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Review of the Effectiveness of Road Safety and Pro-Environmental Interventions

Prepared for National Institute of Health and Clinical Excellence

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EXECUTIVE SUMMARY

Background

As part of its programme for developing public health guidance on behaviour change, NICE commissioned a review of “*the effectiveness of general interventions, approaches and models at individual, community and population level, that are aimed at changing knowledge, attitudes and behaviours outside of public health*”. The aim was to gather evidence on behaviour change from other fields, such as marketing, psychology, the environment or criminal justice, which might transfer to or yield useful learning for public health interventions.

The review was conducted on behalf of NICE by the Institute for Social Marketing (ISM) at Stirling and the Open University. Three topic areas were selected on the basis of their relevance to the guidance and their potential for yielding useful evidence:

- Road safety
- Pro-environmental behaviour change
- Marketing to low income consumers

In light of the breadth of the topic areas, and the fact that considering interventions in these areas in relation to public health is a relatively novel activity, the decision was made to focus on review-level literature. The advantages and disadvantages of this approach have been discussed elsewhere¹.

The review of marketing interventions is reported in a separate document. This report presents the methods and results for the road safety and pro-environmental topic areas.

Review Aims

The road safety section of the review aimed to examine the effectiveness of interventions designed to improve road safety related knowledge, attitudes, behaviour and wider outcomes by addressing the following three review questions:

1. What are the characteristics of road safety interventions?
2. What is the evidence for effectiveness of interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?
3. What information if any is provided on factors which influence effectiveness?

The pro-environmental section of the review aimed to examine the effectiveness of interventions designed to encourage the adoption of pro-environmental knowledge, attitudes, behaviour and other related outcomes by addressing the following three questions:

1. What are the characteristics of pro-environmental interventions?
2. What is the evidence for effectiveness of interventions in terms of changes in pro-environmental knowledge, attitudes, behaviours and other related outcomes?
3. What information if any is provided on factors which influence effectiveness?

¹ See, for example, Swann, C, Naidoo, B & Kelly, M (2006) Evidence for public health practice: conceptual and methodological challenges. In A Killoran, C Swann & M Kelly (eds) (2006) *Public Health Evidence: Tackling health inequalities*. Oxford: Oxford University Press.

Review Methods

Comprehensive literature searches were designed and carried out to identify systematic reviews, meta-analyses and other reviews to provide information on the effectiveness of interventions designed to improve road safety and pro-environmental behaviours and other related outcomes. Results from each database search (containing at least the author, title, publication year, source and ideally an abstract for each record) were downloaded as text files and imported into ORL (Owl Research Limited) software. The titles and abstracts for each topic (road safety and pro-environmental behaviours) that were generated by the searches were then examined according to pre-defined inclusion and exclusion criteria.

Eighteen reviews met the inclusion criteria for the road safety review and six met the criteria for the pro-environmental review. These reviews were then subject to a full critical appraisal to determine their relative quality.

Road safety: Results

The 18 reviews covered the following:

- cycle helmet ownership use
- seatbelt/child restraint within motor vehicles
- education of child pedestrians
- the effectiveness of graduated licence systems and driver education
- drink driving interventions
- traffic calming and safety cameras

The interventions were aimed at various road user groups (car drivers, motorcyclists, cyclists, pedestrians), had wide-ranging aims, and adopted a variety of strategies. Individual, community and population level interventions were all examined. The results of the interventions examined by these reviews are now briefly described.

Educating children about road safety can increase their knowledge, but for young children the effects on behaviour may be limited, therefore it may be better to separate or protect children from the road environment rather than expect them to interact with it safely. Educating parents and children about the correct use of child restraints and/or cycle helmet use can be effective, but using a multiple strategy by combining education with incentives, legislation or coercion can increase effectiveness. However, the effect of these interventions drops off with time. Peer pressure and good examples set by adults can also be effective in changing behaviour.

A graduated licensing system for newly qualified or young drivers, where restrictions are placed upon these drivers for a period of time, is a very effective method for reducing accidents for these drivers. Driver education at best is ineffective; paradoxically, educating drivers, pre or post licence, appears to increase accident rates. Administrative per se drink driving interventions may be effective in preventing re-offending. Ignition interlock systems have short-term effects and it is probably more effective to combine these interventions with some form of rehabilitation. A lower (a zero) blood alcohol concentration level for new or young drivers reduces the injury accident rates for these drivers. Safety cameras reduce the accident rates in the immediate area of the cameras, and most likely in the wider area as well.

Pro-environmental review: Results

The six reviews (two meta-analyses and four narrative reviews) addressed a small range of environmentally responsible behaviours. Three focused exclusively on recycling, one examined the conservation of resources like energy and water (Abrahamse et al 2005), one examined litter reduction (Huffman et al 1995), and the final review, a meta-analysis, reported on several environmentally responsible behaviours including recycling, energy conservation, water conservation, efficient transportation and litter reduction. The interventions were aimed at various target groups (e.g. residential households, school pupils, college students), had wide-ranging aims, and adopted a variety of strategies. The majority of interventions involved individual or community-level changes. The results of the interventions examined by these reviews are now briefly described in turn by behaviour-type.

There is some evidence that an awareness of the need to recycle and knowledge of recycling programmes are strong predictors of recycling behaviour. There is also evidence that the use of prompts can increase recycling behaviour, as the studies that examined this strategy tended to report consistent positive effects. Commitment strategies also produced consistent positive improvements in recycling. Altering the environment and increasing the frequency of the collection of recyclables or scheduling the kerb-side collection of recyclables to coincide with regular waste collection can have small moderating effects on recycling behaviour. When comparisons were made, strategies that attempted to manipulate aspects of the environment in order to make recycling easier and more convenient for people were shown to be less effective than other strategies like offering monetary rewards or getting people to make a commitment to recycle.

There is some evidence that monetary rewards can improve recycling behaviour, as the studies that examined this as an intervention strategy reported consistent positive effects. When compared to other interventions strategies, reward-based strategies produced greater improvements in recycling behaviour though changes tended to be fairly short-term and participation in reward-based interventions was usually low. Providing people with feedback about their performance in recycling was found to be a promising strategy for promoting recycling but further research is needed.

There is some evidence from a meta-analysis of environmentally responsible behaviours that the most effective strategies for increasing recycling are providing incentives, using social norms, getting people to make a commitment, setting goals and manipulating situational factors (eg. increasing the proximity of recycling bins).

Getting people to make a commitment was also an effective strategy in encouraging reductions in their energy use. Longer-term effects were seen in one study (six months). Monetary rewards also had an overall positive effect in promoting energy conserving behaviours. Although goal setting could be effective in getting people to reduce their energy use, it was more effective if combined with feedback on how people were doing in terms of meeting their goals.

Providing people with tailored information about their energy use – through, for example, home energy audits – tended to show more positive effects than other more general information strategies like mass media campaigns, especially in achieving behavioural change. Modelling and demonstrating appropriate energy saving behaviours resulted in improvements in knowledge and behaviour in one study. Providing people with feedback

about their energy use was also generally effective in getting them to adopt more energy saving behaviours.

There is some evidence from a meta-analysis of environmentally responsible behaviours that the most effective strategies for conserving energy are providing incentives, using prompts and getting people to make a commitment.

Prompting strategies were again shown to have consistent positive effects on littering behaviour. Both community involvement and modelling strategies were also effective in getting people to dispose of litter correctly. Removing prior litter was also found to be an effective strategy in nine studies.

Environmental design strategies, like increasing the proximity of litter bins and improving the way they are labelled and decorated, were also shown to have positive effects on littering behaviour. Reward-based interventions were effective in the studies that examined them. Only two studies examined the effects of feedback on littering and both reported positive results.

Getting people to make a commitment, and setting goals, were the interventions identified through one meta-analysis to have the strongest relationships with environmentally responsible behaviours in general, suggesting that they are likely to produce the best results. In contrast, providing incentives and 'changing the situation' (which refers mostly to environmental changes like increasing the proximity of recycling containers) had the weakest relationships with environmentally responsible behaviours. This is surprising given that rewards and incentives were consistently shown by the reviews that exclusively addressed specific areas (recycling, energy conservation and litter reduction) to have positive effects (though these were notably usually short-term), and interventions that involved altering the environment were shown to have moderate effects in the other reviews.

1.0 BACKGROUND

1.1 Interventions outside of public health

As part of its programme for developing public health guidance on behaviour change, NICE commissioned a review of “*the effectiveness of general interventions, approaches and models at individual, community and population level, that are aimed at changing knowledge, attitudes and behaviours outside of public health*”. The aim was to gather evidence on behaviour change from other fields, such as marketing, psychology, the environment or criminal justice, which might transfer to or yield useful learning for public health interventions.

The review was conducted on behalf of NICE by the Institute for Social Marketing (ISM) at Stirling and the Open University

In light of time and resource constraints, the decision was taken to restrict this review to three topic areas. From a long list of five topics -

- Pro-environmental behaviour change (eg. efforts to improve waste conservation or encourage recycling)
- Road safety (eg. strategies for reducing speeding)
- Marketing (eg. advertising’s impact on low income consumers)
- Management of organisational change (eg. strategies for coping with organisational restructuring or reductions in the workforce)
- Social enterprise (eg. strategies for community regeneration)

- three were selected on the basis of their relevance to the guidance and their potential for yielding useful evidence:

- Pro-environmental behaviour change
- Road safety
- Marketing to low income consumers

This mix of areas was felt to provide good coverage of interventions at different levels including individual, community, and environmental or policy changes. Road safety is of such global importance that the United Nations World Health Day for 2004 was devoted to the subject; within the UK road accidents in 2002 were estimated by the Department for Transport in their Highways Economics Note No 1 to have cost £17,760m. The UK Government “Tomorrow’s Roads: Safer for Everyone” sets a target of reducing all road related casualties by 40%, and a 50% reduction of child related casualties. It proposes that strategies to achieve this might include structural or technology-based measures (eg. speed bumps, speed cameras), enforcement measures, and public education campaigns. The Government targets refer to drivers, motorcyclists, pedestrians and horse riders, with a specific section on child road safety.

Environmental issues have shared a similarly high profile, especially in recent years. Environmental targets have been set at regional, national, European, and global levels to address a broad range of environmental issues including global warming, pollution, waste management, and ozone depletion. A key environmental policy for tackling global warming is the United Nations Framework Convention on Climate Change (UNFCCC), which is an

international treaty aimed at reducing emissions of greenhouse gas. The Kyoto Protocol extends this treaty by imposing mandatory targets for the reduction of greenhouse gases among over 160 countries that are committed to the protocol (UNFCCC 2006). The introduction of wider environmental policies like Kyoto has led to the development of interventions designed to improve a whole range environmental behaviours. Again, changes can be implemented at different levels. For example, interventions to tackle waste management problems might involve providing individual households with bins for separating their waste for collection or, at a policy level, sanctioning councils or governments that fail to meet environmental targets.

Marketing was chosen because NICE had a particular interest in learning from the efforts of commercial marketers to change behaviour. However, as this is potentially a very broad field, it was decided to restrict the focus of the examination of marketing. The review was limited to evidence concerning *low income consumers* as targets of and consumers of marketing activities. As tackling health inequalities remains a crucial priority in public health, and as disadvantaged groups are considered 'hard to reach' through many conventional public health intervention channels, it was felt that there was potentially valuable learning to be gained from studying how disadvantaged populations and individuals are 'reached', and with what effect, by marketers: what methods and channels are used to communicate with them, what sort of message and persuasion strategies are used, and how effective are they? Secondly, as much work has already been conducted by public health specialists and researchers to examine the effects of commercial marketing on smoking, drinking and diet (eg. Hastings et al 2003, Lovato et al 2003, Hastings et al 2005, McDermott et al 2005, McGinnis et al 2006), it was decided that this work would be excluded from the review.

The marketing review also summarised findings from existing reviews, one on the nature and effects of food marketing, and three on the nature and effectiveness of social marketing interventions.

The report is structured as follows. The remainder of section 1 outlines the aims and research questions, and section 2 outlines the methodology. Section 3 presents findings from the review of road safety interventions, and section 4 presents findings from the review of pro-environmental behaviour interventions. Section 5 presents the evidence tables, which summarise each review included in the dataset for this report.

1.2 Aims and research questions

The aims and research questions are described below.

1.2.1 Road safety

The aim of this part of the review was:

To examine the effectiveness of interventions designed to improve road safety related knowledge, attitudes and behaviour, and wider outcomes.

The research questions were as follows:

1. What are the characteristics of road safety interventions?
2. What is the evidence for effectiveness of interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?
3. What information if any is provided on factors that influence effectiveness?

1.2.2 Pro-environmental behaviour

The aim of this part of the review was:

To examine the effectiveness of interventions designed to encourage the adoption of pro-environmental knowledge, attitudes or behaviour.

The research questions were similar to those for the road safety section of the review:

1. What are the characteristics of pro-environmental interventions?
2. What is the evidence for effectiveness of interventions in terms of changes in pro-environmental knowledge, attitudes, behaviours and other related outcomes?
3. What information if any is provided on factors that influence effectiveness?

In light of the breadth of both topic areas, and the fact that considering interventions in these areas in relation to public health is a relatively novel activity, the decision was made to focus on review-level evidence. The advantages and disadvantages of this approach have been discussed elsewhere², but in this case conducting a ‘tertiary’ level review allowed for the creation of a comprehensive map of characteristics of interventions, and their effectiveness, across the full breadth topics, given resource limitations.

1.2.3 Additional factors

In addition, both parts of the review considered the role of other factors that might influence the effectiveness of interventions. Where available, evidence on the following was reported:

- the cost-effectiveness of interventions
- the role of intervention setting, and
- effects on different target populations, including low income groups.

The effectiveness of different ‘levels’ of interventions, namely, individual, community and population level interventions, was also considered. For the purpose of this review, individual level interventions are those that focus primarily on the individual, community level interventions are those that focus on community groups (where communities can be along distinct geographical boundaries, such as villages and towns, or small social units such as work places, schools or special interest groups), and population level interventions are those on the macro level that affect entire populations.

² See, for example, Swann, C, Naidoo, B & Kelly, M (2006) Evidence for public health practice: conceptual and methodological challenges. In A Killoran, C Swann & M Kelly (eds) (2006) *Public Health Evidence: Tackling health inequalities*. Oxford: Oxford University Press.

2.0 METHODOLOGY

2.1 Changing road-user behaviour

2.1.1 Literature search

A comprehensive literature search was designed and carried out to identify systematic reviews, meta-analyses and other reviews to provide information on the effectiveness of interventions designed to improve road safety related knowledge, attitudes and behaviour, and wider outcomes, in order to answer the proposed research questions (see Section 1.2.1).

The search strategy was created from a pre-prepared search filter for systematic reviews added to road safety search terms covering six categories: road users, modes of road transport, types of road, behaviours or actions, means of safety and potential consequences (see Box 2.1 for examples of each). Each of the first three categories' terms was combined with each of those in the last three categories. It was the researchers' intention that the strategies be specific enough to pick up relevant reviews in the downloaded citations without being so insensitive as to produce many irrelevant results. See Appendix 6.2 for examples of the search strategies used (a complete set of search strategies is available on request).

Box 2.1: Examples of road safety search terms

- | | |
|----------------------------|---|
| 1. Road Users | e.g. cyclist, driver, pedestrian |
| 2. Modes of Road Transport | e.g. car, lorry, traffic, bus |
| 3. Road Type | e.g. road, street, carriageway, pavement |
| 4. Behaviour/Action | e.g. speeding, careless driving, drunk driver |
| 5. Means of Safety | e.g. seat belt, speed bump, road marking |
| 6. Potential Consequence | e.g. accident, crash, fatal injuries |

The given date parameters were from the beginning of 1995 up to the date of the searches. The electronic database searches were conducted between the 11th April and the 26th April 2006. The content of all the databases is international, although the search was restricted to English language reviews only. Standard rapid review databases, such as the Cochrane Library and *Medline*, were selected and searched using the pre-defined strategy. In addition, subject-specific databases, such as *Transport* and *PsycINFO*, were identified and searched. See Table 2.1 for a complete list of the electronic databases searched.

Table 2.1: Electronic databases used for the road safety literature search

Database	Brief Description
ASSIA	Applied Social Sciences Index and Abstracts - index to journals in the fields of sociology, social services, health, psychology, education and politics.
Cochrane Database of Systematic Reviews	Completed reviews carried out by the Cochrane collaboration following rigorous procedures, plus protocols for reviews in preparation.
DARE	Database of Abstracts of Reviews of Effects - Published and unpublished systematic reviews assessed according to strict quality criteria by the Centre for Reviews and Dissemination (CRD).
HTA Database	Health Technology Assessments - completed and ongoing studies of the medical, social, ethical and economic implications of health care interventions.
Embase	A biomedical and pharmaceutical database with an international scope.
Medline	The U.S. National Library of Medicine's database of published medical literature.
PsycINFO	Index to journal articles, technical reports, dissertations and books in psychology. Also resources relating to psychological aspects of healthcare, nursing, sociology, psychiatry, education, law, business and linguistics.
Social Policy & Practice	Source of applied social science and evidence-based social policy and practice and includes grey literature and semi-published reports.
Sociological Abstracts	Index to journal articles, dissertations and citations to book reviews covering social work, social policy and welfare, community development, and human services.
Transport	International transportation information, featuring research reports, books, journal articles and reviews, theses, specifications and standards, conference proceedings and summaries of research in progress.
Zetoc	The British Library's table of contents covering journals and conference proceedings on all subjects.

The core search strategy was refined slightly for each database but broadly the same strategy was used in all of the databases. There were only three exceptions to this. Firstly, *Transport* produced a vast number of 'hits' using the strategy, but this is unsurprising given the database's main subject area. The search strategy for *Transport* therefore included a 'subject' filter which removed references which did not specifically cover the six categories mentioned above. Each database entry in *Transport* is coded by a series of subject headings, making this filter possible. (See Appendix 6.2 for the Subject Codes used.)

The two other exceptions were *Social Policy & Practice* and *Zetoc*. These two databases do not allow Boolean searches or allow a series of searches to be combined but the researchers felt it was important they were still included: *Social Policy & Practice* as it may include governmental policies and *Zetoc* for its conference proceedings content and particularly broad journal base. A simplified search strategy was created that still made an attempt to filter reviews and a selection of the road safety search terms was used.

Results from each database (containing at least the author, title, publication year, source and ideally an abstract for each record) were downloaded as text files and imported to a suite of bespoke bibliographic software supplied by Owl Research Limited (ORL). This software was designed to store records, to automatically remove duplicates and to provide data extraction forms to complete for each record, as described below.

An internet search was conducted for further significant reviews. A series of relevant websites were searched with key terms using either the site's own search engine or a generic 'current site search' or by 'handsearching' the organisation's online publications list. This search did not yield any relevant reviews for inclusion that had not already been identified in the electronic database searches above.

2.1.2 Selection of reviews for inclusion

A set of inclusion criteria (see Box 2.2) was applied to the records based on their titles and abstracts:

Box 2.2: Inclusion criteria

1. Published in English language
2. Published in or after 1995
3. Publication is a review of intervention studies
4. Publication must evaluate the effectiveness of “road safety interventions”, therefore the paper must fulfil the criteria:
 - Does the paper review a road safety solution(s)?
 - Does the paper examine road users’ knowledge, attitudes or behaviour?
 - Does the solution(s) in the paper have the aim of improving road safety?

The ORL bibliographic software had the facility to indicate the reason for exclusion, as well as marking that further information was needed to make an assessment. The bibliographic databases’ results should have contained only English language publications from 1995 onwards, however this was checked for errors. The records were then excluded with the following hierarchy:

- paper was off subject
- paper was not a review
- the paper did not meet the effectiveness criteria
- it did not review a road safety solution
- it did not examine road users’ knowledge, attitude or behaviour or the solution(s) in the article did not have the aim of improving road safety

A flow-chart in Appendix 6.4 gives an overview of the number of records removed at each stage of this exclusion hierarchy, showing that a total of 128 records were included from the original 9304.

A second reviewer audited the appraisal process by checking 10% of the records (930 records), which resulted in a discrepancy of four records (0.4%), three of which were differences on exclusion reasons: off subject rather than not a review; did not examine road users’ knowledge, attitude or behaviour rather than not having aim of improving road safety; not a review rather than being off subject. The second reviewer had the opinion that the fourth paper excluded may have been a review despite being excluded for not being one.

