grounds. The figures from the five interviews, shown in Table 8, confirm that the cars used to bring the children to school previously are still being used for a trip at about the same time. It seems likely that the car is being used to go to work by a parent even though the child is using the walking bus. In other words, even though the child has started using the walking bus, there is not a reduction in the number of car trips. More generally, in the questionnaire surveys undertaken in another part of this project (Mackett et al, 2002), it was found that 28% of the trips to school by car were made solely to take a child to school. The rest were made in the course of trips to other destinations, mainly workplaces. This confirms the limited scope for walking buses to reduce the number of cars on the road.

Table 8 Use of the car at the time of the journey to school in terms of the mode used prior to use of the walking bus

Mode of travel before using the walking bus	**Use of the car at the time of the journey to school**			
	Car used every day	**Car used on some days**	**Car not used**	**Total**
Car	11	1	0	12
Mixture of car and walk	0	10	0	10
Walk	0	0	16	16
Total	11	11	16	38

Source: The walking bus interviews

3.4 The impacts on time use

One of the positive aspects of walking buses is the low monetary cost involved, but they do consume a large amount of time for the co-ordinator and volunteers. They also impose constraints on time in the morning when many people are rather short of time. For example, being on the walking bus may mean that the child has to be in a particular place for 8.30 rather than 9.00,

which can reduce flexibility within the household. Also, it is not possible to take the child by car on days when there is a domestic crisis if the parent is a volunteer that day. This loss of flexibility in time is the biggest negative aspect of walking buses for parents (Table 5).

Table 9 shows the number of parents saving and losing time as a result of the walking bus, based on data collected in the five interviews. The parents who are volunteers are the ones who lose time either because they have to travel further or because they are involved in procedural matters, such as waiting until the official departure time. The people who save time are those who are not volunteers, possibly the parents who are dropping their children off from the car at the start of the walking bus and then carrying on to work. It might be argued that the parents who escort the walking bus probably do not have paid employment and so, in economic terms have a low value of time, while those who drive off to their jobs have a higher value of time, but that argument cannot be regarded as equitable in social terms. Indeed, anecdotal evidence suggests that there is resentment towards parents who are not prepared to be volunteers on some days, and that some walking buses only allow people who are prepared to be volunteers to use it. The parents who are volunteers probably live within walking distance of the school, and may well have walked to school with their children previously. This may partly explain why there are relatively few transfers from car to the walking bus. This suggests that if it is desired to increase the number of car users transferring to the walking bus, there needs to be an equitable way of organising the volunteers. In theory, those who use the walking bus but are not volunteers could be asked to pay money to the volunteers, but that is hardly likely to encourage more use of the walking bus by car users.

Table 9 Number of parents saving and losing in time as a result of the walking bus in the walking bus interviews

	Save time	Lost time	No change	Net change in time use
Volunteer every day	0	11	5	-11
Volunteer some days	3	2	6	+1
Not a volunteer	9	0	0	+9
Total	12	13	11	-1

Source: The walking bus interviews
Note: Two parents gave ambiguous answers

3.5 The impacts on long-term behaviour

There is another possible effect of walking buses, namely that children who used the walking bus at their first school get into the habit of walking and so continue to use the walking bus when they move onto their next school. In the surveys in schools in the project (Mackett et al, 2002), of the 192 children who had moved on to another school, none of the class activities or training exercises seemed to reduce the use of the car whereas of the 15 children who had used a walking bus at their previous school, 11 now walked and four went by bus, and none went by car. These are very small numbers, but they

suggest that going on a walking bus may give children the confidence to walk unescorted, or more likely, give their parents the confidence to let them walk.

3.6 The impacts on children's physical activity

The other main positive impact of the walking bus besides reducing car use, identified by the headteachers, the parents and the children, was the fact that it gives the children more exercise. There is little doubt that encouraging children to do more physical activity is good. Although health professionals acknowledge that it is not possible to define precisely the minimal or optimal amount of exercise required by children they make the following recommendations (Biddle, Sallis and Cavill, 1998):

- All young people should participate in physical activity of at least moderate intensity for one hour per day;
- Young people who currently do little activity should participate in physical activity of at least moderate intensity for at least half an hour per day.