Full text articles were obtained for the 128 included records, and these were re-screened for relevance, selection criteria, systematicity, quality and relevance to the UK using the ORL software (see Appendix 6.6). Records were either excluded or included into the evidence base, with 20 being included and 102 excluded. Eight records were not assessed for various reasons:

- Three papers could not be obtained within the timeframe (traffic engineering measures designed to reduce pedestrian injuries, drink driving, child restraint)
- Two articles referred to a search strategy that was contained in another article, and this article could not be obtained within the timeframe (older driver capabilities, child safety seats).

- One article was obtained electronically and the file was corrupt, and this could not be re-obtained within the timeframe (driver error).
- One of the papers obtained was written in Chinese (the elderly and motor vehicle crashes)
- One of the articles obtained was found to be a response to the required article, and not the article itself, and the full article could not be obtained with the timeframe (reducing injuries to motor vehicle occupants).

Appendix 6.4 has the details on inclusion/exclusion. The exclusion process was secondary assessed with 100% agreement on what should, and should not, be included.

2.1.3 Quality appraisal

The 18 included studies were assessed for quality using the ORL software (see Appendix 6.7), using a similar checklist method to that in Appendix A.1 of the NICE ‘*Methods for Development of NICE Public Health Guidance*’ manual. Reviews were graded for the quality of the review, applicability to the UK and the type of evidence it was reviewing (e.g. RCT, non-RCT).

Bias scoring

The quality of the reviews with respect to bias was assessed into three levels using guidance in the NICE ‘*Methods for Development of NICE Public Health Guidance*’ manual section A2.10 using the ORL software (see Appendix 6.8). It should be noted that those articles rated ‘-’ were not necessarily of poor quality, as authors may not have fully reported the details of the review (for example the author may not have indicated if searches were, or were not, restricted to English language only).

The criteria used to determine the classification of the three categories is shown in Table 2.2. The criteria were considered not to be fulfilled if: it was not clearly stated; it was not described; or not enough detail was provided to make a decision.

Table 2.2: Criteria used to determine the potential for bias

Criteria	++	+	-
1. Was there a focused aim or research question?	✓	✓	
2. Explicit inclusion / exclusion criteria	✓	✓	✓
3. More than 1 assessor / selector	✓		
4. Provide details of databases searched	✓	✓	✓
5. Lists years searched	✓	✓	
6. Followed up references in bibliographies	✓		
7. Experts consulted for further sources			
8. Grey literature included / searched			
9. Specified search terms / strategy	✓	✓	
10. Not restricted to English language papers only	✓		
11. Quality assessed	✓	✓	✓
12. Data supports conclusions	✓	✓	✓

Key: ++ All or most of the criteria have been fulfilled and where they have not been fulfilled the conclusions of the review are thought **very unlikely** to alter; + Some of the criteria have been fulfilled and where they have not been fulfilled, or described, the conclusions are thought **unlikely** to alter; - Did not fulfil the criteria for a very high quality systematic review, and are of variable quality. Where they have not been fulfilled, or described, the conclusions of the review are possible to alter.

To be rated as ‘++’ at least all 10 ticked criteria had to be met, to be rated ‘+’, at least all 7 criteria had to be met, and for a ‘-’ rating at least four criteria had to be met.

Evidence scoring

The type of evidence included in the review was also rated depending on whether the systematic review only considered RCTs studies or other types of studies were considered (see Table 2.3).

Table 2.3: Evidence scoring

Classification	Types of evidence
1	Systematic reviews of RCT
2	Systematic reviews of non-RCT studies: case control studies; cohort studies; controlled before and after (CBA); interrupted time series (ITS) and correlation studies.
1&2	Systematic review of both RCT and non-RCT studies

2.1.4 Study categorisation

There were 18 studies included in this review, all of which were assessed for their potential bias. Table 2.4 shows the number of reviews fulfilling each of the criteria. From this table it can be seen that five criteria were fulfilled for all reviews: a focused aim or research question; explicit inclusion/exclusion criteria; details of databases searched; quality assessed; and data supports conclusions.

Table 2.4: Percentage of included reviews (n=18) meeting criteria for bias

Criteria	n	%
1. Was there a focused aim or research question?	18	100%
2. Explicit inclusion/exclusion criteria?	18	100%
3. More than one selector/assessor?	16	88%
4. Provide details of databases searched?	18	100%
5. List years searched?	16	88%
6. Followed up references in bibliographies?	15	83%
7. Experts consulted for further scores?	11	61%
8. Grey literature searched/included?	11	61%
9. Specified search terms/ strategy?	16	88%
10. Not restricted to English language only?	7	38%
11. Quality assessed?	18	100%
12. Data supports conclusions?	18	100%

Table 2.5 shows the bias scores for the reviews, where a review could score between 0 (no criteria met) and 12 (all criteria met). All the reviews fulfilled at least 7 of the criteria, with 50% fulfilling at least 11 of the criteria, indicating that the quality of the reviews was high.

Table 2.5: Number of reviews cross-tabulated with bias scores (n=18)

Bias score (out of 12)	# Reviews	Probability Density Function (PDF) (%)	Cumulative Density Function (CDF) (%)
0	0	0%	0%
1	0	0%	0%
2	0	0%	0%
3	0	0%	0%
4	0	0%	0%
5	0	0%	0%
6	0	0%	0%
7	2	11%	11%
8	2	11%	22%
9	1	6%	28%
10	4	22%	50%
11	5	28%	78%
12	4	22%	100%

Combining bias scores with intervention type allows a summary of the quality levels to be seen, as shown in Table 2.6. Note that each review may cover more than one behaviour.

Table 2.6: Review quality for each intervention category (n = 18)

Intervention	High quality reviews			Well conducted reviews			Reviews of variable quality			Non-rated reviews			Total
	1 ++	1&2 ++	2 ++	1 +	1&2 +	2 +	1 -	1&2 -	2 -	1	1&2	2	
Seatbelt/child seat use	0	1	0	0	0	1	0	1	1	0	0	0	4
Pre- and post-license education	1	0	0	1	0	1	0	1	0	0	0	0	4
Drink driving	0	1	1	0	1	0	0	0	0	0	0	0	3
Safety cameras	0	0	1	0	0	1	0	0	0	0	0	0	2
Traffic calming	1	0	0	0	0	0	0	0	0	0	0	0	1
Visibility clothing	1	0	0	0	0	0	0	0	0	0	0	0	1
Bicycle helmet use	0	0	0	0	0	1	0	0	0	0	0	0	1
Pedestrian education	1	0	0	0	0	0	0	0	0	0	0	0	1
Community injury prevention	0	0	0	0	0	0	0	1	0	0	0	0	1

2.1.5 Assessing applicability to the UK

Each review was scored for its relevance to the UK according to Tables 2.7. Table 2.8 illustrates the number of each relevance score by intervention types.

Table 2.7: Relevance to the UK scoring

Score (A-D)	Description
A (directly relevant)	Review includes UK studies
B (probably relevant)	Review includes non-UK studies of interventions that would be most likely to equally apply to UK settings.
C (possibly relevant)	Review includes non-UK studies that may have some application to UK settings but should be interpreted with caution.
D (not relevant)	Review contains non-UK studies that are not relevant to UK settings.

Table 2.8: Relevance to the UK scoring by intervention (n=18)

Intervention	A	B	C	D
Seatbelt/child seat use	1	3	0	0
Pre- and post-license education	0	4	0	0
Drink driving	0	3	0	0
Safety cameras	1	1	0	0
Traffic calming	1	0	0	0
Visibility clothing	0	1	0	0
Bicycle helmet use	1	0	0	0
Pedestrian education	1	0	0	0
Community injury prevention	1	0	0	0
Total	6	12	0	0

2.1.6 Data extraction and synthesis

Data were extracted from the reviews by one reviewer, using ORL software. This was checked by a second reviewer. The data extraction method used within the ORL software is adapted from the data extraction forms in appendix D of the NICE '*Methods for Development of NICE Public Health Guidance*' manual. No formal synthesis was undertaken as this was a review of reviews; instead, a narrative summary of the results was provided.

Evidence statements

Evidence statements were drawn up based upon the level of evidence, the efficacy of the intervention and the applicability of the research to the UK. Each evidence statement comprised two parts, the quality of the review and the effect of the intervention.

2.2 Promoting pro-environmental behaviour

2.2.1 Literature search

A wide-ranging literature search was designed and carried out to identify systematic reviews, meta-analyses and other reviews to provide information on the effectiveness of interventions designed to encourage the adoption of pro-environmental knowledge, attitudes or behaviour in order to answer the proposed research questions (see section 1.2.2).

The search strategy was created by combining a preset search filter for systematic reviews with a comprehensive list of pro-environmental terms. Due to time constraints, a formal scoping exercise had not been carried out on the topic so little was known about the quantity of suitable reviews to be found. It was decided to keep the subject matter of the search strategy as broad as possible to include individuals', corporate and national pro-environmental behaviours (predominantly energy-saving and pollution reducing behaviours). Examples include recycling waste, using public transport, composting, changing to renewable energy sources, reducing harmful emissions, insulating buildings, and reusing materials. It was the researchers' intention that the strategies be specific enough to pick up relevant reviews in the downloaded citations without being so insensitive as to produce many irrelevant results. See Appendix 6.3 for examples of the search strategies used (a complete set of search strategies is available on request).

The date range given was from the beginning of 1995 up to the date of the searches. The electronic database searches were conducted between the 10th May and the 5th June 2006. The content of all the databases is international, although the search was restricted to English language reviews only.

Until very recently, few systematic reviews have been conducted on topics other than health-related ones, so due to the subject matter, the traditional review databases such as the Cochrane Library's were not used. Subject-specific environmental databases, such as *Enviroline*, *Geobase* and *Environmental Sciences & Pollution Management* were selected alongside social science databases and medical databases for the behaviour change element. See Table 2.9 for a complete list and description of the electronic databases searched.

Table 2.9: Electronic databases used for the Pro-Environmental Behaviour literature search

Database	Brief Description
ASSIA	Applied Social Sciences Index and Abstracts - index to journals in the fields of sociology, social services, health, psychology, education and politics.
Embase	A biomedical and pharmaceutical database with an international scope.
Enviroline	Covers periodicals, conference proceedings, government documents, industry reports and project reports, on how, for example, management, technology, planning, law, economics, biology relate to environmental issues.
Environmental Sciences & Pollution Management	Provides comprehensive coverage of the environmental sciences drawing from journals, conference proceedings, reports, monographs, books and government publications (with a particular focus on US legislation).
Geobase	Source for geographic, geological and ecological information journal articles, reports, monographs and conference proceedings.
Medline	The US National Library of Medicine's database of published medical literature.
PsycINFO	Index to journal articles, technical reports, dissertations and books in psychology. Also resources relating to psychological aspects of healthcare, nursing, sociology, psychiatry, education, law, business and linguistics.
Social Policy & Practice	Source of applied social science and evidence-based social policy and practice and includes grey literature and semi-published reports.
Sociological Abstracts	Index to journal articles, dissertations and citations to book reviews covering social work, social policy and welfare, community development, and human services.
Zetoc	The British Library's table of contents covering journals and conference proceedings on all subjects.

The core search strategy was refined slightly for each but broadly the same strategy was used in all of the databases. The two exceptions were *Social Policy & Practice* and *Zetoc*. These two databases do not allow Boolean searches or allow a series of searches to be combined but the researchers felt it was important they be included: *Social Policy & Practice* as it may include governmental policies and *Zetoc* for its conference proceedings content and particularly broad journal base. A simplified search strategy was created that still made an attempt to filter reviews and a selection of the pro-environmental search terms was used.

Results from each database (containing at least the author, title, publication year, source and ideally an abstract for each record) were downloaded as text files and again imported to ORL bibliographic software.

An internet search was conducted for further significant reviews. A series of relevant websites taken from a comprehensive list of external resources on environmental relationships provided online by The ESRC Centre for Business Relationships, Accountability, Sustainability and Society (http://www.brass.cf.ac.uk/externalresources/External_Web_Links--Environmental_Relationships.html, accessed 10th August 2006) were searched with key terms using either the site's own search engine or a generic 'current site search' or by 'hand-searching' the organisation's online publications list. This search yielded one additional review that was not identified in the electronic database searches above.

2.2.2 Selection of reviews for inclusion

A set of inclusion criteria (see Box 2.2) was applied to the records based on their titles and abstracts:

Box 2.2: Inclusion criteria

1. Published in English language
2. Published in or after 1995
3. Publication is a review of intervention studies
4. Publication must evaluate the effectiveness of “pro-environmental interventions”, therefore the paper must fulfil the three criteria below:
 - Does the paper report evaluation data?
 - Does the paper review a pro-environmental solution(s)?
 - Does the solution(s) in the paper have the aim of improving pro-environmental knowledge, attitudes, behaviour or other relevant outcomes?

The bibliographic databases’ results should have contained only English language publications from 1995 onwards, however this was checked for errors. The records were then excluded along the following hierarchy:

- paper was off subject
- paper was not a review;
- paper did not review a pro-environmental solution(s)
- paper did not have the aim of improving pro-environmental knowledge, attitudes or behaviour.

A flow-chart in Appendix 6.5 gives an overview of the number of records being removed at each stage of this exclusion hierarchy, showing that a total of six records were included from the original 9065 abstracts.

A second reviewer audited the appraisal process by checking 10% of the records for screening (655 records), which resulted in a discrepancy of six records (0.9%), all of which were differences on exclusion reasons. The first reviewer agreed with three of these discrepancies; two records were recoded as off subject (rather than not a review) and one record was recoded as more information needed (rather than off subject). The other three records remained as originally coded, with the agreement of the second reviewer.

Full text articles (or complete abstracts, where missing) were obtained for 87 records, and these were re-screened for relevance. Only six met the full relevance criteria for the review and these were then appraised in terms of selection criteria, systematicity, quality and relevance to the UK using the ORL software. The final set of six reviews included two meta-analyses and four narrative reviews. Though the narrative reviews did not meet the usual quality standards for inclusion, a decision was made in consultation with NICE to include these articles in the review, given the paucity of relevant good quality reviews. The exclusion process was secondary assessed with 100% agreement on what should, and should not, be included.

2.2.3 Quality appraisal

The six included reviews were assessed for quality using the ORL software, again using a similar checklist method to that in appendix A.1 of the NICE *Methods for Development of NICE Public Health Guidance* manual. Reviews were graded for the quality of the review, applicability to the UK and the type of evidence it was reviewing (e.g. RCT, non-RCT).

Bias scoring

The quality of the reviews with respect to bias was assessed using the same procedures as for road safety (see section 2.2.3). None of the four included narrative reviews met the criteria for even a ‘-’ rating and are therefore labelled as ‘unscored’ in the results section.

Evidence scoring

The type of evidence included in the review was also rated depending on whether the systematic review only considered RCTs studies or other types of studies were considered. A new category of review was created within the critical appraisal form to account for the narrative reviews (see Table 2.11 below).

Table 2.10: Evidence scoring

Classification	Types of evidence
1	Systematic reviews of RCT
2	Systematic reviews or meta-analyses of non-RCT studies: case control studies; cohort studies; controlled before and after (CBA); interrupted time series (ITS) and correlation studies.
1&2	Systematic review of both RCT and non-RCT studies
3	Narrative review of non-RCT studies.

2.2.4 Study categorisation

There were six reviews included in this report, all of which were assessed for their potential bias, Table 2.12 shows the number of reviews fulfilling each of the criteria. From this table it can be seen that two criteria were fulfilled for all reviews: a focused aim or research question and data supports conclusions.

Table 2.11: Percentage of total number of included reviews (n=6) meeting criteria for bias

Criteria	n	%
1. Was there a focused aim or research question?	6	100
2. Explicit inclusion/exclusion criteria?	5	83
3. More than one selector/assessor?	2	33
4. Provide details of databases searched?	3	50
5. List years searched?	0	0
6. Followed up references in bibliographies?	3	50
7. Experts consulted for further scores?	2	33
8. Grey literature searched/included?	2	33
9. Specified search terms/ strategy?	2	33
10. Not restricted to English language only?	0	0
11. Quality assessed?	2	33
12. Data supports conclusions?	6	100

Table 2.13 shows the bias scores for the reviews, where a review could score between 0 (no criteria met) and 12 (all criteria met). Two of the reviews (both meta-analyses) fulfilled at least 10 of the criteria, with the remaining reviews fulfilling four or less of the criteria, thus indicating that the quality of the reviews was relatively low.

Table 2.12: Number of reviews cross-tabulated with bias scores (n=6)

Bias score (out of 12)	# Reviews	Probability Density Function (PDF) (%)	Cumulative Density Function (CDF) (%)
0	0	0%	0%
1	0	0%	0%
2	1	17%	17%
3	1	17%	33%
4	2	33%	67%
5	0	0%	67%
6	0	0%	67%
7	0	0%	67%
8	0	0%	67%
9	0	0%	67%
10	2	33%	100%
11	0	0%	100%
12	0	0%	100%

Combining the bias with the behaviour type allows a summary of the quality levels to be seen, as shown in Table 2.14.

Table 2.13: Review quality for each behaviour-type category (n = 6)

Intervention	High quality reviews				Well conducted Reviews				Reviews of variable quality				Non-rated reviews				Total
	1	1&2	2	3	1	1&2	2	3	1	1&2	2	3	1	1&2	2	3	
	++	++	++	++	+	+	+	+	-	-	-	-					
Recycling	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	3
Energy Conservation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Litter Reduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Responsible Environmental Behaviour	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

2.2.5 Assessing applicability to the UK

Each review was scored for its relevance to the UK according to Table 2.15. Table 2.16 illustrates the number of each relevance score by behaviour type.

Table 2.14: Relevance to the UK scoring

Score (A-D)	Description
A (directly relevant)	Review includes UK studies
B (probably relevant)	Review includes non-UK studies of interventions that would be most likely to equally apply to UK settings OR review is not explicit about the geographical origin of included studies though the interventions are most likely to equally apply to UK settings.
C (possibly relevant)	Review includes non-UK studies that may have some application to UK settings but should be interpreted with caution.
D (not relevant)	Review contains non-UK studies that are not relevant to UK settings.

Table 2.15: Relevance to the UK scoring by intervention (n=6)

Intervention	A	A1	B	C	D
Recycling	0	0	3	0	0
Energy Conservation	0	0	1	0	0
Litter Reduction	0	0	1	0	0
Responsible Environmental Behaviour	0	0	1	0	0
Total	0	0	6	0	0

2.2.6 Data extraction and synthesis

Data were extracted from the reviews by one reviewer, again using ORL software. This was checked by a second person.

Evidence statements

Evidence statements were drawn up based upon the level of evidence, the efficacy of the intervention and the applicability of the research to the UK. Each evidence statement addresses both the quality of the review and the effect of the intervention(s).

3.0 ROAD SAFETY: SUMMARY OF FINDINGS BASED ON RESEARCH QUESTIONS

Eighteen reviews are included in this section, reporting on a range of interventions. The interventions were aimed at various road user groups (car drivers, motorcyclists, cyclists, pedestrians), had wide-ranging aims, and adopted a variety of strategies. The table below illustrates the coverage of the 18 reviews in terms of the main focus of the interventions examined in the review and the groups targeted by the interventions. It should be noted that the review of ‘community injury prevention’ was extremely heterogeneous, and included interventions that addressed topics also covered in other reviews, such as seat belt use and drink driving (see Appendix 6.9 for the included reviews’ references).

Table 3.1: Coverage of the reviews in terms of road user groups and focus of intervention

Focus of interventions	Target group	No. of reviews	Reviews
Seatbelt/child seat use	Drivers, parents, children, passengers	4	Ehiri et al 2006; Grossman & Garcia 1999; Segui-Gomez 1999; Turner et al 2005
Pre- and post-license education	Drivers, future drivers	4	Hartling et al 2004; Ker et al 2003; Roberts et al 2001; Vernick et al 1999
Drink driving	Drivers, offenders	3	McArthur & Kraus 1999; Willis et al 2004; Zwerling & Jones 1999
Safety cameras	Drivers	2	Aeron-Thomas & Hess 2005; Pilkington & Kinra 2005
Traffic calming	Drivers	1	Bunn et al 2003
Visibility clothing	Drivers	1	Kwan & Mapstone 2002
Bicycle helmet use	Cyclists	1	Spinks et al 2005
Pedestrian education	Children, parents	1	Duperrex et al 2002
Community injury prevention	All road users	1	Klassen et al 2000

Findings are arranged by focus of interventions. It was not possible to arrange the findings by behavioural outcomes because some reviews examined a very specific behaviour (eg. correct use of child seats) while others used only very general outcomes such as crashes or injuries. Similarly, it was not possible to arrange findings by intervention type because some reviews covered a wide range of interventions (eg. education, legislation, mass media) and results were not always reported in sufficient detail for the different kinds of intervention.

Within each of these sections (sections 3.1 to 3.9), findings are reported using the same sub-structure. Findings are first of all reported for the first research question, ‘What are the characteristics of road safety interventions?’ Here, the following features of the interventions are described:

- aims
- outcome measures
- strategies and approaches
- target population
- intervention setting
- level of change
- use of behavioural theories or models

By ‘level of change’, we refer to whether the interventions were delivered at an individual, community or population level (see section 1.2.3). It should be emphasised that, where reporting findings relating to the ‘characteristics of interventions in terms of objectives, levels at which change is sought, target groups, rationale for targeting, approaches and methods’, we have endeavoured to include as much detail as possible from the included reviews on each characteristic and to be consistent in our reporting. If, for example, no information is given on any theoretical models or approaches underpinning interventions, this is because that information was not given in the review in question.

For each topic (Sections 3.1 to 3.9) findings are then reported for the second research question, ‘What is the evidence for effectiveness of road safety interventions in terms of changes in road safety knowledge, attitudes, behaviours and other related outcomes?’ Where the results of statistical tests are reported, these are included in either the main text or the evidence tables (5.1). Evidence statements are then presented for each topic.

Section 3.10 addresses the third research question, ‘What information if any is provided on factors that influence effectiveness?’ Here, rather than address the issues topic by topic, the review attempts to look across topics at overriding issues such as intervention duration, setting and approaches. Section 3.11 presents an evidence summary for the whole section and section 3.12 describes the gaps in the evidence base.

3.1 Seatbelt/child seat use interventions

3.1.1 What are the characteristics of seatbelt/child seat use interventions?

Interventions to promote use of seat belts, correct seat restraints for children or rear seats for children are examined in four reviews.

One review (Turner et al 2005) (2- B) of eight studies examined community interventions designed to promote the proper use of car restraints for children under the age of sixteen. The interventions were in the USA and Sweden and were described as community-based programmes involving legislation, targeted education and mass media. Effectiveness was measured in terms of injuries to children requiring emergency department, hospital treatment or resulting in death; relative risk of severe injury and mortality due to motor vehicles; and observed use of booster child restraints. The interventions targeted both children under the age of sixteen and parents. Little information was provided in the review about any theoretical approaches underpinning the interventions or about their specific methods and activities.

Non-legislative community and clinical programmes for increasing the use of proper child restraints were examined in another review (Grossman & Garcia 1999) (1&2- B). Eighteen studies were included, comprising community campaigns (two studies), day care centre education programmes (5 studies) and infant car seat loan programmes during the peripartum period (11 studies). Effectiveness was measured in terms of increased observed restraint use. The interventions targeted children under the age of five years and their parents, and were implemented in the USA, Canada and New Zealand. Again, little information was provided on any theoretical approaches underpinning the interventions, although more information was provided than in the previous review on intervention methods, which varied across the three intervention groupings. Three of the day care centre education programmes consisted of a formal curriculum targeted at children and their families and the other two used an incentive reward system to promote car seat use. Of the

two community campaigns, one used a lottery reward system for families who were observed to have seat belts fastened, along with car seat use messages on radio, newspaper and flyers. Information concerning the 'reward' was advertised on local radio, but the review gives no information about how the observation was carried out. The intervention that did not use incentives broadcast its safety message via a public information campaign utilizing TV, newspapers and radio, distribution of posters and pamphlets, and by emphasising deaths and injuries to unrestrained children. The car seat loan programmes involved one or more of the following interventions:

- receipt of a free or loaned car seat
- brief encounter with a physician, nurse, or film stressing importance of car seat use
- receipt of pamphlets and other written materials promoting car seat use
- follow-up reinforcement of the safety messages during routine health visits to the child by health care professionals
- a home visit.

One review of six studies examined two types of interventions - legislative (four studies) and educational (two studies) - for promoting the use of rear seats for children (Segui-Gomez 1999, 2+ A). The measured outcomes in this review were the number of children riding in rear seats, and the number of correctly restrained children. The legislative approach was a population intervention, while the educational interventions (using our earlier definition - see section 1.2.3) operated at the community level. Interventions targeted parents and children aged under fourteen, and were implemented in Denmark, Australia, the USA and the UK. Little information was provided on the approaches or methods of the two education interventions, other than that one only emphasised the seating position of the child within a car, while the other primarily emphasised proper child restraint, with the secondary emphasis being on correct seating location. The four studies that examined legislative interventions all considered laws that were designed to ensure that children were correctly restrained when seated in the front seats.

Educational interventions on their own and combined with incentives, discounts, free booster seats or coercion, plus one enforcement intervention, were examined in one review of five studies (Ehiri et al 2006) (1&2++ B). These interventions sought to increase acquisition and use of car booster seats in motor vehicles among parents of four to eight year olds and operated at the community level. The populations studied were:

- children attending 45 preschools (randomly selected from the telephone directory) in Newcastle, Australia;
- child care centres and after school programmes in Seattle, USA;
- low-income families whose children were attending preschool (aged four to five years old) in Washington state, USA;
- children aged four to six years old in Indianapolis, USA;
- children between the ages of 3½ and eight years old and weighing between 16 to 36kg, in Virginia, USA.

The Indianapolis intervention was based on the Health Belief Model of behavioural change; no details were given of any theoretical approaches underpinning the other interventions. The intervention methods are summarised below:

- The Newcastle intervention was designed to increase children's acceptance of being restrained and taught children to insist on wearing a restraint when travelling in the

car. The intervention also issued parents with letters from the Chief Inspector of Police outlining the legislation concerning the wearing of safety restraints by children, and warned parents that police would be conducting random checks in the area and would fine parents whose children were not adequately restrained.

- The Seattle intervention was a multi-faceted campaign to increase the use of booster seats consisting of: a community partnership to promote the use of booster seats with parents and caregivers providing feedback (this also helped to ensure community involvement); a community education programme to increase knowledge of the importance of booster seats including newspaper articles and a booster seat website, along with information addressing the practicalities of booster seat use (types of booster seats, where they are available from); discount booster seat coupons; and training programmes about booster seat use for health and child care providers.
- The Washington State programme was delivered by school-based home visitors and included educational materials and free child safety equipment, with those in the comparison group receiving only written information encouraging them to purchase booster seats.
- The Indianapolis intervention compared education plus distribution of booster seats with education plus incentives. The educational element comprised two parts, one part teaching parents how to install and use a booster seat and the second part teaching children why they needed to be properly seated in a booster seat. The education plus distribution group parents received a free booster seat after their educational session, while the education plus incentives group were informed that if they were using a booster seat in six months time they would be entered into a draw to win a gift voucher.
- The Virginia intervention assessed whether booster seat information pamphlets plus money-off coupons would increase booster seat ownership, and also whether pamphlets alone would increase risk perception.

3.1.2 What is the evidence for effectiveness of seatbelt/child seat use interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

Four reviews examined the effects of interventions to promote correct use of seat belts, seat restraints and rear seats for children. Overall the reviews found mixed results.

Five out of eight studies included in Turner et al (2005) (2- B) had positive effects on increasing child seat restraint use in cars (for children aged birth to five years, children aged four to eight, and children under fifteen; the other two studies did not specify the ages of the children studied). Three studies (aimed at children aged one to five, five to sixteen, and no ages were stated for the third study) did not show any positive effects.

The review (Grossman & Garcia 1999) (1&2- B) that examined the effectiveness of non-legislative, community and clinical programmes to increase the rate of child motor vehicle occupant restraint use among children under the age of 5 years found short-term increases for day care centre education programmes, although effects generally diminished after a month or more. The two community-based campaigns were associated with short-term increases in child restraint use, and one of these (the community campaign which did not involve incentives) was also associated with longer term gains, up to six months. Although outside the remit of the review of only looking at interventions aimed at under fives, the effects of the

interventions on older children were smaller. The car seat loan programmes had mixed results, with some programmes showing positive effects. However, the author concluded that intervention programmes to increase car child restraint generally appeared to only have moderate short-term effectiveness, and with time these positive effects generally diminished further. Many of the studies had major design flaws that may have overestimated the effects of the interventions, and the reviewer recommended a need for RCTs to look at the effectiveness of child restraint interventions, especially in the long-term.

The review (Segui-Gomez 1999) (2+ A) of six studies to promote the use of the rear seats for children found increases in the proportion of children riding in the rear seats following two educational interventions, but only in one study were the increases statistically significant. The other four studies examined changes in seating location as a side effect of legislation requiring child restraint use among children travelling in the front seats. In two of these, the percentage of children riding in the rear seats increased significantly, and in the other two studies the small increase in children riding in the rear seats was not significant.

The review (Ehiri et al 2006) (1&2++ B) of four educational and one enforcement intervention with the outcome of booster seat use showed, via meta-analysis, that there was a significant increase in use when any intervention was compared to no intervention (Relative Risk (RR) 2.18; 95% CI 1.12 to 4.23; n = 3,070). For education-only interventions, booster seat use after two weeks was 75%, compared to 60% in the control group, and those in the intervention group were also more likely to purchase booster seats than the control group (38%, compared to 3% after 30 days). The combined results from the two studies showed a beneficial result with a RR of 1.32 (95% CI 1.16 to 1.49, n = 563). For interventions that consisted of distribution of booster seats combined with education, booster seat ownership was 22% (5% in control group) in one study and 67% (control 52%) after six months in another study. The combined RR was 2.34 (95% CI 1.50 to 3.63 n = 380). For interventions that combined incentives with education, 34% in one study had purchased booster seats at one month (control 3%) and in one study 26% were using booster seats (control 20%). However, a third study found no difference in booster seat use after six months. The combined results from the three studies had a RR 2.75 (95% CI 2.41 to 3.13 n = 1898). An enforcement-only intervention found no significant difference in the use of booster seats with RR 1.04 (95%CI 0.91 to 1.20 n = 520).

3.1.3 Evidence statements for seatbelt/child seat use interventions

There is evidence of variable quality (Turner et al 2005) (2- B) that community-based interventions delivered to children under 16 and their parents can be effective at increasing use of child restraints in cars, although not all studies showed this.

There is evidence of variable quality (Grossman & Garcia 1999) (1&2- B) that non-legislative community-based and clinical programmes can increase use of child restraints in cars but generally only in the short-term, with the effect of intervention beginning to reduce after as little as seven weeks.

There is statistically significant evidence of good quality (Segui-Gomez 1999) (2+ A) that both legislative and educational interventions delivered to children under 14 and their parents can have positive effects on the use of rear seats by children.

There is evidence of good quality (Ehiri et al 2006) (1&2++ B) that community interventions, including education, education combined with discounts and education combined with the distribution of booster seats, can significantly increase acquisition and use of child booster seats. The combined approach, of education with distribution of booster seats or education with incentives, gives better results than education alone.

3.2 Pre- and post-license education interventions

3.2.1 What are the characteristics of pre- and post-license education interventions?

Four reviews addressed this topic. Two examined whether school-based pre-license education increases the likelihood of obtaining a driving license and reduces subsequent likelihood of accidents, injuries and driving violations. The rationale for pre-license education programmes is that, per licensed driver, young people are at greater risk for fatal crash involvement than any other age group. In the UK, drivers aged 17-21 years comprise 7% of license holders but 13% of drivers involved in road traffic crashes resulting in injury, and the UK government has proposed to tackle this problem with driver education programmes in schools and colleges. Most of the interventions can be considered community interventions as they are implemented in educational settings in local communities.

The first review (Vernick et al 1999) (1&2- B) of nine studies examined programmes aimed at young people aged 15-17 in terms of the likelihood of obtaining a driver's license, likelihood of being involved in an RTA (road traffic accident) or committing a violation, and reduction of RTAs within the community. The interventions were targeted at high school children (fifteen to seventeen) and the majority were carried out in the USA (the States of Georgia, Connecticut, and studies also looking at 27 states, 47 states and 50 states), and one study was in Australia. There was very little information given concerning the methodology for design of the interventions, or the content of the driver education courses. The second review (Roberts et al 2001) (1+ B) examined three studies of school based pre-license driver education aimed at 15-24 year olds. In this review the measured outcomes were the proportion of students obtaining a driver licence and the accident rate of these drivers, along with related injuries. The instruction methods varied, but included:

- the Safe Performance Curriculum (72 hours of formal instruction and testing);
- the Pre-Driver Licensing Curriculum (24 hours of formal instruction and testing);
- the Shepparton On-Road programme (11 hours of theoretical instruction, 5 hours on-road and off-road driving and 6 hours in-car observation);
- the Shepparton Off-Road programme (11 hours of theoretical instruction, 5 hours off-road driving and 6 hours in car observation);
- the Royal Automobile Club of Victoria programme (2 hours theoretical instruction and 5 hours off-road driving);
- and the Automobile Association of New Zealand driver training programme (8 hours behind the wheel instruction, 8 hours as a passenger while another student was being instructed, 8 lectures on road traffic law and correct attitudes and 2 lectures on motor mechanics).

Graduated Driver Licensing (GDL) systems were discussed in one review (Hartling et al 2004) (2+ B) of twelve studies. GDL schemes place restrictions on young drivers that limit their exposure to higher risk driving situations for a specified period of time after obtaining

their license, based on the rationale that young drivers are more likely to be involved in motor vehicle crashes compared to older drivers. As this is a legislative solution it can be described as a population level intervention, although it can also be considered an individual intervention because the restriction is applied at individual level. The GDL studies were conducted in the USA, Australia and New Zealand. Effectiveness was assessed against the outcomes of: crash rates (overall and Killed or Serious Injury (KSI) accidents; night-time crashes; alcohol related crashes and traffic violations. The different types of GDL examined in the review included supervised driving for the first six months of holding a licence; curfew on driving at night; restrictions on type of vehicle that can be driven; restriction on the type of roads that can be used; and lower blood alcohol concentration (BAC) limits.

Post-licence driver education programmes were discussed in a review (Ker et al 2003) (1++ B) of 24 studies with a total of over 300,000 participants. Effectiveness was measured in terms of reduction in traffic crashes. Driver education for licensed drivers can comprise remedial programmes for poor drivers, or advanced courses for drivers generally, and can be considered as both individual-level and community interventions. The population studied was motor vehicle drivers (including motorcyclists) of all ages and driving experience who hold a valid driving licence, and the programmes were implemented in the USA and Sweden. Two types of educational programmes were examined: remedial, aimed at drivers who have poor driving records (crashes and/or offences), and advanced education aimed at the ‘general driver’ who wants to improve their driving skills. Intervention methods ranged from a mailed-out advisory letter or driving manual to formal educational courses delivered in an individual or a group setting. Three types of educational courses were considered:

- correspondence education involving no direct contact with an instructor;
- group education;
- and individual instruction given on a one-to-one basis in which information could be tailored to the individual.

3.2.2 What is the evidence for effectiveness of pre- and post-license education interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

The review (Vernick et al 1999) (1&2– B) of nine pre-license education studies found evidence from four RCT studies that those undertaking training were more likely to (a) obtain a licence earlier than those who do not undertake training, with the amount of take-up being dependent on the type of training offered, and (b) to be prosecuted for a violation and to be involved in a crash. The data from the five ecological design studies similarly found that those receiving education were more likely to obtain their driving licence earlier but were not associated with lower fatal crash rates. It was also found that there was about a 27% reduction in crashes for young people in schools which removed driver education programmes, compared to no change for those schools who kept their programmes. There was no credible evidence that school based driver education reduces crash involvement for young drivers.

A second review of pre-license education (Roberts et al 2001) (1+ B) found similarly equivocal results. One trial found no difference in crash rates for those who received training and those who did not; however, another trial saw a small increase in crashes for those receiving training, along with a higher rate of licensing. One trial found that trained students

obtained their licence much earlier than those not receiving training (111 days compared to 300 days for males; 105 to 415 days respectively for females). However, this same study also found that 16% of those who received training had been involved in a crash, compared to 14.5% of those who had not. There was no evidence from either review that driver education reduced the crash rate of young drivers. Rather, this intervention appeared to be counterproductive, as it led to earlier licensing which actually may have increased the number of crashes in which newly qualified drivers were involved.

The review (Hartling et al 2004) (2+ B) of GDL systems for young drivers found an overall reduction in crash rates across different crash types for 16 year olds. One year after GDL was introduced, studies found:

- an overall drop in crashes for sixteen year old drivers (varying from 8% to 73%) in six locations;
- a drop in crashes for teenage drivers (varying from 7% to 19%) in three locations;
- changes in crashes for accidents involving injuries for sixteen year olds between +3% and a drop of 43%, with only one study reporting a rise (out of nine studies) in eight locations;
- a drop in crashes causing injuries for teenagers (varying from 11% to 23%) in six locations.

Two studies reported on crashes involving sixteen year olds that caused someone to be hospitalized, both in New Zealand, with reductions of -35% and -27%; four studies from two locations reporting on crashes involving sixteen year olds that caused someone to be hospitalized found drops of between 19% and 28% (adjusted). The evidence showed that GDL was effective in reducing the accident rate of young drivers, although the reviewers recommended that more research was carried out.

The review (Ker et al 2003) (1++ B) that evaluated the effectiveness of post license driver education for reducing traffic crashes found no evidence that post license education was useful in preventing accidents (injury crashes: pooled RR = 1.12 (95% CI 0.88, 1.41- trial heterogeneity was significant $p < 0.00001$; all crashes; all crashes RR = 0.98 (95% CI 0.94, 0.98 – trial heterogeneity was not significant $p = 0.75$). The overall results were compatible with small reductions in traffic offences (RR = 0.96 (95% CI 0.94, 0.98 – trial heterogeneity was significant $p < 0.00001$), but this may have been caused by selection bias. Results were consistent across the different educational methods (correspondence course, group education, individually tailored education). The reviewer concluded: “because of the large number of participants included in the meta-analysis we can exclude, with reasonable precision, the possibility of even modest benefits” for preventing crashes.

3.2.3 Evidence statements for pre- and post-license education interventions

There is evidence from two reviews (Vernick et al 1999 (1&2- B) and Roberts et al 2001 (1+ B)) that pre-license education for young people leads to earlier licensing and increases their subsequent likelihood of having crashes, and is therefore counterproductive.

There is evidence of good quality (Ker et al 2003) (1++ B) that post-licence driver education is not effective.

There is evidence of good quality (Hartling et al 2004) (2+ B) that Graduated Driver Licensing systems reduce the crash rates of young drivers. However, the relative contribution of different provisions within a Graduated Driver Licensing programme remains uncertain.

3.3 Drink-driving interventions

3.3.1 What are the characteristics of drink-driving interventions?

Three types of legislative interventions for reducing drink driving were examined in three reviews: ‘administrative per se’ laws, ignition interlock devices, and low blood alcohol concentration (BAC) laws for younger drivers. Legislative interventions are population-level interventions, although they may also be considered individual interventions as they are applied at the individual level.

‘Administrative per se’ laws in the USA were examined in one review (McArthur & Kraus 1999) (1&2++ B), which sought to examine if such laws are more effective than other forms of sanctions for reducing drunk driving recidivism. Administrative per se laws for drink driving enable penalties, such as licence suspension, to be imposed on the driver almost immediately, through administrative channels rather than via the courts. It is assumed that the immediacy of the sanction increases its effectiveness. The effectiveness of this intervention was assessed by comparing drivers who had their licenses suspended through an administrative per se route to those who had their licenses suspended by the courts. This was done by examining the recidivism and accident rates for both sets of drivers during the time period when their licenses were suspended and also in the period when their licenses were returned. The target population for the interventions was drivers arrested for driving while under the influence offences.

The effectiveness of ignition interlock programmes on recidivism rates of drink drivers was examined in one review of 14 studies (Willis et al 2004) (1&2+ B). An ignition interlock device requires that the driver’s breath is tested for alcohol prior to starting the car, and will not allow the car to be driven if the driver is over the blood alcohol concentration limit. These programmes are considered an appropriate strategy for repeat drink-driving offenders who resist rehabilitation. Effectiveness was measured in terms of recidivism rates: while the driver was involved in an ignition interlock programme; after the ignition interlock had been removed; and during the entire study period. The interventions were implemented in the USA, Canada and Sweden.