Biddle, Sallis and Cavill (1998) state that moderate intensity activities for children may include brisk walking, cycling, swimming, most sports or dance, and that such activities may be carried out as part of transportation, physical activity, games, sport, recreation, work or structured exercise, and for younger children, as part of active play. Hence, the normal everyday activities in which children participate, including travelling to school, can contribute to their daily quantum of physical activity, which in turn, can lead to healthier lives.

It is this logic which led to the part of the project where children were fitted with RT3 portable sensors for four days. The children monitored were all in Years 6 and 8. Volunteers were recruited from schools that had completed questionnaire surveys in a previous phase of the project. A total of 149 children were monitored between April and July 2002. Two children did not provide enough information in their diaries to be of use: one boy who was ill for both school days and a girl who did not record any events in her diary, but they did provide RT3 data. The age and gender breakdown of the remaining children is shown in Table 10. It can be seen that there is a fairly even spread across the groups.

Table 10 The numbers of children fitted with RT3 portable sensors

	Year 6 (age 10/11)	Year 8 (age 12/13)	Total
Boys	35	42	77
Girls	30	42	72
Total	65	84	149

By relating the information in the travel and activity diaries to data from the RT3 sensors it is possible to establish the total activity calories spent on various activities over the four day period. In this paper the emphasis is on the travel to and from school and the school day. More detailed analysis is presented elsewhere (Mackett et al, 2003d).

Table 11 shows the number of activity calories used travelling to and from school, PE, and over the whole day, for the school days on which measurements were taken. It can be seen that there are some differences between the groups of children over the whole day: the boys are more active than the girls and the older children are more active than the younger. Because of these differences the analysis has to be carried out for each age/gender group separately. This is also because there are differences in the use of the modes of travel to school, as shown in Table 12. For example, younger children do not travel by bus and there are very few bicycle trips. Girls are more likely to travel by car than boys. As children become older (and transfer to secondary schools) they tend to travel by car much less and quite a few go by bus.

Table 11 Number of activity calories consumed in various activities over the school day

	Main mode to or from school			Mean over all modes	PE	Mean for day
	Car	Bus	Walk			
Year 6 boys	18		23	21	111	670
Year 6 girls	15		23	18	107	587
Year 6 overall	16		23	19	109	606
Year 8 boys	18	39	61	49	185	1017
Year 8 girls	23	41	68	52	224	911
Year 8 overall	21	40	64	50	207	945
Overall mean	18	40	48	37	157	797

Note: The travel is for a single journey to or from school; the travel data are based on the 552 one-way trips for which data were available but excluding the 6 one-way bicycle trips; the PE figures are for the 92 children who did PE; the daily total is for all 149 children.

Table 12 Percentage of one-way trips to school by main mode of travel

	Car	**Bus**	**Walk**	**Bicycle**	**Total**
Year 6 boys	44	0	56	0	100
Year 6 girls	62	0	38	0	100
Year 8 boys	17	20	59	4	100
Year 8 girls	23	22	55	0	100

It can be seen that the older children who walk use about three times as many calories on the journey than those who use the car. The differences are much smaller for the younger children, but the walkers still use more calories than the car users. The differences may be partly due to the different journeys lengths. This can be allowed for by considering the intensity, calculated by dividing the number of activity calories by the duration of the activity, as shown in Table 13. This shows that overall, walking uses over twice as many calories per minute as travelling by car. There are large differences by age: for the younger children, walking uses about 50% more activity calories whereas for the older children it is much higher at about 2.3 times as much.

Table 13 Averages of the intensities (activity calories per minute) for various activities over the day

	Main mode to or from school			Mean over all modes	PE	Mean day
	Car	Bus	Walk			
Year 6 boys	1.1		1.6	1.4	2.5	0.8
Year 6 girls	1.0		1.8	1.3	2.6	0.8
Year 6 overall	1.1		1.7	1.4	2.6	0.8
Year 8 boys	1.2	1.3	3.0	2.3	3.3	1.3
Year 8 girls	1.5	1.6	3.5	2.6	4.2	1.1
Year 8 overall	1.4	1.5	3.2	2.5	3.8	1.2
Overall mean	1.2	1.5	2.6	2.0	3.2	1.0

Note: See note under Table 11.