The effectiveness of different low blood alcohol concentration (BAC) laws for younger drivers (up to the age of 25) was examined in one review (Zwerling & Jones 1999) (2++ B). These are laws which set a lower BAC level for younger drivers than for the general driving population, and are intended to have a deterrent effect by lowering the threshold at which young drivers who drive under the influence will be prosecuted. The rationale for different laws was that, compared to all age groups, young drivers have the highest risk of fatal crashes, and in the USA 21% were killed in crashes in which the driver had a BAC of greater than 0.10%. The BAC law interventions examined in the review were implemented in Australia and the USA. Effectiveness was measured in terms of all motor vehicle crashes, crashes involving injury and fatal crashes. Some of the interventions attempted to impose reduced, or zero, BAC levels for the first year of holding a driving licence, while other laws imposed lower BAC levels up to a specific age, either 20 or 21 years old.

3.3.2 What is the evidence for effectiveness of drink-driving interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

The review (McArthur & Kraus 1999) (1&2++ B) to determine whether administrative per se laws are more effective than other forms of sanctions for reducing drunk driving recidivism found positive results in some states but not others. It found a combined odds ratio of 0.78 for subsequent drunk driving offences, an OR of 0.65 for subsequent traffic crashes and an OR of 0.73 for subsequent alcohol-related crashes. Three of the states (North Dakota, California and Nevada) had positive results for at least one year following the initial license suspension; however two states did not (Mississippi and Louisiana). The ineffectiveness of the intervention in these two states could not be readily explained and therefore it was unclear how generalisable the positive effect was to other populations, especially those whose cultural experiences of alcohol and its relationship to motor vehicles differ. The review authors commented that as socio-cultural factors may have been important to the success of this intervention, there was a need for further research that takes into account these elements.

The review (Willis et al 2004) (1&2+ B) assessing the effectiveness of ignition interlock programmes on recidivism rates of drink drivers found that ignition interlocks had an effect only while they were installed. In the one RCT study recidivism was lower while the device was installed (RR = 0.36 95% CI 0.21, 0.63) but increased (to 1.33 95% CI 0.72, 2.46) once the device was removed, therefore when the two results were combined the overall effectiveness of the interlock was seriously compromised. A similar pattern was seen in all thirteen non-randomised controlled trials, with lower recidivism when the interlock was installed (significant for nine of the trials) but no effects after the interlock was removed. The two controlled trials that reported the combined effect of the time period of when the interlock installed and the period after removal found that the interlock did not reduce recidivism.

The review (Zwerling & Jones 1999) (2++ B) of six studies to determine whether low blood alcohol concentration (BAC) laws for younger drivers reduce motor vehicle injuries generally found positive effects. One study found that a 0.02 BAC for first year drivers reduced night-time injuries for drivers under eighteen by 17% (not significant). Another study that assessed the effect of a legal limit of 0.02 BAC for drivers under 21 on teenage drivers found a statistically significant reduction in “had been drinking” crashes when comparing teenage drivers with older drivers. A zero BAC for first year drivers saw a reduction in injuries for 17-20 year olds (18%), and another study saw a small reduction (4%) in Killed or Serious Injury (KSI) accidents (not significant). Other studies saw similar reductions in accidents (including KSI).

3.3.3 Evidence statements for drink-driving interventions

There is evidence of good quality (McArthur & Kraus 1999) (1&2++ B) that administrative per se laws sometimes have a positive effect on drink-driving recidivism and subsequent alcohol-related crashes. However, effectiveness may be influenced by social and cultural factors.

There is evidence of good quality (Willis et al 2004) (1&2+ B) that ignition interlock programmes reduce drink-driving recidivism while they are installed but not after their removal.

There is evidence of good quality (Zwerling & Jones 1999) (2++ B) that lower BAC laws for younger drivers reduce motor vehicle injuries, and that the more restrictive the law, the greater the effect.

3.4 Safety camera interventions

3.4.1 What are the characteristics of safety camera interventions?

Two types of safety camera interventions were covered by the literature: cameras to detect motorists who are exceeding the speed limit, and cameras to detect motorists who drive through red lights. Safety cameras can be considered population-level interventions that involve an engineering solution backed up by legislation and enforcement.

One review of fourteen studies (Pilkington & Kinra 2005) (2++ A) examined whether speed cameras reduced road traffic collisions and casualties, with the outcomes of road traffic accidents (RTAs), injuries and deaths. The assumption behind speed camera interventions is that speed is a major preventable factor in road traffic collisions and casualties. Six studies assessed the effect of fixed cameras, four studied the effect of mobile cameras, and four studied the effects of a combination of fixed and mobile cameras. The interventions included:

- mobile speed cameras used at 101 sites in the South Wales police force area;
- 49 fixed camera sites in Cambridgeshire;
- 599 fixed and mobile cameras in eight pilot areas in the UK;
- fixed cameras in ten routes across the UK;
- fixed and mobile cameras at 174 speed camera sites across nine UK police force areas;
- fixed cameras at eight sites in Oxford;
- cameras at 12 locations along a highway corridor in Canada;
- mobile cameras at 30 sites also in Canada;
- 73 mobile radar devices operated from marked and unmarked police cars in Victoria, Australia;
- fixed and mobile cameras across 60 sites across Australia;
- 54 speed cameras operated from unmarked police vans at various sites in Australia;
- fixed cameras in 24 speed camera zones in New Zealand;
- fixed and mobile cameras at 1300 sites across New Zealand;
- and fixed cameras along 64 road sections in Norway.

The second review, of ten studies, examined the effects of safety cameras designed to detect motorists who 'jump' red traffic lights (Aeron-Thomas & Hess 2005) (2+ B). Effects were measured in terms of incidence of RTAs, including KSI, and of red-light violations, at camera sites as well as the surrounding area. The rationale behind this intervention was that red-light running is a common cause of crashes at signalised intersections and that red-light cameras can promote compliance with traffic signals. The safety camera measures examined in the studies included:

- a total of 98 signalised junctions divided into camera and control sites with an average of 7-19 cameras rotated amongst 46 camera sites in South Melbourne, Australia;
- 5 red-light cameras rotated amongst 15 signalised junctions with high traffic volumes in Adelaide, Australia;
- 6 red-light cameras rotated amongst 16 signalised junctions in Sydney, Australia;

- a city-wide comparison of Oxnard, USA (with red-light cameras) with three control cities without red-light cameras, with red-light cameras installed at 11 of 125 signalised junctions (2% of all signalised junction approaches) in the camera city;
- a comparison of seven signalised junctions in Fairfax, Virginia, USA and 2 signalised junctions in nearby counties, with five red-light cameras at signalised junctions;
- 19 red-light cameras at 19 approaches at 19 sites compared to all other junctions in San Diego, USA;
- 10 red-light cameras rotated amongst 16 approaches at 11 junctions and compared to all other junctions in Sacramento;
- four red-light cameras rotated amongst 11 junctions and compared to non-signalised junctions in Oxnard, California, USA;
- 18 red-light cameras at 18 approaches, compared to all other Los Angeles County intersections;
- and a comparison of 84 signalised junctions in Singapore, with 42 red-light cameras and 42 comparison signalised junctions (all high-risk locations with similar layouts).

3.4.2 What is the evidence for effectiveness of safety camera interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

The review (Pilkington & Kinra 2005) (2++ A) of speed cameras found in thirteen of the fourteen studies that safety cameras were effective up to three years after their installation, with one study showing effectiveness 4.6 years after introduction. Reductions in the immediate area of the camera sites ranged from 5% to 69% for collisions, from 12% to 65% for injuries, and from 17% to 71% for deaths; reductions over a wider area were also of a similar size. The review showed that safety cameras were an effective way of reducing road traffic accidents and casualties.

The review (Aeron-Thomas & Hess 2005) (2+ B) of red-light cameras found a reduction of: total casualty crashes (Risk Ratio (RR) 0.84); right angle crashes (RR 0.76); rear end casualty crashes (RR 0.87); total crashes (RR 0.85) and red-light violations (RR 0.53). The review concluded that red light cameras were effective, particularly for total casualty crashes, although the evidence was not as conclusive for specific crash types and violations, as these reductions are not statistically significant.

3.4.3 Evidence statement for safety camera interventions

There is evidence of good quality (Pilkington & Kinra 2005) (2++ A) that speed cameras reduce road traffic accidents both in the immediate and wider area, and evidence of good quality (Aeron-Thomas & Hess 2005) (2+ B) that red-light cameras also reduce road traffic accidents.

3.5 Traffic calming interventions

3.5.1 What are the characteristics of traffic calming interventions?

Area Wide Traffic Calming (AWTC) measures designed to discourage the use of residential streets for through travel were examined in one review of 16 studies (Bunn et al 2003) (2- A). Effectiveness was measured in terms of pedestrian deaths and injuries, pedestrian-motor vehicle collisions and all road user deaths, injuries and crashes where 'road users' included pedestrians and cyclists as well as drivers and occupants of motor vehicles. Traffic calming can be considered either a community intervention (because it is implemented in a local community) or a population intervention because it does not discriminate between communities, and involves engineering solutions. For schemes to be included in this review they must have involved a number of specific changes to the road layout, road hierarchy, or road environment. The areas in the studies were predominantly residential, often located close to the central commercial sector of a large town or city. The interventions comprised:

- various measures including different levels of road surface, staggered lanes and 30km speed limit (Berlin, Germany);
- road narrowing, speed restrictions and a wide range of traffic restraint measures (Buxtehude, Germany);
- reconstruction of major roads and renewal of residential roads (Esslingen, Germany);
- road narrowing, redesign of major roads, traffic free zones and speed restrictions (Borgentreich, Germany);
- reconstruction of public spaces, road narrowing and narrowing of road entrances (Mainz, Germany);
- rebuilding of major roads and increasing the level of vegetation in streets (Moabit, Germany);
- road humps, horizontal road shifts, road closures and restrictions, road narrowing (Rijswijk and Eindhoven, The Netherlands);
- roundabouts, pedestrian crossings and changes to intersections (Swindon, UK);
- junction redesign and closures of through routes (Bradford, UK);
- junction redesign, mini-roundabouts, right turn bans, improvement of pedestrian crossings, improved road signs and markings, and road closures (Bristol, UK);
- road closures, right turn bans and mini roundabouts (Reading, UK);
- road closures, traffic islands, central refuges, additional pedestrian crossings and turning restrictions (Sheffield, UK);
- speed humps, slow points, roundabouts and a 40km speed limit (Sydney, Australia);
- dense coverage of traffic calming devices including speed humps, roundabouts and road closures.

3.5.2 What is the evidence for effectiveness of traffic calming interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

The review of traffic calming measures (Bunn et al 2003) (2- A) found, using pooled ratios across the studies, a reduction in fatal accidents (0.63 - 95% CI 0.14, 2.59 although care should be taken in interpreting this result due to the low number of events), with a smaller reduction in accidents causing injury (0.89 – 95% CI 0.80, 1.00) and a small reduction in all accidents (0.95 – 95% CI 0.81, 1.11). In addition, one trial found that residents in the ‘calmed’ area supported the changes, while another trial found that the majority (65%) felt that the safety of the area had remained the same or had diminished. The authors conclude by suggesting that area-wide traffic calming in towns and cities may be an effective intervention for reducing road traffic injuries and deaths.

3.5.3 Evidence statement for traffic calming interventions

There is evidence of variable quality (Bunn et al 2003) (2- A) that area-wide traffic calming in towns and cities may be an effective intervention for reducing the number of road traffic injuries, and deaths, although there is weaker evidence for its impact on accidents.

3.6 Visibility clothing interventions

3.6.1 What are the characteristics of visibility clothing interventions?

The effect of visibility aids for pedestrians and cyclists on drivers’ detection ability was examined in one review of 37 studies (Kwan & Mapstone 2002) (1++ B). The focus of the review was on the effects on drivers rather than on interventions to increase the awareness or use of this clothing by pedestrians and cyclists. The rationale for this intervention was that late detection of other road users is one of the basic driver failures responsible for collisions, and the outcomes of interest were the occurrence of pedestrian- or cyclist-motor vehicle collisions and injuries, as well as drivers’ responses in terms of detection of pedestrians and cyclists wearing visibility aids. However, no studies which reported the effect of visibility aids on collisions or injuries were found, therefore only their effectiveness in terms of drivers’ detection of those wearing visibility aids was discussed in the review. Different types of visibility clothing were examined, including ‘active’ materials (lights, flashing or non-flashing lamps, light emitting diodes and coloured lights) and ‘passive’ materials (bright colours, reflective materials, coloured garments, accessories such as fluorescent and retro-reflective vests), and 'biological motion' clothing which was designed to reflect recognisably human motion.

3.6.2 What is the evidence for effectiveness of visibility clothing interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

This review (Kwan & Mapstone 2002) (1++ B) of the effect of visibility clothing for pedestrians and cyclists found evidence that drivers’ detection of other road users did increase with the wearing of visibility aids. Fluorescent materials in yellow, red and orange colours improved detection and recognition in the daytime, and night time detection and recognition was improved by: lamps, flashing lights and retro-reflective materials in red and yellow colours. In addition, retro-reflective materials arranged in a 'bio-motion' configuration (designed to reflect recognisably human motion) enhanced recognition. None of the 37

studies reviewed reported the effect of visibility aids on the occurrence of pedestrian and cyclist-motor vehicle collisions and injuries.

3.6.3 Evidence statement for visibility clothing interventions

There is evidence of good quality (Kwan & Mapstone 2002) (1++ B) that high visibility clothing of certain types worn by pedestrians and cyclists' increases drivers' ability to detect them. Effects on vehicle-pedestrian collisions are not measured.

3.7 Bicycle Helmet Use Interventions

3.7.1 What are the characteristics of bicycle helmet use interventions?

Interventions to promote the use of cycle helmets were discussed in one review (Spinks et al 2005) (2+ A). The outcomes of interest were: observed helmet use; reduction of head injuries admitted to A&E; self reported helmet use; bicycle related injuries using hospital discharge data; injury rates for children admitted to the accident and emergency department and bicycle injury that did not include head injury. The interventions were community level interventions targeting children aged 0 to 14. Intervention approaches included education, incentives, awareness campaigns and legislation, although no information was provided on any theoretical models underpinning the interventions. The methods used in the interventions varied and included:

- school-based educational talks with age-specific information backed up with true case scenarios and videos of brain-injured children;
- bicycle safety education as part of the school curriculum backed up with discounted helmets;
- an educational programme promoting primary school children's helmet use with helmets provided free to the poorer students;
- establishment of an interest group (doctors, police, school principals, etc) and an awareness campaign in the local media;
- community-based organising committee coordinating the intervention programme (posters, role playing, increasing helmet availability, awards for helmet use);
- a mass media awareness raising campaign, press conferences, posters, brochures and stickers; promoting helmet use by prominent sports figures; lobbying to reduce helmet costs and using discount coupons as a way to subsidise helmet cost;
- helmet use promotion campaign at public events, backed up with public service announcements;
- awareness campaigns implemented via conferences, mass media events, a 'be bike smart week', a resource book, posters with major sports figures, and legislation;
- the enactment of legislation making helmet use compulsory backed up with practical courses on helmet use and distribution of helmets;
- and legislation making helmet use compulsory, with the police having the power to impound bikes if a helmet was not being worn.

3.7.2 What is the evidence for effectiveness of bicycle helmet use interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

This review (Spinks et al 2005) (2+ A) found that community interventions positively influenced cycle helmet use across all of the outcomes examined. School-based educational talks with age specific information, backed up with true case scenarios and videos of brain-injured children also reduced the injury rates for children admitted to A&E. Another intervention consisting of bicycle safety education as part of the school curriculum, backed up with discounted helmets, increased the use of cycle helmets. An intervention that included establishing an interest group (doctors, police, school principals, etc), along with running an awareness campaign in the media found a rise of observed helmet use from 0.75% to 50.2%, and a similar scheme, with a community based organising committee coordinating the intervention programme (posters, role playing, increasing helmet availability, wards for helmet use) had an increase of use from 1.3% to 32.5%. An advertising campaign raising awareness by using mass media, press conferences, posters, brochures and stickers found a rise in observed helmet use over a two year period.

Promoting helmet use by prominent sports figures, along with lobbying to reduce helmet cost and using discount coupons as a way to subsidise helmet cost, found reductions in children (five to nine year olds and 10 to 14 year olds) being admitted to accident and emergency with head injuries. A helmet use promotion campaign at public events, backed up with public service announcements, increased observed helmet use (11% increase, control dropped by 15%). An educational programme promoting helmet use with primary schools had a self reported helmet use of 37.2%; when helmets were provided free to the poorer students, self reported helmet use rose to 67.6%. Another study examining awareness campaigns implemented via conferences, mass media events, a 'be bike smart week', a resource book and posters featuring major sports figures found increased observed helmet use from 0% to 45% in four years, and this rose to 67% after legislation; head injury hospital admissions also decreased, with further reductions after legislation was enacted. Many other studies looking at legislation found an increase in observed helmet use. Enactment of legislation making helmet use compulsory, backed up with practical courses on helmet use and distribution of helmets, reduced serious head injury by 73%, minor head injury by 52%, and injury that did not include head injury by 42%. Legislation making helmet use compulsory, with the police having the power to impound bikes if a helmet was not being worn, had an observed helmet use increase for 5 to 15 year olds. The author noted that there was not enough detail of methods provided in the studies and that this hindered replication.

3.7.3 Evidence statement for bicycle helmet use interventions

There is evidence of good quality (Spinks et al 2005) (2+ A) that community-based interventions using education, legislation and incentives in various combinations increase cycle helmet wearing by children and young people.

3.8 Pedestrian education interventions

3.8.1 What are the characteristics of pedestrian education interventions?

Safety education of pedestrians was examined in one review (Duperrex et al 2002) (1++ A) of 15 studies. The interventions sought to change knowledge and behaviour and measured the following outcomes: children's perceptions about the safest place to cross the road; knowledge of road safety; observed responses and verbal explanations concerning safety behaviour; simple traffic knowledge and simple safety rules; and individual knowledge test scores. These were community level interventions targeting children and, in one study, 'mentally handicapped' (*sic.*) adults. No information was given regarding any theoretical models underpinning the interventions. Eight interventions involved 'direct education' of children, and seven involved the use of parents or teachers as educators. Six of the studies were conducted in the UK, with the remainder in the USA, Australia, Canada, Japan and Germany. Most of the interventions were delivered in primary schools or kindergartens, and formats and methods across the studies comprised:

- a 6-session training course on safe road crossing;
- training to improve children's understanding of the concept of speed;
- training in crossing the street as part of the Safety City education programme, which involved using a mock intersection of the traffic environment, a lecture in classroom, a booklet and a rock concert reinforcing the messages;
- training in proper sidewalk behaviour, recognition of an intersection, and crossing the street using a tabletop model of a road layout and independence training in a semi-real traffic situation;
- three simulation games targeting attitude, behaviour and both;
- training in real traffic environments;
- training in real traffic environments and using a table top model;
- training using only a tabletop model;
- a road safety education package for class teachers including lectures, class discussions and group activities;
- a booklet for improving parental road safety education and road supervision;
- teaching parent volunteers through a film and instructional booklet how to teach safe pedestrian behaviour to their children;
- a multi-media traffic safety programme, Beltman, which focused on seat-belt wearing and correct pedestrian behaviour;
- traffic education materials for class teachers in infant, junior and middle schools;
- and a comparison of a detailed caution, a simple caution and no caution.

3.8.2 What is the evidence for effectiveness of pedestrian education interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

This review (Duperrex et al 2002) (1 ++A) generally found positive results for the various measures of knowledge and observed behaviour. For example, four primary school studies found that children chose a higher proportion of routes classified as safe to cross following both training in a real traffic situation and training using a table top model, compared to a control group, and one of these studies found that the proportion of 'safe routes' chosen as safe were for those trained in a real traffic environment (σ):

- before training 0.13 (0.20)
- immediately after training 0.72 (0.28)

- nine-weeks after training 0.50 (0.36).

Similar results were found for those trained using a tabletop model. After eight months the figure for both trained groups was 0.38 (0.23) compared to 0.12 (0.15) in the control – WMD 0.26 (95% CI 0.9, 0.43), indicating that the effect of the training decreased with time.

A study using a tabletop model only also found better results than for a control group. Following the Safety City education programme, the intervention group had an increased mean score on a safety knowledge test (maximum score 16 points) from 4.31 to 6.21 (control group changed from 4.27 to 5.63), with the mean change (σ) between pre- and post-tests being 1.9 (2.7) for intervention group and 1.4 (3.5) for control group.

A study comparing the effects on children's observed crossing behaviour of a detailed caution, a simple caution and no caution found results for safe behaviour of detailed caution vs no caution: RR 2.43 (95% CI 1.13 to 5.24); simple caution vs no caution: RR 1.83 (95% CI 0.81 to 4.15).

A Canadian study compared three simulation games targeting attitude, behaviour and both. The three intervention groups achieved higher mean scores than the control group on tests of transfer of learning, attitude and behaviour. For example, the means of the behaviour tests with a maximum score 5 (σ) were:

- attitude simulation game 4.9 (0.2)
- behaviour simulation game 4.3 (0.8)
- attitude and behaviour simulation game 4.5 (0.7)
- control 4.0 (1.1)

Among the 'indirect education' studies, a study of traffic education materials by class teachers found greater 'mastery' (mastery was defined as scoring at least 80% in the test) in traffic situations for children in intervention groups compared with control groups:

- Book one (infants) pre-intervention 28%, post-intervention 34% (control 28%, 30%)
- Book two (lower juniors) pre 32%, post 45% (control 32%, 33%)
- Book three (upper junior and middle) pre 28%, post 35% (control 29% and 31%).

No information was supplied about standard deviations.

A study of a road safety education package for class teachers found knowledge scores (σ) after the intervention of 83.3% (10.6) compared to 35.7% (25.3) for the control group.

One of the interventions examined training which aimed to improve children's understanding of the concept of speed in the hope that this would enable them to make safer road crossing decisions. The percentage of children with the correct understanding of the concept of speed before and after training for four set tasks (no details given concerning the tasks) were:

- Task 1 (speed and time variables are fixed; children operate on distance variable (complex case of unequal speeds)):
 - In the intervention group (n=69), the proportion giving the wrong answer decreased from 78% to 25% between pre and post-test

- In the control group (n=69), the proportion giving the wrong answer decreased from 80% to 62% between pre and post-test.
- Task 2 (speed and time variables are fixed; children operate on distance variable (simple case of equal speeds):
 - In the intervention group (n=69), the proportion giving the wrong answer decreased from 36% to 6% between pre and post-test
 - In the control group (n=69), the proportion giving the wrong answer decreased from 29% to 9% following testing.
- Task 3 (speed and distance variables are fixed; children operate on time variable (complex case of unequal speeds):
 - In the intervention group (n=69), the proportion giving the wrong answer decreased from 54% to 10% between pre and post-test
 - In the control group (n=69) the proportion giving the wrong answer decreased from 47% to 35% following testing.
- Task 4 (speed and distance variables are fixed; children operate on time variable (simple case of equal speeds):
 - In the intervention group (n=69), the proportion giving the wrong answer decreased from 27% to 0% between pre and post-test
 - In the control group (n=69), the proportion giving the wrong answer decreased from 20% to 7% following testing.

The overall RR was 1.27 (95% CI 1.07 to 1.50).

A study of training parent volunteers found that the proportions of children aged three to four years old who stopped at the kerb without being distracted were 4% pre intervention, 83% post intervention, and 20% nine weeks post intervention. The results were 5%, 43% and 15% respectively for the control group (no standard deviations given). A similar pattern of results was found for stopped whilst being distracted, and for children aged 5 to 6 years (14%, 82%, 31% for the intervention group and 9%, 56%, 29% for the control group).

A study of the Beltman programme, with a booster of two sessions four months after the intervention, reported outcomes for children's behaviour (looking before crossing the road) as reported by parents as:

- Beltman programme versus No training: RR 1.40 (95% CI 0.87 to 2.25);
- Beltman+Booster versus No training: RR 1.74 (95% CI 1.15 to 2.65).

Finally, a study with 30 'mentally handicapped' institutionalised adults measured target behaviours (proper sidewalk behaviour, recognition of an intersection, crossing the street) at a city intersection, and reported the results for classroom versus control: RR 1.91 (95% CI 1.23 to 2.98) and independence training versus control: RR 1.43 (95% CI 0.89 to 2.30).

The authors comment that, despite the generally positive results across the studies with primary school children, behaviour changes observed in simulated traffic environments may not translate to real traffic situations.

3.8.3 Evidence statement for pedestrian education interventions

There is evidence of good quality (Duperrex et al 2002) (1++ A) that road safety training of pedestrians can increase their safety knowledge and also increase correct behaviour, although effects on behaviour varied widely. It is unclear to what extent effects might transfer from simulated to real traffic environments.

3.9 Community injury prevention interventions

3.9.1 What are the characteristics of community injury prevention interventions?

One review examined community based interventions to reduce unintentional injuries to children by changing social norms concerning acceptable behaviour relating to safety (Klassen et al 2000) (1&2- A). The review covered a wide range of interventions targeted at drivers, parents, children, pedestrians and cyclists, as well as non-road safety interventions. Most of the road safety interventions in the review were concerned with pedestrian and cyclist behaviour (four and twelve studies respectively). All four of the pedestrian interventions sought to teach safe crossing behaviour to children, with one intervention aimed at three-and-a-half to four year olds, two at four to six year olds and one at five year olds. The specific outcomes were: incidence of running ahead; improved safety behaviour when crossing on quiet streets with parked cars, junctions; actions taken during a quasi-real-life traffic setup; and safety behaviour in simulated traffic. One of the interventions comprised home-based education with parents' facilitation of learning; the other three were school-based education programmes, with details being given for two of the programmes: instruction by a parent and an assistant; education with attitude simulation, behaviour simulation and both attitude and behaviour simulation activities. Another set of twelve studies examined interventions concerned with safer bicycle use by children, with the outcomes examined mainly being helmet ownership/use, and to a lesser extent hospital admissions. The actual interventions were educational, but varied in their approach, with most comprising school-based programmes, sometimes backed up by incentives or legislation. In two of the studies the parents and public were also educated.

Some studies examined in the review were concerned with increasing use of child restraints or correct seating in cars (four studies), and with teenagers' safety knowledge and behaviour regarding seatbelt use (two studies) and drink driving (two studies). The child restraint interventions targeted at parents were educational, but varied in their approach. One pre-school intervention, targeting both low and high income groups, used parental activities with training, while another pre-school educational intervention used a coercive strategy of threatening parents with random police checks that may result in fines. There was also an evaluation of 'good' interventions against 'poor' ones, but there was no information about how good or poor educational programmes were defined. The interventions targeting teenagers were delivered in high schools through the curriculum. One of the teenage seatbelt interventions involved delivering an emotionally charged message, while the other intervention was part of the high school physics course, covering forms of energy, types of vehicular collisions, seat belts, and g-forces.

Very little information was provided on other interventions, although the authors list selected theoretical models used in the interventions as a whole; these include the Health Belief Model (Haggerty 1977), Social Learning Theory (Becker & Mainman 1975), and the PRECEDE Model (Green 1990).

3.9.2 What is the evidence for effectiveness of community injury prevention interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

The review (Klassen et al 2000) (1&2- A) found some positive effects for interventions concerned with children's safe crossing behaviour. Home-based education, with the parent assisting learning, led to a reduction in running ahead for three-and-a-half to four year olds, although there was no change in parent supervision behaviours. School based education for children aged four to six, also with instruction by a parent and an assistant, improved road crossing on quiet streets, between parked cars and at junctions, with the results not being dependent on who provided the education (parent or assistant). In one study that used school based behavioural and attitudinal simulations for five year olds, the intervention groups did marginally better on measures of attitude and behaviour. In another school based education for children aged four to six, there were no differences in observed behaviours regardless of: the presence or absence of a running motorcycle; detailed or vague verbal instructions. The review did not discuss knowledge gains but did conclude that community based interventions can be successful in some child injury reductions, although poorly designed or implemented interventions were not effective.

In terms of bicycle helmet use, the same review found mixed results for education only and for education coupled with incentive interventions, but found only positive results for interventions combining education with legislation. Education-only did not increase helmet use, but there was a 22% take-up of helmets when the education was coupled with financial incentives; however, a similar study found no effect of education with incentives. School/peer/parent based education had no influence on helmet wearing; however, helmet use jumped from 11.4% to 37.5% when this education was coupled with legislation. A similar study found that helmet use went from 8% to 19% for education only and from 4% to 47% for education plus legislation. In a study looking at helmet use for different income brackets using school based parent/public education for five to 14 year olds plus financial incentives, no significant difference was found for the lower income group, although helmet use in the higher income group went from 4% to 36%. A similar study only looking at low income groups found no increase, but a third study with five to 12 year olds found increases for both low and high income groups. A study that looked at the long-term effects of parent/public education coupled with financial incentives found an immediate positive effect on helmet use, with the increase sustained over a twelve-month period. One study found a decrease in hospital admissions (inpatient) for bicycle injuries after a school education programme aimed at parents/public, along with economic incentives. The reviewer concludes that community based interventions can be successful in some child injury reductions within the road safety fields, but that poorly designed or implemented interventions are not effective.

The same review found generally more positive results for interventions to increase child seat restraint use than for safety interventions targeting teenagers. An educational seatbelt intervention incorporated with a high school physics course for 15-17 year olds led to a positive change in seatbelt use knowledge and behaviour which was still evident two years later. However, an emotionally charged educational programme for high school students increased seat belt use knowledge but had no impact on behaviour. An educational intervention for fourteen year olds aimed at increasing knowledge of drink driving and reducing the rate of riding with a driver who has been drinking found an increase in knowledge but no significant effect on behaviour. A similar intervention for fifteen year olds

also found an increase in drink-driving knowledge without any significant change in behaviour.

A study that reviewed an intervention using pre-school education and parent activities/training found that child restraints in cars increased, while a study evaluating 'good' and 'poor' education programmes for impact on low and high-income groups (seven year olds) found that good programmes worked better than poor programmes, with the only significant increase being for the low income good programme. A comparison of a coercive with education programme to increase child restraint found increases for both interventions, with the educational intervention having the biggest rise. A study of an intervention consisting of coercive strategy along with parent and pre-school education for two to six year olds found an increase in restraint use.

3.9.3 Evidence statements for community injury prevention interventions

There is evidence of variable quality (Klassen et al 2000) (1&2- A) that education for four to six year olds regarding road safety has mixed results.

There is evidence of variable quality (Klassen et al 2000) (1&2- A) that education combined with financial incentives and/or legislation can increase children's bicycle helmet use.

There is evidence of variable quality (Klassen et al 2000) (1&2- A) that high-school education increases young people's knowledge and attitudes regarding seat belt use and drink-driving, but interventions to reduce adolescents driving or riding with a driver under the influence of alcohol have been unsuccessful.

3.10 What information, if any, is provided on factors that influence effectiveness?

Very few of the reviews conducted analyses to compare different intervention variables such as duration, intensity or methods. The comments in this section should be treated with caution.

3.10.1 Intervention duration and intensity

Few of the reviews commented on the possible relationship between intervention duration and effectiveness. The review (Klassen et al 2000) (1&2- B) of community based injury prevention interventions noted that very short single interventions (information presented in a school assembly) were not effective in influencing teenagers' seatbelt use. The review (Willis et al 2004) (1&2+ B) of alcohol ignition interlock programmes noted that the benefits of the intervention disappear when the device is removed from a car, suggesting that this intervention would only work if permanently installed. The review (Grossman & Garcia 1999) (1&2- B) of non-legislative community and clinical programmes to increase child restraint use in cars did not comment on intervention duration, but noted that effects tended to dissipate one or more months after the completion of the interventions. The review (Duperrex et al 2002) (1++ A) of interventions addressing safety education for pedestrians found evidence that changes in safety knowledge and observed behaviour decline with time, suggesting that safety education must be repeated at regular intervals, which is also supported

by the group with the booster lessons performing better on a knowledge test six months post intervention.

Two reviews commented on the possible relationships between intervention intensity and effectiveness (dose-response). The review (Zwerling & Jones 1999) (2++ B) of low BAC laws for younger drivers found, in one study, evidence of a dose response effect when comparing laws with different levels of BAC, with the most restrictive laws (zero BAC) being associated with the greatest reduction in fatalities. Conversely, the review (Hartling et al 2004) (2+ B) of Graduated Driver Licensing for young drivers did not find any consistent dose-response effects when examining programmes with fewer or more components. The authors suggest that the number and nature of the individual components in a Graduated Driver Licensing scheme “may be less important than the overriding principle of gradually introducing new drivers to higher risk situations as they acquire more driving experience” (p.10). However, they suggest that night curfews and restrictions on number of passengers seem to be important elements.

3.10.2 Multiple versus single mode interventions

None of the reviews directly compared multiple versus single mode interventions. The review (Ehiri et al 2006) (1&2++ B) of interventions to promote use of child booster seats found varying degrees of effects for interventions involving incentives + education, distribution of booster seats + education, and education only. Interventions that combined education with either incentives (discount coupons for purchase of booster seats) or distribution of free booster seats had a beneficial effect on acquisition and use of booster seats, with distribution of free booster seats being more effective than incentives. One study in the review (Klassen et al 2000) (1&2- A) of community-based injury prevention interventions suggested that an educational intervention promoting bicycle helmet use was more effective when coupled with legislation than education alone, and they were also more effective when they were tailored to and fostered ownership by the community, taking into account factors such as ethnicity. Cycle helmet interventions also worked better if they targeted the barriers to helmet use: lack of awareness about the risks of bicycling and the effectiveness of helmets; the cost of helmets; and the perception of negative peer pressure regarding helmet use.

Community interventions using education, legislation and incentives in various combinations to increase cycle helmet wearing by children and young people were examined by the review (Spinks et al 2005) (2+ A). Although the review does not draw conclusions about which interventions work best, the evidence does seem to suggest that multiple interventions work better (for example, an advertising campaign increased helmet use from 5.5% to 15.7% while bicycle safety education backed up with discounted helmets found an increase in use from 8.5% to 32%) However the author comments that there was “not enough detail in all studies of methods employed so interventions could not be replicated”.

The addition of publicity may enhance the effect of a lower BAC for novice drivers (Zwerling & Jones 1999) (2++ B), and the effect of driver alcohol interlock devices (Willis et al 2004) (1&2+ B) may be more effective if they are coupled with rehabilitation programmes. Red light cameras (Aeron-Thomas & Hess 2005) may be made more effective if warning signs are placed in the vicinity of the cameras.

3.10.3 Intervention setting

None of the reviews directly compared the effectiveness of interventions delivered in different settings (eg. home vs. school vs. community). The review (Grossman & Garcia 1999) (1&2- B) of non-legislative community and clinical programmes (in clinics, day care centres and the community) to increase child restraint use in cars did not comment on any relationship between intervention setting and effectiveness. One review (Duperrex et al 2002) (1++ A) which examined safety education of children in different settings (home, classroom, simulated traffic environment) did not appear to find evidence in favour of any particular setting. The authors commented that it was unclear to what extent observed changes in children's behaviour in simulated traffic environments might transfer to real traffic environments, and suggest that a more appropriate focus for child traffic safety interventions might be modification of the environment and enforcement of speed limits. The review (Klassen et al 2000) (1&2- A) of community-based injury prevention interventions in a range of settings, including community, school, pre-school and home, similarly does not comment on any relationship between setting and effectiveness, but suggests that effective programmes use a broad array of strategies and channels and "rely on existing community organisations and infrastructure". The review also suggests that a simulated road environment may not be a particularly effective intervention setting. High school curriculum interventions appear to have little impact on teenagers' behaviour, as opposed to their knowledge, although this may be attributable to poorly designed programmes rather than the particular setting in which they were delivered.

No particular setting (correspondence, group or individual) for post licence driver education (Ker et al 2003) (1++ B) seemed to work better, nor was there any significant difference between remedial and advanced driver education.

There is an indication that for child restraint in vehicles (Grossman & Garcia 1999) (1&2- B) that interventions in the pre-school setting may work better than community based media campaigns.

3.10.4 Socio-cultural factors

The socio-cultural environment in which interventions are implemented may affect their effectiveness. One review (Klassen et al 2000) (1&2- A) suggested that low income groups may be less responsive to bicycle helmet use interventions than high income groups, even when financial help was provided to help low income families purchase helmets, suggesting that barriers to change may be more substantial in low income communities. Studies which assess the effectiveness of different legislative solutions generally caution that their results may not transfer to countries with different legislative, social and cultural values, particularly concerning alcohol and vehicle use. For child seat restraint use (Grossman & Garcia 1999) (1&2- B) there is an implication that middle class, higher income, parents are more likely to use restraints than the poorer lower classes, and that the nature of having to replace child restraints as a child grows may be a barrier to ownership and use for poorer families.

3.10.5 Implementation quality

Several reviews comment that intervention quality is likely to be a factor in effectiveness, although no reviews set out systematically to examine this. The authors of one review (Klassen et al 2000) (1&2- A) comment that the results of one study of a school-based children's traffic safety programme were influenced both by the quality of programme implementation and by socioeconomic status of the target group.

3.10.6 Incentives, rewards and discounts

The review (Klassen et al 2000) (1&2- A) of community-based injury prevention interventions commented that “educational strategies coupled with economic incentives are often successful at increasing bicycle helmet use” (p.87), although the authors note that intensity and duration of interventions is also important. In the same review, a study of bicycle helmet interventions found that offering discounts on the price of bicycle helmets, along with other strategies, was associated with subsequent helmet use, but only in high income children, even though low income children were offered a greater discount. The authors suggest that broader strategies than incentives may be needed in low income communities (for example, strategies to tackle the perceived danger or impracticalities of cycling in particular communities). Consistent reinforcements and messages may help to sustain effects in promotional interventions designed to increase vehicle restraint use for children (Grossman & Garcia 1999) (1&2- B).

3.10.7 Coercion, legislation and enforcement

Several reviews examined coercive, legislative and enforcement approaches. Graduated Driver Licensing systems (Hartling et al 2004) (2+ B) seem to be effective in reducing young drivers’ crash rates. The positive findings for lower BAC laws for young drivers (Zwerling & Jones 1999) (2++ B) support the use of legislative solutions for tackling drink-driving by young drivers, although the evidence is less consistent for administrative per se laws (McArthur & Kraus 1999) (1&2++ B). Alcohol ignition interlock devices (Willis et al 2004) (1&2+ B), another legislative solution, produce effects but only while they are installed in cars. The review (Klassen et al 2000) (1&2- A) of community-based injury prevention interventions found in one study that coercive interventions for child seat restraint use (threatening parents with police checks and fines) seemed to be less effective than an educational intervention directed at the children; the authors speculate that this may have been because parents did not take the threat seriously enough so it did not act as a sufficient deterrent. A study in the same review found that legislation requiring children under 16 to wear bicycle helmets enhanced the effectiveness of educational interventions when compared with education-only strategies.

3.11 Evidence summary

There is some evidence to support the effectiveness of interventions to increase the use of car seat belts, restraints and rear seat use for children. Community-based programmes have shown modest effects, and a combination of incentives with education also appears to be effective, although positive effects may be eroded with time. Bicycle helmet use can be effectively increased through community interventions using education, legislation and incentives in various combinations.

Legislative interventions are effective in some contexts. Ignition interlocks for drivers convicted of drink-driving offences are effective in preventing re-offending, although only while the interlock is installed. Administrative per se interventions which speed up the imposition of sanctions and punishments on drink-driving offenders may also have a positive effect in preventing subsequent arrests for drink-driving, although the results are not all positive and may be culturally determined. Setting a lower BAC level for younger drivers is likely to produce positive effects, with effects increasing with stronger restrictions. Graduated Driver Licensing, which limits young drivers’ exposure to risky situations, has positive effects on accident and casualty rates.

Engineering solutions such as area wide traffic calming may be an effective intervention for reducing the number of road traffic injuries, and deaths. Safety cameras for speeding and red light jumping, a solution which combines engineering and legislation, are effective in reducing RTAs.

Pre-license driver education for young people is not effective in reducing accidents or violations, and may in fact have adverse effects by increasing the ease with which young people can obtain a license without reducing their risk of crashes. Post-license education for drivers seems to be similarly ineffective. High school education can have positive effects on young people's seat belt knowledge and attitude, but effects on behaviour are mixed; similarly, education about drink driving can increase young people's knowledge of their risks but appears to have little impact on behaviour. Educating younger children about road safety can be effective in increasing knowledge and altering behaviour in simulated environments, but the extent to which effects would transfer to real traffic situations is not always clear.