It can be seen that travelling by car, which will include some walking, for example from the car to the school entrance, uses slightly more calories per minute than the average activities over the whole day (including the evening). A more interesting comparison is with physical education (PE) classes. For the younger children, walking to school uses about 65% of the number of calories of a PE lesson whereas for the older children it is about 85%. Children travel to and from school five times a week. Typically they only have PE lessons twice a week. This means that, on the basis of the figures in Table 11, the younger children who walk use about twice as many calories travelling to and from school as in a PE lesson, while older children use about three times as many. These comparisons illustrate how beneficial walking to school can be in terms of physical activity. It has to be acknowledged that children travelling to and from school by car also use quite a lot of calories, but this is partly because car journeys include an element of walking. It is likely that some of the car journeys by the younger children may be quite short and so the walk element may be quite a large fraction of it.

It is worth noting that children travelling by bus use many more calories than those travelling by car (Table 11), but the intensities are close to those for car (Table 13). This means that the bus journeys take much longer than the car journeys. Bus journeys will also all include a walking element, and this is likely to be longer than that for car journeys on average because car journeys will usually begin at the house, bus journeys will not.

On the basis of this evidence, it seems that walking provides considerably more physical activity than travelling by car. This suggests that a child who switches from using the car to using a walking bus should have more exercise, confirming the perceptions of headteachers, parents and children (Tables 2 and 4). However, it should be recognised that most children on walking buses are younger than Year 6 (Mackett, et al, 2003c) and that there is less difference between the intensity of walking and travelling by car for younger children according to Table 11. Nonetheless, it does seem reasonable to conclude that children who travel to school on a walking bus are receiving more exercise than they would be if they were still travelling by car.

4. CONCLUSIONS

There is a growing recognition that ‘soft’ measures may make a significant contribution to the reduction in car use. In order to be confident about the scale of their contribution it is necessary to evaluate them systematically. Because they have a different range of impacts to engineering-based approaches it is necessary to develop new methodologies for evaluating them. It is also necessary to collect data on some of the impacts, because they are not measured within conventional frameworks. Many of these issues are context specific.

This paper has discussed some of these issues using walking buses in Hertfordshire as an example. The analysis started with identifying the various parties, headteachers, co-ordinators, parents and children. The objectives of setting up the walking buses and whether they are perceived to have been achieved were considered. The most popular objective was to reduce road congestion and parking near the school entrance. The evidence suggests that such changes are not being observed. On the other hand, there is a reduction in car use, with about 50% of the trips by walking bus replacing car trips. There are not enough children on walking buses for this to have a noticeable effect on congestion.

The other effect that was anticipated was that the children would have more exercise. Comparing the quantity of physical activity that children undertake when walking compared with travelling by car suggests that this is the case.

Thus, overall, it can be argued that walking buses do have a significant effect on levels of car use and consequently on the amount of exercise that many children undertake. But, there are not enough walking buses for there to be a noticeable impact on congestion, and many of the cars may still be used for trips to work, with the child being dropped off at a different location to previously.

This work is being carried out within a project that is approaching its conclusion. Further work will focus on more detailed analysis of the effects induced by the introduction of walking buses, by examining the changes in trip making of some children who actually use them, and on more analysis of the outputs from the RT3 motion sensors to establish the impacts of walking and car use on children’s physical activity and consequently for their health.

The findings in this paper suggest that initiatives to reduce children car use can be effective, but because the initiatives are small, the impacts are likely to be difficult to observe, and so new methodologies for assessing their effective need to be devised. Given that the possible implications in terms of both health and car use are potentially huge and the subject of policy debates at many different levels, it is important that work in this field is continued.

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The effectiveness of initiatives to reduce children's car use

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Why try to reduce children's car use?

- Similar reasons as for everyone else:
  - reducing environmental damage
  - reducing congestion, etc, etc
- To increase their amount of exercise
- To reduce their potential long-term health damage (e.g. through obesity)
- To reduce their possible long-term car dependency

Reducing children's car use: the health and potential car dependency impacts

- 3-year project funded by EPSRC under the FIT programme
- Started January 2001
- Includes
  - Hertfordshire County Council
  - health experts
  - an epidemiologist
  - a health promotion expert

The work packages

- Surveys of children and parents, plus anthropometric measurements
- Evaluation of walking buses
- Monitoring of children's activity patterns using RT3s
- Attitudes of teenagers to the car
- Effects of car use on children's cognitive and mental development
- Role of women in children's decisions

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- Role of women in children's decisions