Finally, certain types of high visibility clothing for pedestrians and cyclists, such as retro-reflective materials arranged in a 'bio-motion' configuration, can increase drivers' detection of these other road users, although the impact on collisions and injuries is not known.

3.12 Gaps in the evidence base

As the remit of this work was to report on reviews of road safety solutions, and not on the original non-review data, many topic areas were not considered because data were not reported at review-level. Similarly, review papers that did address the relevant topic areas were excluded because they did not meet the quality criteria for the review. A brief overview of these 'missing' areas is now provided.

Most of the papers that were examined and rejected for not being a review were in the area of driving behaviour. A lot has been written on the subject of fitness to drive for medical reasons, such as dementia, psychiatric problems and old age. Other areas of research that were not included for the same reasons addressed issues such as tiredness, stress, and general driving competence/knowledge. Papers discussing human factors (which are often the cause of accidents) were not included in this review, yet, for example, the mental workload of road users and how the effects of speed/environment impact on workload is a major factor for safe road use, as is driving-related fear.

Some of the excluded topics also discussed the effects of police interventions, including airbag safety and daytime running lights (DRL). Other areas such as mobile phone use while driving, road rage, tailgating and 'sensation seeking' was also excluded for not reporting review-level data. With the exception of area wide traffic calming, road-engineering solutions were not discussed and papers covering road asphalt and dynamic speed limits were excluded. Additional, very specific topic areas were also excluded from this review, including papers discussing the particular problems of rural or urban areas and the safety of workers within roadwork areas.

There were also some areas that may impact on road safety, on which no papers were found. There were no papers discussing emergency vehicles, either from the standpoint of their drivers or the reaction of other road users to these vehicles. The papers that dealt with cycling concentrated on helmet use, and not on the best way to train cyclists to ride in a safe manner, although some of the child pedestrian literature may be transferable. Nothing at all

was found discussing horses. There was no literature found that discussed the problems faced by a multi-transport environment consisting of the interaction of many types, including many vulnerable road users. In addition, motorcycling, despite the high accident rate associated with this mode, was not discussed beyond analysis of the accident statistics and the use of helmets.

In terms of target populations, most of the papers that were screened for this review concerned car drivers; some did consider other road users, but these were in the minority. There was also a predominance of north American studies, limiting the transferability of some interventions to the UK context. Very few reviews looked at potential differential impact for groups of different social class groups and none reported data on cost-effectiveness.

4.0 PRO-ENVIRONMENTAL BEHAVIOUR: SUMMARY OF FINDINGS BASED ON RESEARCH QUESTIONS

This section describes the results from six reviews that examine the effectiveness of pro-environmental interventions. Two of the reviews are meta-analyses and four are narrative reviews. As discussed in the methodology chapter of this report, the narrative reviews have been included because of the relative paucity of good quality reviews on this topic. Because of their relatively poor design, these reviews do not even meet the quality criteria for a low quality review. They therefore remain ‘unscored’ and are labelled as narrative reviews where their findings are reported. It should be noted that information on the interventions, and the studies that examined them, is often limited or patchy in the reviews.

The reviews address a small range of environmentally responsible behaviours. Three focus exclusively on recycling (Hornik et al 1995, Porter et al 1995, Schultz et al 1995), one examines the conservation of resources like energy and water (Abrahamse et al 2005), one examines litter reduction (Huffman et al 1995), and the final review, a meta-analysis, reports on several environmentally responsible behaviours including recycling, energy conservation, water conservation, efficient transportation and litter reduction (Osbaldiston 2004). The interventions were aimed at various target groups (residential households, school pupils, college students), had wide-ranging aims, and adopted a variety of strategies. The table below illustrates the coverage of the six reviews in terms of the behavioural focus and the range of intervention strategies described in the reviews. See Appendix 6.9 for the full reference to the included reviews.

Table 4.1: Coverage of the reviews in terms of behavioural outcomes and interventions strategies

Review	Behavioural Focus	Range of Intervention Strategies
Hornik et al (1995)	Recycling	Extrinsic incentives (eg. monetary rewards, social influences), external facilitators (eg. increasing frequency of collection, increasing proximity of recycling bins), intrinsic incentives (eg. personal satisfaction from recycling), and internal facilitators (eg. knowledge about recycling).
Porter et al (1995)	Recycling	Prompting, getting people to make a commitment to recycle, altering the environment, setting goals, providing feedback, rewards and penalties.
Schultz et al (1995)	Recycling	Prompting, getting people to make a commitment to recycle, using social norms, setting goals, removing barriers, providing feedback, and rewards.
Abrahamse et al (2005)	Energy conservation	Providing information, getting people to make a commitment to conserve energy, setting goals, modelling, feedback, and rewards.
Huffman et al (1995)	Litter reduction	Prompting, community interventions and modelling, removing prior litter, environmental design, and rewards.
Osbaldiston (2004)	Various including recycling, energy conservation, litter reduction and efficient transportation.	Providing rewards or incentives, using prompts, providing information, providing rational reasons for change, accessing or making salient pre-existing attitudes or beliefs, using social norms, getting people to make a commitment, setting goals, providing feedback, and manipulating ‘structural’ variables.

The results of the reviews are grouped by behaviour-type: section 4.1 describes recycling, section 4.2 describes energy conservation and section 4.3 describes litter reduction. In the case of one review (Osbaldiston 2004), it was not possible to arrange the findings by behavioural outcomes because it addressed a wide range of behaviours and results were not always reported in sufficient detail for the different behaviour types. Because of this, the findings of this review are reported separately in section 4.4 under the heading ‘responsible environmental behaviours’.

Within each of these sections (4.1 to 4.4), findings are reported using the same sub-structure. Findings are first of all reported for the first research question, ‘What are the characteristics of pro-environmental interventions?’ Here, the following features of the interventions are described: aims, outcome measures, strategies and approaches, target population, intervention setting, level of change, and use of behavioural theories or models. By ‘level of change’, we mean whether the interventions were at an individual, community or population level. The definitions of these interventions are provided in section 1.2.3.

For each topic (sections 4.1 to 4.4), findings are then reported for the second research question, ‘What is the evidence for effectiveness of pro-environmental interventions in terms of changes in pro-environmental knowledge, attitudes, behaviours and other related outcomes?’. In terms of how results are reported, it was not always possible to provide a full set of results for individual studies included in the reviews. This is because of the large number of studies addressed by some reviews and the fact that the reviews themselves don’t often summarise the results of the included studies in a meaningful way. Indeed, often where the results of individual studies (including significance tests and effect sizes) are reported in tables, very little context or explanation is provided, making it difficult to be sure what the results actually refer to and what they mean. No real clarity is provided in the text. Because of this, this section tries to summarise overall trends of results in a particular area, and then provides examples using selected studies – details of the results of these studies and any reported significance values and treatment or follow-up effect sizes are reported where possible.

For each topic (sections 4.1-4.4) the evidence statements are then presented.

Section 4.5 then draws upon the findings of all six reviews to examine what factors influence the effectiveness of pro-environmental interventions. Here, rather than address the issues topic by topic, the review attempts to look across topics at overriding issues such as intervention setting and approaches. Section 4.6 presents the Evidence Summary for the whole section and the last section (4.7) highlights the gaps in the evidence base.

4.1 Recycling

Three reviews (one meta-analysis and two narrative reviews) examined the effectiveness of interventions designed to increase recycling behaviour.

4.1.1 What are the characteristics of recycling interventions?

This section describes the recycling interventions covered by the three reviews in terms of: aims, level of change, intervention strategies and approaches, target populations, intervention settings, outcome measures, and use of behavioural theories or models.

One review of 67 empirical studies used meta-analysis to establish the effects of a range of internal and external influences on recycling behaviour (Hornik et al 1995) (2- B). Rather than review the effects of interventions as such, it undertook analyses designed to identify the best predictors of recycling behaviour. Though the review is not explicit about the levels at which change was sought, it would seem that most of changes were promoted at either an individual or community-level. The review notes that the impact of legislation on recycling behaviour has been rarely investigated.

The various internal and external influences were categorised into four main groups: 'extrinsic incentives', 'external facilitators', 'intrinsic incentives' and 'internal facilitators'. Extrinsic incentives included monetary rewards, social influences, and laws and regulations. External facilitators were those that influenced the time, space, money and effort associated with recycling and included collection frequency, container proximity, and transportation. Intrinsic incentives related to internal motivations to recycle and included, for example, personal satisfaction and gratification from participating in a recycling programme. Internal facilitators were cognitive factors that influenced an individual's ability to recycle. Examples included awareness of the importance of recycling and knowledge about recycling programmes. The influence of demographic variables like education and age were also examined in the meta-analysis.

The review provided very few details about the specific nature of the individual influences examined by the included studies (eg. for the studies that examined frequency of collection, by how much the frequencies were increased, etc.). There was no real data on intervention populations or settings. The review examined effectiveness in terms of propensity to recycle, which was determined by the following outcomes: consumer attitudes towards recycling, behavioural intentions, and actual recycling behaviour (based on either self-report or measures of actual behaviour). There is no discussion of the use of behavioural models or theories. A bibliography of included studies is also missing from this review and attempts to get this information from the author have been unsuccessful.

The second recycling review examined the effectiveness of interventions reported in 27 articles (describing 31 experiments) (Porter et al 1995) (3 B). The majority of interventions examined by this review were community-wide programmes though one study examined legislation. The interventions were grouped as either 'antecedent' or 'consequence' strategies. This kind of grouping is very common in the environmental behaviour literature, and is a helpful sub-categorisation. The authors describe antecedent interventions as those that are introduced before the target behaviour and were examined in 21 studies. Examples include, written and oral prompts (eg. leaflets promoting recycling or face-to-face reminders), getting people to make a commitment to recycle (eg. in the form of a written, signed promise), 'environmental alterations' (eg. making it more convenient for people to recycle by increasing the number of recycling containers in a particular area), and setting recycling related goals (eg. encouraging people to collect a certain amount of glass bottles or aluminium cans in a week). Consequence interventions are introduced after the target behaviour and essentially involve selectively reinforcing the desired behaviour. These interventions were examined in 11 studies. Examples include, providing people with individual or group feedback (eg. written signs indicating the amount of recyclable materials collected), individual or group rewards or prizes (eg. monetary rewards), and penalties for not recycling (eg. payment of a refundable deposit on returnable grocery store containers).

Although target groups and rationale were not clearly summarised, references were made to grocery store customers, adult residents of households, office employees, college students, and elementary school students. The interventions were implemented in a range of settings including residential households, grocery stores, offices, elementary schools, and colleges. The review examined the effects of these strategies on a range of outcomes. 'Percentage participation' in a recycling programme was commonly used. The studies also used various different measures of the amount of recyclable materials collected (eg. weight of recyclable materials in lbs, frequency of materials recycled). Again, no mention was made of behavioural theories or models.

A third review examined the effects of 'situational' and 'personal' factors on recycling using evidence from 28 studies (Schultz et al 1995) (3 B). Situational factors are manipulable aspects of the environment that may facilitate recycling, and personal factors are the characteristics of an individual associated with recycling. The interventions sought change at either an individual or community level. The intervention strategies were similar to those examined in the previous review (Porter et al 1995) (3 B) and were again grouped as either antecedent or consequence strategies. Antecedent interventions included using prompts (eg. brochures), getting people to make a commitment to recycle (eg. sign a pledge), leveraging normative influences (eg. getting residents to encourage other people within their community to recycle), setting goals (eg. encouraging people to record monitor the amount of waste they recycle) and removing barriers to recycle (eg. making collection bins more accessible). The consequence strategies included providing feedback (eg. individual or group feedback on the amount of recyclable material collected) and rewards (eg. money or lottery wins). The interventions ranged in duration from one week to three years.

Target groups included apartment residents, household residents, college students, retirement residents, school children and office employees, and the interventions took place in residential households, colleges, retirement centres, elementary schools, and offices. The range of outcome measures varied considerably though, again, participation in a recycling programme and the amount of material collected (eg. amount of paper, number of cans, 'ratio of recycled materials to discarded materials') were the most commonly used measures. Behavioural theories or models were not mentioned.

4.1.2 What is the evidence for effectiveness of recycling interventions in terms of changes in knowledge, attitudes, behaviours and other related outcomes?

This section describes the evidence for effectiveness. Though there is some overlap between the three reviews that exclusively examined recycling interventions, there are differences in the studies and types of interventions examined by each. Results from each review are therefore reported separately.

Hornik et al (1995, 2- B) used meta-analysis to examine 67 empirical studies on the effects of external and internal factors on recycling.

The analysis showed that internal facilitators (defined as cognitive variables that enable an individual to recycle) were the best predictors of recycling behaviours. Propensity to recycle was quite strongly related to consumer awareness and knowledge about recycling. Knowledge about recycling had the highest correlation with propensity to recycle ($r = 0.541$) and was statistically significant very often (in 87% of studies). Commitment to recycle was also fairly strongly related to propensity to recycle ($r = 0.425$) and was found to be significant

often (in 86% of studies). The second best set of recycling predictors was external incentives. These are the kind of things that may give rise to the internal factors described above and include, for example, social support for recycling, monetary rewards, and laws and regulations. External incentives were shown in the analyses to be reliably related to propensity to recycle. Perceived social influence (defined as support among friends, neighbours and family) was very often significant (in 90% of studies) and predicted recycling behaviour well. Monetary rewards were also a significant (though moderate) predictor of recycling behaviour ($r = 0.327$) and this correlation was also often significant (in 84% of studies).

The third most predictive set of variables was internal incentives (such as personal satisfaction and ecological concern). Of these, personal satisfaction gained from recycling was the best predictor of recycling behaviour ($r=0.370$) and was significant in 76% of studies. The fourth best set of predictors was external facilitators. Of these, the strongest predictor was frequency of collection ($r = 0.290$). Both container proximity and distribution of materials for recyclables had only small positive correlations ($r = 0.186$ and $r = 0.173$ respectively). Though these factors definitely had an influence on recycling behaviour and, according to the review authors, may be useful 'foot-in-the-door' strategies, the magnitude of their relationships with propensity to recycle was modest especially in comparison to the internal factors examined, like knowledge and awareness of recycling. Furthermore, their ability to produce longer term effects is also limited. Overall, external facilitators were as poor a predictor of recycling as demographic variables like age and education.

The second review, Porter et al (1995, 3 B) also examined data from 31 experiments that specifically targeted recycling. Interventions were sub-categorised as antecedent or consequence strategies and results for the following types of interventions were reported: prompting, getting people to make a commitment to recycle, setting goals, altering features of the environment, issuing rewards or penalties, and providing feedback.

Prompts were described as written or verbal communications that encourage a specific behaviour. Examples used in the studies include leaflets, newspaper adverts, or face-to-face encounters that encourage people to recycle and provide them with information about how to use existing recycling services. Overall, the studies showed that using prompts can be an effective strategy for increasing recycling behaviour as six of the seven studies that examined this reported a positive change, with the remaining study reporting mixed results. Improvements were usually seen in terms of improved participation in recycling programmes or increases in the amount of recyclable materials collected.

One study involved getting influential individuals within small residential communities to deliver 'personalised, persuasive appeals' and kerbside recycling bags to a small selection of their neighbours. The study found that participation in the recycling programme increased by 25% more among households that received the intervention, compared with those that received no intervention at all. The reported treatment effect size is 25%. No other statistics are reported. Another study, set in a grocery store, reported that several prompting techniques, including providing people with a leaflet and public feedback on their purchase of returnable bottles, produced an overall increase of 25% in the purchase of returnable soft drinks containers, again, with a reported treatment effect size of 25%. However, overall, improvements from prompting interventions were described as 'short-lived' by the reviewers suggesting that their ability to encourage longer-term changes in recycling behaviour may be limited.

Five experiments examined the effectiveness of encouraging people to make a commitment to recycling. This kind of strategy essentially involved obtaining agreements or promises from people that they will recycle for a specified amount of time. The exact nature of this commitment varied from simple verbal agreements to formal written agreements complete with signature. Overall, the results showed that getting people to make a commitment can subsequently influence their recycling behaviour. All five studies that examined commitment strategies showed that they could improve recycling behaviour - both increases in participation rates in recycling programmes and in the weight of paper recycled were reported. Moreover, three of the five studies measured effects on *both* frequency of participation and the amount of material recycled and, interestingly, reported more consistent effects for the participation measure. Four of the studies examined follow-up effects up to three weeks after the commitment was made and found that recycling behaviour was persistent in all cases. The reported treatment and follow-up effect sizes for these studies, where available, are reported in the evidence tables in Section 5.2. No other statistics were reported in the review.

Only two studies examined the effects of goal setting on recycling and both reported positive findings. One study showed that goal setting by the school principal had a positive effect on the weight (in lbs) of newspaper recycled at an elementary school – however participation rates were still fairly disappointing, remaining at around 5% or less during the intervention period. The reported treatment effect size for this study was ‘186/session’, with a reported follow-up effect size of ‘90/session’. A second study examined the effects of goal setting on the frequency of aluminium cans recycled by college students (weekly mean). The study found that individuals that had been given a recycling goal recycled, on average, around 12 more cans during the two week intervention than individuals who were not given a goal. The study had a reported treatment effect size of ‘12/week’. A follow-up effect size was not reported. It is worth noting however, that almost all participants recycled at least one can meaning that the observed effect was in fact attributable to an increase in the volume of cans per ‘participation’ as opposed to the increases in the participation rate itself. Despite the methodological limitations of these studies, the findings suggest that goal setting may be a promising strategy for getting people to recycle. Clearly further research is needed. In addition, the authors note that in both cases the target groups were assigned goals by other people. Had they set their own goals, the strategies may have proved more effective still.

Six studies examined the effectiveness of ‘environmental alteration’ interventions. These are things that make recycling easier and more convenient for people to perform, like placing recycling containers nearer to the target group and scheduling regular kerb-side collections to coincide with regular collections. Four of the studies involved increasing the proximity of containers to potential recyclers (by adding more containers to a particular area). This strategy was consistently shown to increase recycling behaviour both in terms of increasing participation and increasing the amount of materials recycled. For example, in one worksite study, office employees recycled more paper during a ten week period when they were provided with extra waste bins. Employees who were required to take their recyclables to a centrally located container recycled 9% less paper. The reported treatment effect size was 9%, no follow-up effect size is reported. In another study, the distribution of recycling containers increased participation levels by around 13%, compared with individuals who did not receive any containers but were frequently ‘prompted’ to recycle. Encouragingly, these improvements in participation were maintained during an eight-14 week follow-up period. The reported treatment effect size for this study was 13%, no follow-up effect size is

reported. Scheduling kerb-side collections of recyclables to coincide with the collection of regular waste also proved to be an effective strategy, increasing participation in a recycling programme by 5% in one study, for example (reported treatment effect size 5%, no follow-up effect size is reported).

The same review (Porter et al 1995) (3 B) reported results from eleven experiments examining the effects of consequence strategies on recycling behaviour. Nine of these looked at the impact of providing rewards such as prizes or money. Rewards are described by the review authors as among the most prominent strategies for increasing recycling behaviour. Two of the nine studies examined the effects of issuing rewards that were contingent upon recycling behaviour. One found that offering a reward was a more effective strategy for increasing the weight (in lbs) of newspaper recycled than simply providing information about a recycling programme. In this case, the school recycled an average of 17 times more newspaper when hamburger vouchers were given to classes with high recycling rates, compared with classes that were simply provided with information about recycling. The study had a reported treatment effect size of '2,377/week'. No follow-up effect size or other statistics are reported. The second of these studies showed that offering children prizes (toys) in a trailer park setting increased newspaper recycling by 95% (compared with baseline measures) during an eight-13 week period. Changes were measured in terms of the weight of newspaper recycled (in lbs) and the study had a reported treatment effect size of '169/week' and a reported follow-up effect size of '12/week'.

The remaining seven reward studies evaluated the use of lotteries to encourage recycling. All seven showed a consistent positive effect on recycling. The effect sizes for these studies are reported in the evidence tables in Section 5.2 of the report. No other statistics are reported. Five experiments examined the effectiveness of using both lotteries and contests in promoting recycling, and these strategies were shown to be similarly effective. Despite these very encouraging results, the authors of the review highlight some potential problems with reward-based interventions. The first is that they are very typically characterised by low or declining participation rates. There are also questions about their cost-effectiveness, as the costs of implementing the interventions may not always compare well with the actual value of the recyclables collected.