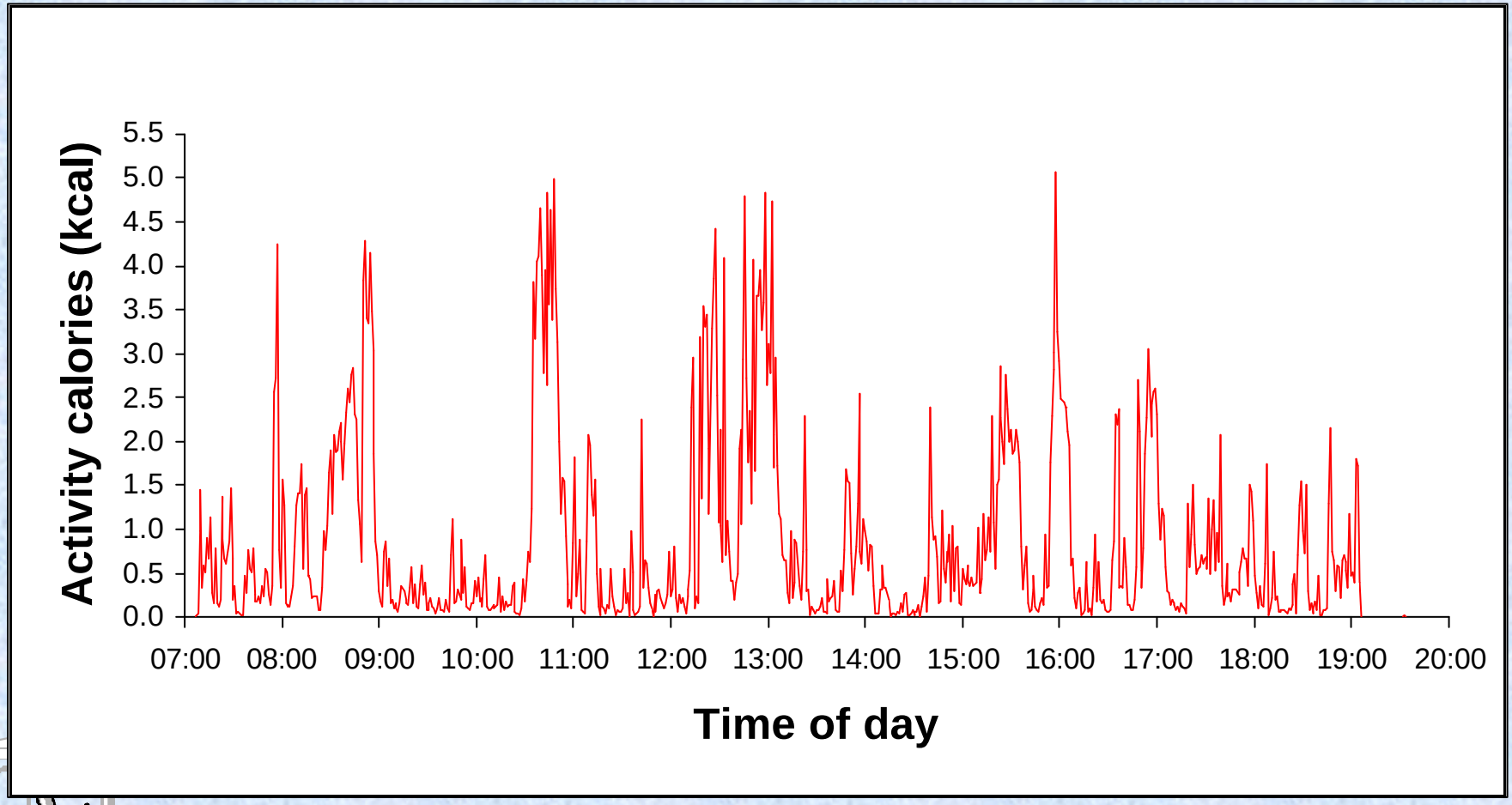
What is a walking bus?

Assessing the effectiveness of walking buses

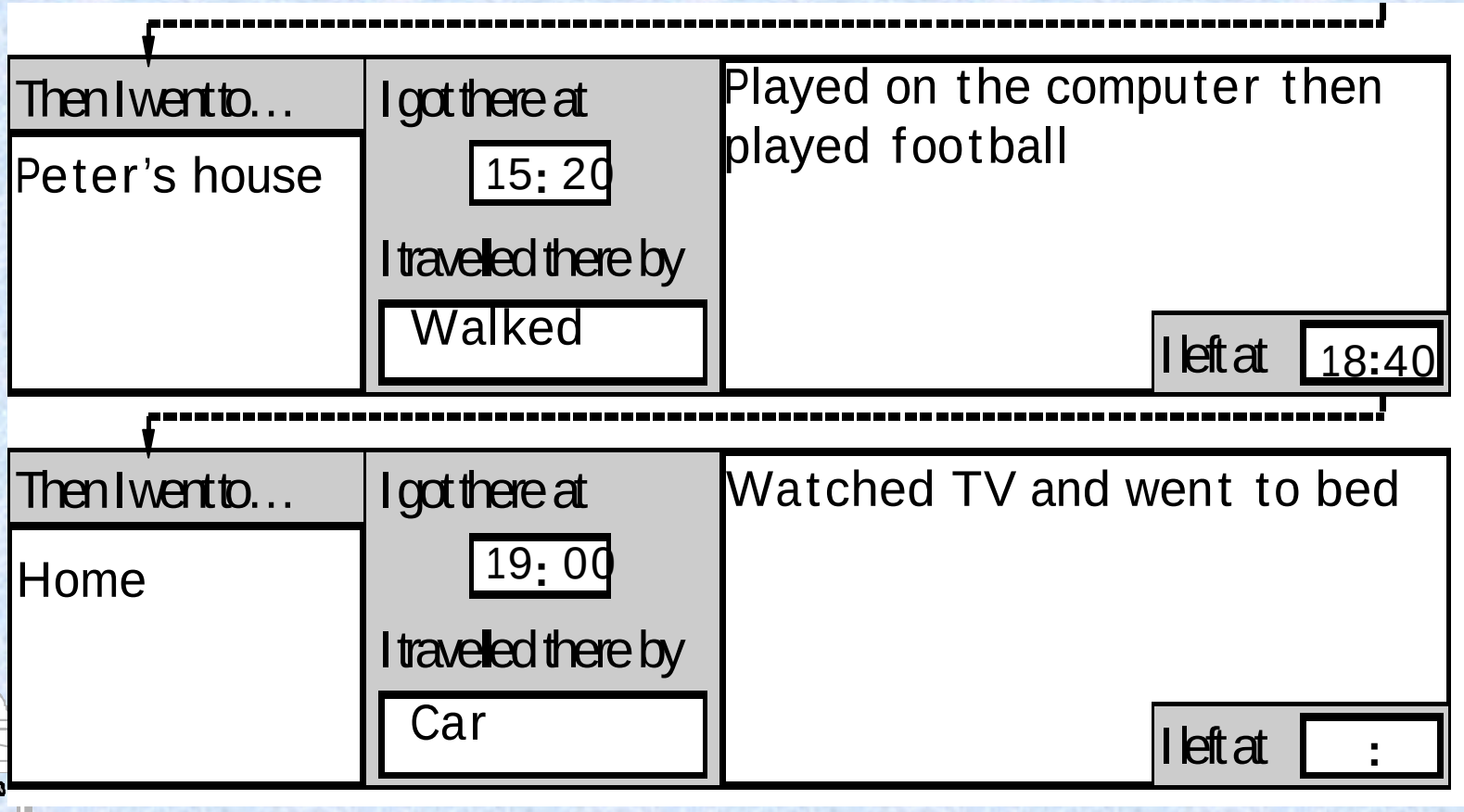
- Postal survey of all primary schools in Hertfordshire
- Monitoring of five walking buses over time, collecting data from:
  - headteachers, co-ordinators, volunteers
  - children and parents (including former users)
- Assembly of data within a systematic framework

The RT3 motion sensor

An example output from an RT3



A child's travel and activity diary



Headteachers' objectives in setting up walking buses

(based on 22 schools in Hertfordshire)

	No
Reduce congestion at the school entrance	20
Give the children more exercise	12
Increase walking to school	7
Reduce car use to school	2
Ensure children reach school on time	2

Achievement of objectives

	Total	Objective achieved?		Success rate
		Yes	In part	%
Reduce congestion	20	10	4	60
More exercise	12	9	1	79
More walking	7	3	1	50
Less car use	2	3	-	100
Punctuality	2	1	1	75
Total	50	28	9	65