Only one study examined the effect of penalties (and indeed the use of legislation) for not recycling. This study evaluated the New York bottle law which requires payment of a deposit on the purchase of recyclable containers such as glass bottles and aluminium cans. Outcomes were measured in terms of the frequency of returnable litter. The evaluation research revealed a sharp 26% decline in the number of returnable containers found in New York once the law was introduced – no such decline was observed in New Jersey which did not have an equivalent law in place. Encouragingly, this effect was maintained one year on. The reported treatment effect size for the study is 127 pieces of litter from baseline and the reported follow-up effect size is 151 pieces of litter from baseline. No other statistics are reported.

A single study focused on using feedback as the primary strategy for increasing recycling. This study found that recycling was effective in increasing paper recycling by approximately 77% above baseline measures. This effect was also maintained to some extent at follow-up though this was fairly short-term (1 week). The study had a reported treatment effect size of 7/day (measured in terms of the weight of paper recycled in lbs) and a reported follow-up effect size of 4/day. No other statistics are reported.

A third review (Schultz et al, 1995, 3 B) examined the effects of situational factors on recycling behaviour, and again grouped them as either antecedent or consequence strategies. The review calculated and reported effect sizes where possible, and these are reported here where the results of individual studies are given. The following were examined in the review: prompting, commitment strategies, normative influences, setting goals, altering the environment, and offering rewards.

Twelve studies looked at the effects of prompts. The authors describe prompts as information about recycling that is provided to potential participants before a recycling programme begins. The information can be factual, persuasive or simple reminders delivered in written form or verbally. Three of the twelve studies showed that one single prompt alone is capable of increasing participation in recycling. All three studies focused on kerb-side recycling and usually written prompts. Full details of the results (in terms of percentage change) are not provided though effect sizes estimates were calculated and reported for two of the studies ($d'=0.28$ and $d'=4.7$).

Several of the other prompting studies showed that combining different types of prompts can enhance effectiveness (see section 4.5.1). The authors of the prompting studies note that it is difficult to draw any conclusions about the long lasting effects of prompting interventions because the studies are usually so short-term. However, the review did identify five studies that examined the effects of prompts over periods of four months or longer. These studies showed that prompting produced sustained effects on recycling in kerb-side and community-based interventions, but not in a study set in college dorms. Of the studies that did observe sustained effects, two reported continual improvements over the intervention period (either 39 weeks or three years) and the remaining two at 12 week and 18 month follow-up.

Seven studies examined the effects of getting people to make a commitment to recycle. In the majority of studies, the commitment involved asking the target group to sign a written statement or pledge. Increases in participation rates in both kerbside programmes and specially organised collections were observed – not only during the treatment period but also at various stages of follow-up (though the longest follow-up period was notably only four weeks). For example, one study reported that getting people to make a group commitment to increase their recycling resulted in improvements from baseline in the amount of paper (in lbs) recycled. These improvements were maintained at 4-week follow-up. No further details of the results are provided and a treatment effect size is not reported.

Four experiments examined the effectiveness of using social norms to encourage recycling. This is described as a relatively new strategy for encouraging environmentally friendly behaviours. Three of the four studies showed that leveraging peer support can help establish community recycling norms which in turn lead to sustainable increases in recycling behaviour. The studies typically involved getting key members of local communities (often referred to as 'block leaders' in the studies) to pro-actively encourage other members of the community to recycle. For example, one study reported participation rates in a kerbside recycling programme of 26.5% in residential areas with a designated 'block leader', compared with only 11.5% in areas without. A treatment effect size is not reported.

This review identified the same two goal setting studies as the previous review (Porter et al 1995) (3 B). Although the positive effects of these studies are again noted, the authors of this narrative review (Schultz et al 1995) (3 B) stress concerns about the very specific nature of

the study populations used (both elementary school and college students) – suggesting that the ability to generalise these results to other populations is limited.

Three experiments examined the effects of bin proximity on recycling participation. These studies consistently showed that the closer individuals were to recycling facilities, the more likely they were to recycle. For example, one study reported an increase of 47% in participation in a drop-off newspaper recycling programme among residents of a ‘mobile home park’ following the placement of six additional recycling bins in the area. No treatment effect size is reported. Although all three bin proximity studies were all fairly short in duration, on the positive side, proximity was shown to work across a range of settings including offices and in residential areas.

One study also considered the effects of the collection method on participation rates in recycling programmes. The most common methods of collection are kerb-side collection or the provision of drop-off facilities where people can take their waste to be recycled. The study reported that a kerb-side collection programme had an estimated 49% participation rate compared with only around half that (25%) in communities with a drop-off location. No other data are provided. These results suggest that removing the need for people to transport recyclable materials to a central location may in fact increase recycling participation rates. Similarly, removing the effort associated with sorting waste was also examined in the review, though only two studies reported data on this issue. One compared participation rates in a community-wide commingled kerb-side recycling programme (where participants can mix all recyclables together in a single collection bin to be sorted at a materials recovery facility) with those of a voluntary waste separation programme (where they are required to sort their own waste). Over 90% of households participated in the commingled programme at least once in five consecutive occasions compared with only 40% in the voluntary waste separation programme. No other data on this study are reported. However, the other study that examined this issue reported no difference in the estimated average participation rates from programmes that required separation and those that did not. Detailed results from this study are not reported in the review.

Of the studies that examined consequence strategies, eight directly examined the effects of rewards on recycling behaviour. All eight reported significant increases in the amount of waste that people will recycle as a result of offering rewards like money or lottery tickets. Specifically, opportunities to win lottery prizes produced stronger effects than small cash incentives, and individual rewards produced better increases than group ones (see section 4.5.3). Rewards were also shown to produce greater improvements in recycling behaviour than several other intervention strategies in the studies that compared them (see section 4.5.7). However, overall, improvements from reward-based interventions tended to be relatively short-term and the review highlighted some uncertainty about the generalisability of using rewards across different types of recycling behaviour (eg. recycling aluminium cans versus newspapers).

The impact of providing people with feedback on recycling was examined in four studies included in the review. Two reported significant increases in recycling ($d=0.25$ and $d=2.47$). In these studies feedback was provided through posters; in one case group feedback was given on the weekly weight (in lbs) of paper collected by college students. More research is clearly needed to determine how effective feedback can be in promoting recycling behaviours.

4.1.3 Evidence statements

There is evidence of low quality (Hornik et al 1995) (2- B) that awareness of the need to recycle, knowledge of recycling programmes, and a commitment to the cause are important predictors of recycling.

There is evidence of low quality (Hornik et al 1995) (2- B) and unscorable quality (Schultz et al 1995) (B) that social support and social pressure are key facilitators of recycling behaviour.

There is evidence of low quality (Hornik et al 1995) (2- B) that monetary rewards are moderate predictors of propensity to recycle. There is evidence of unscorable quality (Porter et al 1995) and (Schultz et al 1995) (B) that monetary rewards, lotteries and contents are effective strategies for getting people to recycle.

There is evidence of low quality (Hornik et al 1995) (2- B) that increasing the frequency of collection and scheduling the kerb-side collection of recyclables to coincide with regular waste collection can have small moderating effects on recycling.

There is evidence of unscorable quality (Porter et al 1995) (3 B) and (Schultz et al 1995) (3 B) that both these strategies can have positive effects on recycling.

There is evidence of unscorable quality (Porter et al 1995) (3 B) and (Schultz et al 1995) (3 B) that the use of prompts can increase recycling behaviour.

There is evidence of unscorable quality (Porter et al 1995) (3 B) and (Schultz et al 1995) (3 B) that getting people to make a commitment to recycle can increase participation rates in recycling programmes and the amount of materials recycled.

There is evidence of unscorable quality (Porter et al 1995) (3 B) and (Schultz et al 1995) (3 B) that goal setting can have a positive effect on recycling behaviour.

There is evidence of unscorable quality (Schultz et al 1995) (3 B) that feedback can increase recycling.

There is evidence of low quality (Osbaldiston 2004) (2- B) that providing incentives, using social norms, getting people to make a commitment, setting goals and manipulating situational factors can have the best effects on recycling.

4.2 Energy conservation

One review examined the conservation of resources like gas, electricity and water.

4.2.1 What are the characteristics of energy conservation interventions?

This section describes the energy conservation interventions covered by the review in terms of: aims, level of change, intervention strategies and approaches, target populations, intervention settings, outcome measures, and use of behavioural theories or models.

Thirty-eight studies with the aim of encouraging households to reduce energy consumption were examined in this review (Abrahamse et al 2005) (3 B). The interventions addressed change at either an individual or community level. As with the recycling studies, interventions were grouped into antecedent and consequence strategies. The majority of antecedent strategies included information studies (eg. workshops or mass media campaigns). Other antecedent strategies examined were commitment studies (eg. written pledges), goals setting studies (eg. encouraging individuals to save 15% energy), and modelling studies (eg. providing examples of recommended behaviours). The majority of consequence strategies were feedback studies (eg. giving individual households information about their energy consumption), though reward studies (eg. monetary rewards) were also described. The duration of the interventions ranged from three hours (in the case of a workshop) to three years.

The interventions took place in residential households with the target group being 'household residents'. Little explanation was given in terms of the targeting rationale.

Outcomes were focused on electricity, gas, and/or water use by encouraging 'efficiency' and 'curtailment' behaviours. Efficiency behaviours are 'one-shot' energy saving behaviours (eg. purchasing energy-efficient equipment such as insulation) while curtailment behaviours are repetitive energy saving behaviours (eg. lowering thermostat settings). No mention was made of behavioural theories or models.

4.2.2 What is the evidence for effectiveness of energy conservation interventions in terms of changes in knowledge, attitudes, behaviours and other related outcomes?

This section describes the evidence for effectiveness from the review (Abrahamse et al 2005) (3 B) which examined the effectiveness of interventions that aimed to encourage households to reduce energy consumption. Thirty-eight studies were assessed and again interventions were categorised as either antecedent or consequence strategies. The review calculated and reported effects sizes where possible, and these are provided here where the results of individual studies are reported.

Three studies examined the effects of getting people to make a commitment (again, taken to mean either an oral or written pledge) on their energy use. All three studies showed that commitment could be a successful strategy for reducing household energy use. For example, one study reported that households that had signed a public commitment to conserve energy (a publication in a leaflet) showed a lower rate of increase in energy use (gas and energy consumption) than households in the control group. Encouragingly, effects were maintained over a six month period following the implementation of the intervention. Further details of the results of this study are not provided and there is no reported effect size.

The impact of setting goals in relation to energy use was also examined by this review but only in two studies. One study found that simply providing people with an easy goal alone was not effective, though combining a difficult goal with feedback produced a saving in energy use of 15.1% (this difference between the intervention and control group in this respect was significant, $d=0.97$). The research shows that combining goal setting with providing feedback was a more effective strategy than just goal setting alone (see section 4.5.1). The 'provision of information' was also examined as another antecedent strategy. This is described by the review as a commonly used approach for encouraging people to reduce their energy consumption. Three main categories of 'information' were examined in the review: workshops, mass media campaigns, and tailored information (home audits). Only one study examined the use of workshops and found that participation in a three hour workshop led to improvements in knowledge about energy conservation and stronger intentions to save energy. Despite these improvements however no changes in behaviour were seen. No specific data are provided. Three studies examined the use of mass-media campaigns designed to promote energy conservation. Again, evaluations of these campaigns tended to report improvements in knowledge or attitudes but there was no clear evidence that they were capable of producing changes in energy related behaviours. Again, full details of the results of these studies are not provided and effect sizes are not reported. Several studies examined the effects of home energy audits, which tend to provide 'highly personalised and specific information' about energy use in attempts to encourage households to engage in energy saving behaviours. Though the results were somewhat mixed, overall, some studies did report positive effects on household energy use and 'the extent to which efficiency actions were taken'. For example, one study showed that households that had received a home energy audit providing detailed information about their use of heating and air conditioning, subsequently used 21% less energy than the control group. No follow-up measures were taken and no effect size is reported for this study.

Modelling, another antecedent strategy which involves providing examples and demonstrations of recommended energy saving behaviours, was examined by one study in this review. In this case, the intervention comprised television programming that depicted a variety of energy saving behaviours. This was accompanied by a booklet featuring cartoon images of similar behaviours. The study found that energy consumption reduced significantly in the intervention group (by 10%) when compared with the control group. Improvements in energy related knowledge were also seen in the intervention group but not in the control group. However again effects were not maintained at follow-up (one year). No treatment effect size is reported.

The review also examined a number of consequence interventions. Feedback is described as 'giving households information about their energy consumption or energy savings'. Overall, the research included in the review shows that feedback can be an effective strategy for reducing household energy use. Limited detail on the results of these studies is provided in the review. One study showed that daily feedback on the costs of electricity use produced a decrease of 4% among intervention households compared with baseline measures. This group also conserved more electricity than the control group. No other data (eg. treatment effect size) are provided.

The effects of reward-based interventions were also examined by the review. Monetary rewards could be either contingent upon the amount of energy saved or a fixed amount. Overall, rewards had a positive impact on energy savings - all of the relevant studies reported

significant differences between households who received a reward and those that did not. However, as with the recycling reward-based studies, the effects of reward-based interventions were relatively short-term.

4.2.3 Evidence statements

There is evidence of unscorable quality (Abrahamse et al 2005) (3 B) that getting people to make a commitment to reduce their energy use is an effective way of conserving energy.

There is evidence of unscorable quality (Abrahamse et al 2005) (3 B) that monetary rewards can have a positive effect on energy conservation, though changes are usually short-term.

There is evidence of unscorable quality (Abrahamse et al 2005) (3 B) that goal setting can be effective in getting people to reduce their energy use, especially if combined with feedback on performance in meeting set goals.

There is mixed evidence of unscorable quality (Abrahamse et al 2005) (3 B) that personalised, tailored information interventions like undertaking home energy audits are more effective than providing more general information in promoting energy conservation, especially in terms of producing changes beyond awareness and attitudes.

There is evidence of unscorable quality (Abrahamse et al 2005) (3 B) that the modelling of appropriate energy saving behaviours can improve energy related knowledge and behaviour.

There is evidence of unscorable quality (Abrahamse et al 2005) (3 B) that providing people with feedback about their energy use can increase energy saving behaviours.

There is evidence of low quality (Osbaldiston 2004) (2- B) that providing incentives, using prompts and getting people to make a commitment are the most effective strategies for promoting energy conserving behaviours.

4.3 Litter reduction

One review examined litter reduction interventions.

4.3.1 What are the characteristics of litter reduction interventions?

This section describes the litter reduction interventions covered by review in terms of: aims, level of change, intervention strategies and approaches, target populations, intervention settings, outcome measures, and use of behavioural theories or models.

Fifty-nine studies with the objective of reducing litter were examined in this review (Huffman et al 1995) (3 B). The interventions again involved change usually at either an individual or community-level. Consistent with the interventions aimed at recycling and conservation of resources, litter interventions were divided into antecedent (46 studies) as well as consequence (13 studies) strategies. Antecedent strategies included prompting (eg. anti-littering signs), community interventions and modelling (eg. active community participation in cleaning up litter), prior littering (eg. the presence or absence of prior litter) and environmental design (eg. presence of rubbish receptacles). Rewards (eg. contingencies for clean backyards) were examined as the common consequence strategy used to tackle litter control.

Target groups were not homogeneous and target group rationale was not provided. The interventions were community-based and took place in a wide range of settings: cafeterias, theatre stores, state parks, schools, campgrounds, pools, parking garages, residential neighbourhoods, universities, sporting trips, grocery stores, stadiums, malls, institutions, amusement parks, fast food restaurants, prisons, museums, railroads, and highway exits. Again, various measures were used to examine effectiveness including, for example, the percentage of people who littered or did not litter, the amount of litter on the ground, and the amount of litter collected. No information is provided on any behavioural models or theories that may have been used by the interventions.

4.3.2 What is the evidence for effectiveness of litter reduction interventions in terms of changes in knowledge, attitudes, behaviours and other related outcomes?

This section describes the evidence for effectiveness from the review (Huffman et al 1995) (3 B) which examined the effects of interventions designed to reduce littering. Fifty-nine studies were examined and again the interventions were grouped as either antecedent or consequence strategies. Effects sizes and significance results were not provided in this review.

Twelve experiments examined the effects of prompts on littering behaviour. Overall, the interventions had a positive impact with studies reporting, for example, reductions in the percentage of people who littered and reductions in the amount of litter dropped or found. For example, one study set in a university cafeteria used written prompts and reported a 33% reduction in the percentage of people who littered. In another study set in a school, the use of verbal prompts increased the percentage of pupils that did not litter by between 40 and 60%. The findings from all but two of the prompting studies also suggest that prompts involving specific instructions can be more effective in increasing correct litter disposal than non-specific instructions (see Section 4.5.9).

Thirteen studies examined the effects of community-involvement and modelling (which were grouped together in the review) – and both types were effective overall with a reported nine studies yielding positive results. The community involvement interventions usually involved some kind of active participation by residents in cleaning up and maintaining their local neighbourhood and they reported generally positive results. One example is a study of community groups who tackled dog fouling by patrolling the streets asking dog owners to clean up after their dogs. The intervention successfully reduced the amount of dog fouling by 88% but the study suffered from several methodological problems including having interventions take place simultaneously – making the results somewhat dubious.

The modelling interventions reported in the review involved someone demonstrating an appropriate litter-related behaviour (ie. the correct way to dispose of litter). Overall, this body of research suggests that modelling can be a helpful strategy for reducing litter. For example, one study looked at the effects of showing an experimental confederate either picking up litter or walking right past it in two different settings. The study found that littering rates were less in the modelling condition in both study settings. Only a 6% increase in the amount of litter was seen among those that saw the confederate pick up the litter compared to an increase of 23% in the ‘walk-by’ group. Another successful intervention involved providing dog owners with instructions about how to clean up after their dog and a demonstration in how to correctly use a plastic bag for collecting dog litter. This was examined in two studies. Both studies reported positive effects in terms of reducing dog litter (pick-up levels were

reported as 87-89%), with these effects being sustained at one month in one study and 13 months in the other. Though the results of these studies are positive, the review authors note that it is somewhat difficult to generalise results due to the fairly specific nature of the studies.

Nine studies that examined the effects of 'prior littering' were reported in the review. These studies found that more littering occurred in an already littered area, suggesting that the removal of prior litter can be an effective strategy. Twelve studies examined the effects of 'environmental-design' interventions. Examples included increasing the availability of waste receptacles and providing specially decorated and labelled receptacles. Overall, the studies provide sufficient evidence that environmental-design interventions can be effective in reducing litter. For example, one study found that an increase in the presence of ashtrays reduced the amount of cigarette litter found on the ground in a university setting (no specific data are provided). The authors also point out that these kinds of interventions are fairly straightforward to implement and can be easily generalised to different situations.

The review also examined 13 studies that looked at rewards and penalties. These interventions are consequence strategies as they occur after behaviour; a reward will increase the likelihood that a desired behaviour will be performed again, and a penalty will decrease the likelihood that an undesired behaviour will occur again. Examples of rewards provided in the studies include contingency for free rides at an amusement park, cash rewards, badges and toys, and newspaper feedback. The consequence strategies were shown to be effective in all 13 studies. Reductions in the amount of litter dropped/found and increases in the number of litterbags used, for example, were reported. For example, one study in the US paid children 10 cents for returning a bag full of litter collected in a theatre and reported a 57% reduction in the amount of litter found. However, again, the effectiveness of rewards was often countered by the costs of implementing the intervention. The effects of feedback as a consequence strategy were only examined in two studies. One study published information in a local newspaper about the amount of litter found in a certain area and compared it to the amount found the previous day. The amount of litter in these areas following the newspaper appeal reduced, however these effects were not maintained. The second study examined the effects of providing feedback to elementary school children about the cleanliness of the school playground. The study reported a 75% reduction in litter, with effects sustained six months later. Together, these findings suggest that feedback may prove a worthwhile strategy for tackling litter problems.

4.3.3 Evidence statements

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that prompting can reduce littering.

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that both community involvement and modelling strategies can be effective in getting people to dispose of litter correctly.

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that removing prior litter can effectively reducing littering.

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that environmental design strategies, like increasing the proximity of litter bins and improving the way they are labelled and decorated, can have positive effects on littering behaviour.

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that reward-based interventions can improve littering behaviour.