Ranking of positive outcomes

	Outcome for		
	children	children	parents
	as perceived by		
	children	parents	parents
Social	1	1	4
Exercise	4	3	3
Other	2	2	2
None	3	4	1

Ranking of negative outcomes

	Outcome for		
	children	children	parents
	as perceived by		
	children	parents	parents
None	1	2	2
Other	2	1	3
Time use	-	3	1
Social	3	4	-

Shift from cars

(based on data from 11 schools)

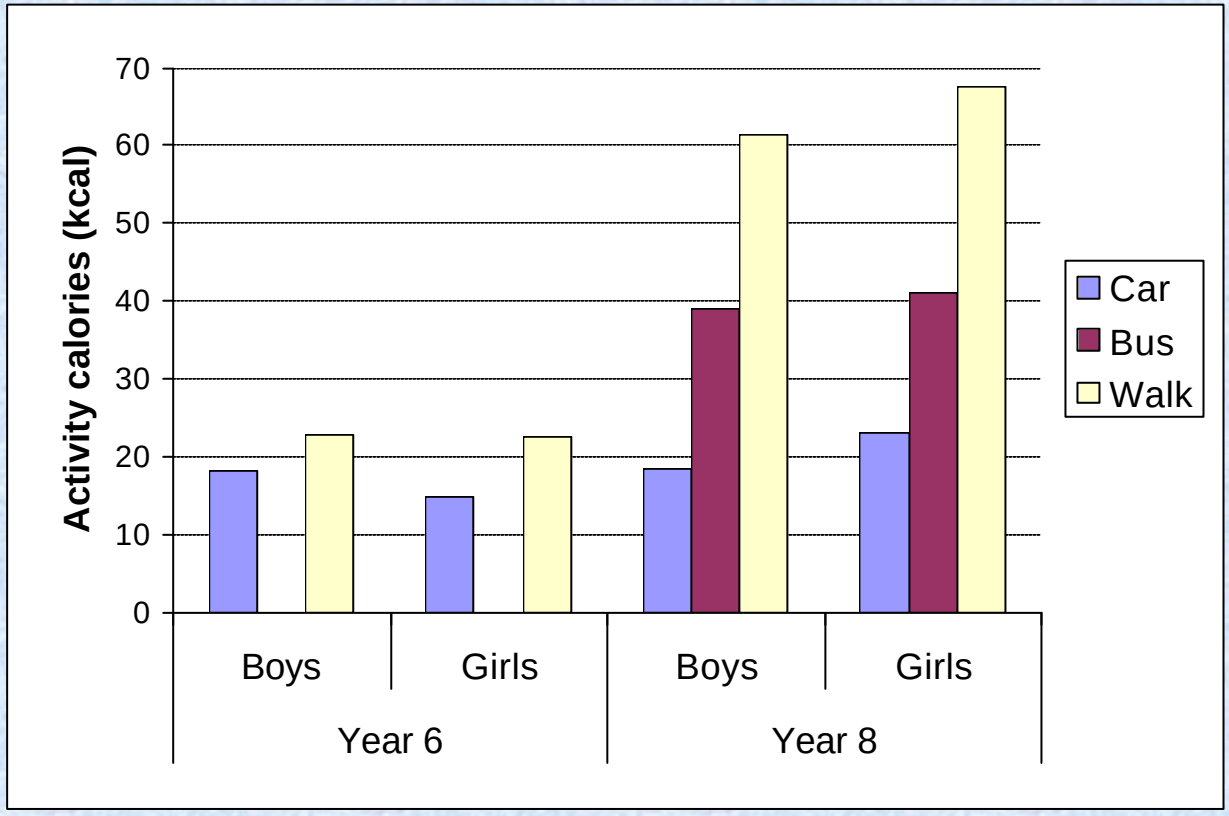
- Number of children = 172
- Number of children who used to travel by car = 107
- % who used to travel by car = 62%
- Range of % shift: 31% to 100%
- Note: not all children previously travelled by car every day and not all use the walking bus every day

Car and walking bus use

Mode used before using walking bus	Is the car used at the time of the journey to school?		
	Every day	Some days	Not used
Car	11	1	0
Mixture	0	10	0
Walk	0	0	16

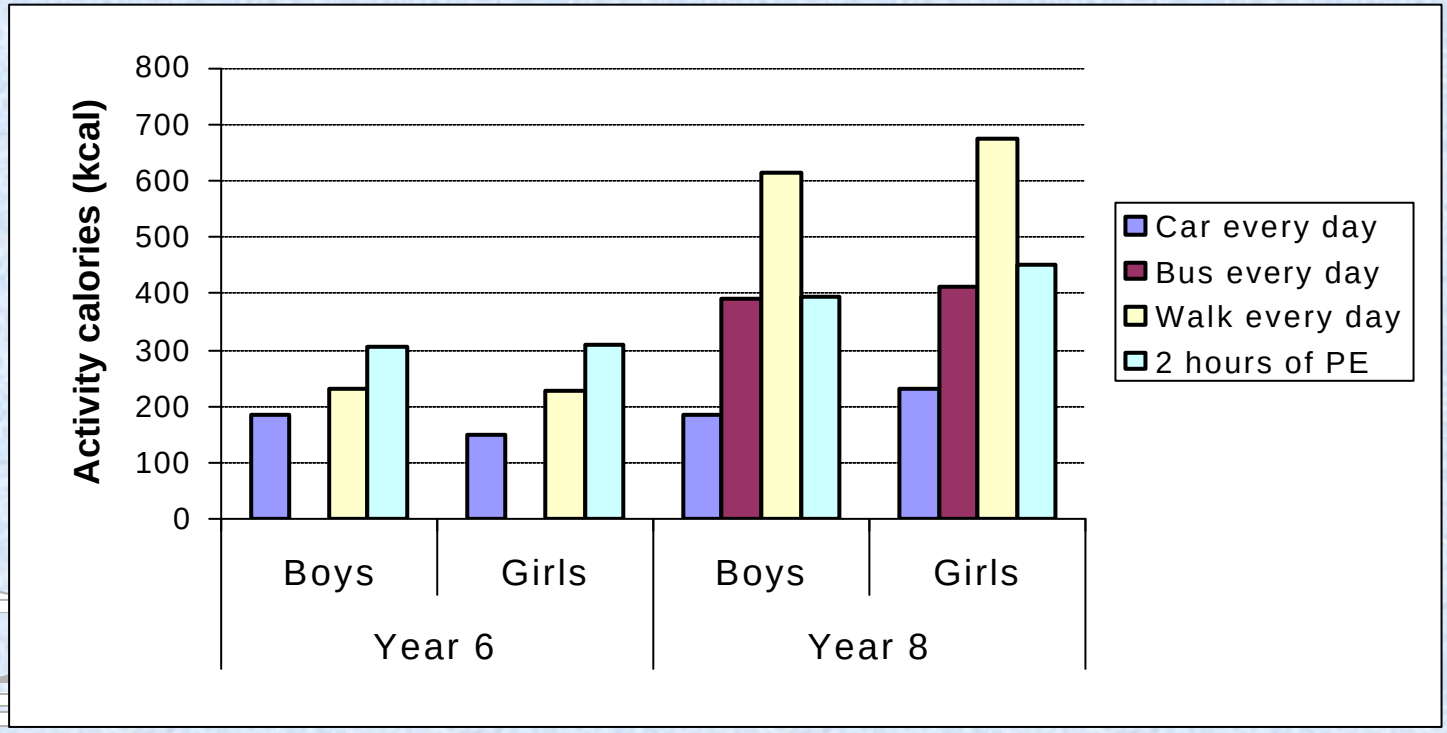
Travelling to and from school

- Walking to school uses more calories than going by car or bus, especially for older children



Travelling to school and PE

- Schools are recommended to offer 2 hours of PE a week
- The older children use lots more calories walking to school than in 2 hours of PE in a week



Conclusions

- Initiatives to reduce children's car use can be effective, but their impacts are likely to be difficult to observe
- In particular, about half the users of walking buses formerly used car
- But the effects on congestion are likely to be very small
- This is partly because many car trips to school are part of trips to work

More conclusions

- The benefits of walking buses to users include social aspects and exercise
- The disbenefits are the time constraints on parents and social aspects
- Walking to school can contribute significantly to children's daily exercise
- Walking to school can provide more exercise than PE lessons

Final conclusions

- Soft transport measures can reduce car use
- But, they need to be evaluated systematically
- New methodologies will have to be developed to do this
- The possible implications are huge so it is important that work continues