There is evidence of unscorable quality (Huffman et al 1995) (3 B) that feedback can reduce littering.

4.4 Responsible environmental behaviours

One review broadly examined the effects of a range of intervention strategies on responsible environmental behaviours (REB).

4.4.1 What are the characteristics of responsible environmental behaviour interventions?

This section describes the interventions covered by review in terms of: aims, level of change, intervention strategies and approaches, target populations, intervention settings, outcome measures, and use of behavioural theories or models.

One review of responsible environmental behaviours used meta-analysis to examine 62 studies aimed at measuring changes in water conservation, littering, energy conservation, recycling, gas conservation and other behaviours (Osbaldiston 2004) (2- B). The interventions addressed change mostly at an individual or community level.

The effects of ten different intervention techniques on these REBs were examined:

- (i) providing rewards or incentives
- (ii) using prompts (which are defined as 'non-informational reminders')
- (iii) providing 'procedural' information
- (iv) providing rational reasons for change
- (v) accessing or making salient pre-existing attitudes and beliefs
- (vi) utilising social interactions and social norms
- (vii) encouraging people to make a commitment
- (viii) setting goals
- (ix) providing feedback
- (x) manipulating 'structural' variables.

These techniques were implemented using a range of communications methods including the postal system, leaflets, face-to-face communication, and print or broadcast media. The majority of interventions were described as ‘passively involving’ (n=99).

School students, college students, community residents, office and factory workers, and environmental group members were among the target populations, and the interventions were implemented across a range of intervention settings usually either ‘residential settings’ or in universities. The review described university students or residential households in the US as the most common target population for interventions aimed at REB. In terms of outcomes, the review reports that each treatment was coded for one outcome, usually the type of behaviour. Of the treatments examined in the review, 56 promoted recycling, 44 promoted energy conservation, nine promoted water conservation, nine promoted efficient transportation and the remaining treatments promoted ‘other’ behaviours. Four theories of behaviour change from the ‘person-situation’ perspective and ‘motivation’ perspective were used to evaluate REB interventions. The person-situation perspective contends that human behaviour is determined by features unique to each individual and situation. One theory from this perspective claims that personality factors, knowledge, and situational factors predict REB, while an alternate theory maintains that attitudinal factors, personal capabilities, contextual factors, habit and routine predict REB. On the other hand, the motivation perspective states that human behaviour is regulated by motivational forces centred within the person and may stem from basic psychological needs. One theory from this perspective contends that intrinsic incentives, extrinsic incentives, internal facilitators, and external facilitators predict REB, while another comparable theory describes external, introjected, identified, and intrinsic motivators as predictors of REB.

4.4.2 What is the evidence for effectiveness of responsible environmental behaviour interventions in terms of changes in knowledge, attitudes, behaviours and other related outcomes?

The effects of the ten different intervention treatments were examined. To test the effectiveness of the different interventions, each study was coded according to its primary ‘treatment’ focus, and the mean effect size for each treatment was calculated. Of the total set of 133 studies, 22 treatments had confounded or multiple treatments. These studies were excluded from the analyses because they did not allow an effect size to be computed for a single treatment.

The two treatments with the largest effect sizes were ‘making a commitment’ and ‘setting goals’. Twelve studies that used ‘making a commitment’ as the exclusive primary focus and four additional studies that combined ‘making a commitment’ with some other kind of treatment as the primary focus. For these 16 studies, the mean weighted effect size was $Md = 0.55$, 95% CI = 0.39, 0.72 (for both fixed and random effects models). There were two studies that used goal setting as the primary focus and six additional studies that combined setting goals with some other treatment as the primary focus of the study. For these eight studies, the mean weighted effect size was $Md = 0.49$ 95% CI = 0.25, 0.73 (for both fixed and random effects models).

The two treatments with the smallest effects sizes were ‘changing the situation’ and ‘providing incentives’. This result is surprising given that both of these treatments have internal validity – and because they were shown to have fairly positive results in the other reviews. Both of these treatments did have positive significant effects, meaning that they

were effective, they were just not as effective as some of the other treatments examined in the analysis.

Recycling had the greatest effect sizes when the treatments were using incentives, establishing social norms, making commitment, setting goals and manipulating situational conditions. For energy conservation, the most effective treatments were ‘using incentives’, ‘using prompts’ and ‘making a commitment’. For these data, the minimum significant difference between effect sizes is 0.25 assuming the median sum of weights is 118. Providing incentives and making commitment are the only treatments that are relatively effective for both recycling and energy conservation. Although the omnibus test is significant for water conservation, efficient transportation and litter reduction, because these behaviours are included in only a few studies no contrasts were computed.

The review also examined which REBs were amenable to change. The author’s hypothesis that recycling and litter reduction should have higher effect sizes than energy and water conservation and efficient transportation was not supported. There were too few studies on water conservation, efficient transport and litter reduction to allow any inferences to be drawn.

4.4.3 Evidence statements

There is evidence of low quality (Osbaldiston 2004) (2- B) that making a commitment and goal setting have the strongest relationships with performing environmentally responsible behaviours.

There is evidence of low quality (Osbaldiston 2004) (2- B) that providing incentives and ‘changing the situation’ have the weakest relationships with environmentally responsible behaviours.

4.5 What information, if any, is provided on factors that influence effectiveness?

This section examines some of the factors that influence the effectiveness of pro-environmental interventions. The results are grouped by the different factors that influence effectiveness (eg. targeting, population and setting) and the evidence for different behaviour-types is reported together under these subheadings.

4.5.1 Multiple vs. single mode interventions

Two of the reviews included studies that compared the efficacy of using intervention strategies in isolation with combinations of different intervention strategies.

The narrative review (Porter et al 1995) (3 B) included research that compared the effectiveness of written prompts alone with a combination of both verbal and written prompts on recycling. The results show that a combination of both types of prompts was the more effective strategy as participation rates in a kerb-side recycling programme increased by 3% in this condition, compared with the very little change seen for written prompts and control groups. Similarly, another study from the same review found that combining both verbal and written prompts was more effective than either prompt when implemented alone. This time, individuals in the combined intervention group reported a greater number of visits to a city recycling centre. However, it is worth noting that this particular study relied on people’s self

reports and that these measures were not validated by an additional, more objective measure of participation.

The narrative review (Schultz et al 1995) (3 B) also included similar studies showing that effects on recycling could be improved by combining different types of communications approaches in prompting interventions. For example, one study showed that using leaflets in addition to newspaper advertisements increased participation in a recycling programme by two to four times that produced by using the newspaper adverts alone. Two other studies, also reported in this review, showed that combining prompts *and* increasing the proximity of collection bins increased recycling. The authors suggest that these particular strategies are highly complementary, as it provides individuals both with the encouragement to recycle, as well as the means to be able to do so.

The narrative review (Porter et al 1995) (3 B) reported findings from a study that examined the relative efficacy of prompting and getting people to make a commitment to recycle, as well as a combination of both strategies. The study found that the biggest improvement in recycling was seen in the written commitment group where household participation in a kerbside recycling programme increased by 19%. This was compared with increases of 15% in the prompting alone group and 18% in the combined intervention group. However, the differences between treatments groups were not significant.

Studies included in the narrative review (Schultz et al 1995) (3 B) of energy conservation interventions showed that combining goal setting with feedback was a more effective strategy than just goal setting alone. One study reported that, when setting goals, individuals who received a more difficult goal combined with feedback conserved the most energy (15.1%) – when compared with groups that were just allocated a goal (no feedback) or received no treatment. However, the differences between the two treatment groups were not significant. Another study applied a combination of goal setting with feedback in relation to a very specific energy-related behaviour: washing clothes in a washing machine. This study used a laboratory setting to provide participants with a goal and feedback in terms of how much energy they were using (this information was displayed on the panel of a washing machine). Individuals who received both a goal and feedback saved more energy per washing trial than individuals that received only feedback. There were no significant differences between individuals who had set their own goal and those that had been assigned a goal.

4.5.2 Level of change

The majority of interventions promoted change at either an individual or community level. For example, some studies involved providing individuals or households about their energy consumption in efforts to get them to engage in energy conserving behaviours. Others involved getting bigger groups, such as community residents or school students, to participate in specially organised recycling programmes. There was a notable absence of research that examined wider population-level interventions. Only one study examined the effects of legislation (see Section 4.1.2) and found that it was effective in promoting recycling behaviour, even noting sustained improvements at one year follow-up.

Interventions that were implemented at an individual level and community level appeared to be similarly effective in promoting environmentally responsible behaviours. Though not quite a comparison of individual and community-level approaches, there is some evidence that focusing on individuals as opposed to groups may produce better improvements in behaviour.

For example, in the review (Porter et al 1995) (3 B), although both group and individual-based commitment strategies were shown to be effective, one study of college students, reported in the narrative review showed that individual commitments produced the largest effects both in terms of frequency of participation in recycling programmes and the amount of paper recycled. The effects on participation were sustained among those in the individual commitment group at three week follow-up. Research included in the review (Schultz et al 1995) (3 B) of recycling interventions also found that individual commitment strategies produced greater participation in a recycling drive held at a college than did group commitments. These findings suggest that putting the onus on the individual may prove to be a more effective strategy than getting them to make a commitment as part of a group.

4.5.3 Intervention, population and setting

The review (Osbaldiston 2004) (2- B) investigated whether intervention, population and setting were significant moderators of intervention effectiveness across a range of environmentally responsible behaviours including recycling, conservation of resources and litter reduction. The author hypothesised that interventions involving people and situations with some kind of authority would result in greater improvements in environmentally responsible behaviours, and these hypotheses were supported by the analysis: $X^2(1) = 10.90, 10.41, p < 0.01$, respectively.

The narrative review (Schultz et al 1995) (3 B) reported several studies examining the effectiveness of prompting strategies across a range of settings. Most of the studies examined either kerbside collection or community drop-off programmes, though one study examined an intervention implemented in apartment complexes and three others examined interventions undertaken with college students or staff. Prompting worked well in the kerbside collection and community drop-off campaigns but two of the three studies in college settings were the only studies not to show positive effects of prompting on recycling.

Three studies reported in the narrative review (Porter et al 1995) (3 B) consistently showed that increasing the proximity of recycling bins to potential recyclers worked across a range of settings including offices and residential areas.

4.5.4 Incentives, rewards and discounts

Reward-based interventions were shown to be a very effective strategy across a range of environmentally responsible behaviours. In two reviews, (Porter et al 1995) (3 B) and (Schultz et al 1995) (3 B), opportunities to win lottery prizes produced greater improvements in recycling behaviour (both in terms of participation and the amount of materials collected/recycled) than cash incentives. For example, one study in review (Porter et al 1995) (3 B) compared the relative efficacy of a lottery prize with three other conditions: the market rate for the amount of paper recycled, informational prompts only, and no treatment at all. The study showed that, although all treatment groups produced higher frequencies of participation than the control group, the biggest improvements were seen in the lottery prize group where participation increased by 14%. It is worth noting, however, that differences in the amount of paper collected by the different groups were not significant. Studies reported in the review (Schultz et al 1995) (3 B) showed that individual rewards produced better effects than group-based ones.

4.5.5 Targeting

The narrative review (Abrahamse et al 2005) (3 B) examined the efficacy of providing different types of information on home energy use. Though no studies that directly compared these information types were included in the review, the findings from studies of tailored home energy audits were generally more positive than those from studies examining the effects of less specific kinds of information (such as mass media campaigns). Providing tailored information was especially effective in producing effects beyond changes in knowledge and attitudes, unlike the other more general information strategies.

Other research included in this review examined the relative efficacy of different types of feedback on energy conserving behaviour. Comparative feedback (ie. that compares an individual's performance on energy saving relative to the performance of others) was not shown to be any more effective than individual feedback.

4.5.6 Social interaction

Several reviews identified the importance of social influences in changing pro-environmental behaviours. The review (Hornik et al 1995) (2- B) used meta-analysis to identify a strong relationship between perceived social influence and propensity to recycle; the influence of neighbours, family and friends were found to positively influence recycling behaviour.

The narrative review (Porter et al 1995) (3 B) included studies that compared the effectiveness of different kinds of prompts on recycling behaviour. These studies found that the most effective types of prompts were those involving some kind of face-to-face prompting from other residents within the community. For example, in one study examined by the review, well known and highly involved individuals from within a community were labelled as 'block leaders' and asked to tell their neighbours about the kerbside recycling programme and encourage their involvement. They also used prompts to remind their neighbours to participate. Over a seven-month period, the involvement of these individuals significantly increased participation in the kerbside programme above baseline measures; people who were contacted by a block leader recycled more often than groups that received only an informational brochure or nothing at all. However, it is noted that the difference was 'practically small'. Using individuals in this way is helpful because it encourages the target group to see recycling as a normative behaviour of their local community, thus motivating their involvement (for fear of otherwise being socially cast out). Similar studies were included in narrative review (Schultz et al 1995) (3 B). Three of the four studies examined in this review again showed that leveraging peer support can help establish community recycling norms, leading to sustainable increases in recycling behaviour. For example, one study - again involving block leaders - produced a weekly participation rate in a kerbside recycling programme of 25.5%, compared with a rate of only 11.5% in areas that did not have a designated leader.

Several of the prompting studies included in the review (Huffman et al 1995) (3 B) that examined littering interventions, showed that the effectiveness of verbal prompts increased as the amount of social interaction increased and when this involvement was directly tied to the littering problem (eg. personal appeals to reduce littering). However, analyses in review (Osbaldiston 2004) (2- B) - to examine whether increased levels of social interaction in interventions to increase environmentally responsible behaviours increased their efficacy - were not significant.

Though the use of social norms in intervention studies of pro-environmental behaviours is a relatively new area of research, it is still fairly disappointing that the majority of this research follows a similar format that involves the use of ‘block leaders’. It would be useful if alternative approaches to mobilising social norms were explored.

4.5.7 Sustainability of effects

One review (Hornik et al 1995) (2- B) of recycling showed that external incentives such as monetary rewards were very helpful in producing short-term improvements in recycling behaviour. However, the review notes that these kinds of interventions – though a useful ‘foot-in-the-door’ strategy – may be less effective in bringing about longer-term changes. That authors suggest that improvements in internal incentives (eg. personal satisfaction from recycling) and facilitators (eg. knowledge about recycling programmes) may bring about more sustained effects on recycling behaviours.

4.5.8 Relative efficacy of different intervention strategies

All of the intervention strategies examined by the reviews were shown to be successful to at least some extent in improving environmentally responsible knowledge, attitudes or behaviour. Several studies included in the reviews directly compared the relative efficacy of different intervention strategies and their results are reported here.

The narrative review (Schultz et al 1995) (3 B) included studies that compared the relative efficacy of prompting with other intervention strategies. All of the studies that drew direct comparisons (with one exception) found that the use of prompts alone was less effective than other strategies including providing feedback and offering rewards.

The review (Schultz et al 1995) (3 B) included several studies that compared the efficacy of reward-based recycling interventions with other strategies including prompts, feedback and getting people to make a commitment to recycle. Overall, rewards were shown to produce greater improvements in recycling than the other strategies, though these improvements tended to be fairly short-term. The review (Porter et al 1995) (3 B) reported one study that compared the relative efficacy of rewards with simply providing information about a recycling programme. The study found that offering a reward was a more effective strategy for increasing newspaper recycling than simply providing information about a recycling programme; the school recycled an average of 17 times more newspaper when hamburger vouchers were given to ‘high-recycling’ classes compared with classes that were just provided with information about the programme. Another study in this review, compared the effectiveness of using a lottery with prompting and goal setting plus feedback in workplace setting. The research found that the lottery interventions produced higher participation rates in aluminium can recycling and a greater quantity of can recyclables brought from home than the other intervention strategies.

The review (Schultz et al 1995) (3 B) included five studies that compared the efficacy of commitment strategies with other approaches showed that, in general, commitment strategies produced more sustained effects on recycling behaviour than rewards, prompts, or simply providing information. Getting people to make a written commitment to recycle was more effective than providing an informational prompt alone at increasing participation in a household recycling programme and the amount of paper recycled. Research included in a narrative review (Porter et al 1995) (3 B) showed that written commitment strategies were at

least as effective as reward-based strategies in improving recycling behaviour. Feedback was shown to be less effective than setting goals, but only in one study.

Two studies included in the review (Schultz et al 1995) (3 B) compared the effects of personal contact through a 'block leader' with information alone and found that the areas with designated block leaders participated significantly more in kerbside recycling (58% of households recycled at least once during the post-treatment phase) than areas that simply had information about the scheme left at their door (38%). However the authors of this review note that the studies did not consider the importance of certain features of the community, such as whether individuals perceive themselves to be part of the community or tend to feel fairly isolated.

The review of energy conservation studies included research that directly compared the efficacy of giving households a small request to fill out a questionnaire, with a bigger request to sign a commitment to conserve energy, with a combination of both types of requests, and noted that households in all three treatments groups saved more energy than households in the control group. In a later study by the same author, two additional treatment conditions were added for comparison: providing households with a reward (based on the amount of energy that they saved) and a combination of all interventions (ie. a small request to complete questionnaire + a bigger request to make a commitment to conserve energy + information about conserving energy + a reward). The study found that households in the commitment group and the combined intervention groups showed the biggest reductions in energy use. However these effects were only observed during the first week of the intervention.

Osbaldiston (2004, 3 B) used meta-analysis to identify the most effective strategies for increasing environmentally responsible behaviour. The analysis showed that the two treatments with the largest effect sizes were making a commitment and setting goals. Surprisingly, the two treatments with the smallest effects sizes were 'changing the situation' (meaning strategies like increasing the proximity of recycling bins, etc.) and providing incentives. Analyses were also undertaken to examine which intervention strategies were most effective in improving recycling and energy conservation behaviours in particular (there were too few studies to perform similar analyses for other behaviours). Recycling reported the greatest effect sizes when the treatments were using incentives, establishing social norms, making commitment, setting goals and manipulating situational conditions. For energy conservation, the most effective treatments were using incentives, using prompts and getting people to making commitment to save energy.

4.5.9 Methodological features of the studies

Abrahamse et al (2005, 2- B) examined whether certain methodological features of included studies influenced the impact of internal and external factors on propensity to recycle. Both mode of data collection and sample size had statistically significant coefficients. When actual measures of recycling behaviour were used, as opposed to self-report, the magnitude of correlation was higher. Sample size did not hugely effect the size of the correlation. Although the variance attributable to these methodological factors was sizeable (19%), the biggest proportion of variance was, in fact, due to the recycling variables (34%).

Similarly, Porter et al (1995, 3 B) also noted that the apparent effectiveness of recycling interventions was influenced by the dependent variable measured, with the biggest effects usually reported on the percentage of subjects participating in a recycling programme.

Weaker effects were found when the dependent measure was of the absolute amount of material recycled. In some cases no changes were observed in the amount of waste recycled, even where significant improvements in programme participant rates were reported. Again, stronger effects were also seen on self-report rather than direct measures of actual behaviour. Though this certainly makes the findings of some studies a little suspect, overall consistent patterns in findings were observed.

Osbaldiston (2004, 2- B) examined the possible moderating effects of six methodological variables on interventions studies on a range of environmentally responsible behaviours. The variables were: study population, intervention setting, research design, metric of the effect size, statistics used to calculate the effect size, and the nature of the control group. Though the hypotheses for population and setting were supported (see section 4.3.2), none of the other factors played a significant role.

4.5.10 Other factors

Studies that directly examined the relative effect of different types of commitment strategies on recycling behaviour found that agreements in the form of a signed, written statement were generally the most effective. Though both group and individual-based commitments can be effective, one study of college students, reported in the narrative review (Porter et al 1995, 3 B) showed that individual commitments produced the largest effects both in terms of frequency of participation in recycling programmes and the amount of paper recycled. The effects on participation were sustained among those in the individual commitment group at three week follow-up.

Two studies included in a narrative review (Schultz et al, 1995, 3 B) directly compared various commitment approaches with one another. The studies found that written commitment produced greater increases in both kerbside participation and the amount of recyclables collected, and again that individual commitments produced greater participation in a recycling drive held at a college than did group commitments. The review of energy conservation interventions (Abrahamse et al, 2005, 3 B) showed that getting people to make a public commitment to conserve energy proved to be a more effective strategy than getting them to make a private commitment. These effects were maintained at six months.

Prompts were examined in the narrative review that focused exclusively on litter reduction interventions (Huffman et al 1995, 3 B). The findings from several studies suggest that prompts involving specific instructions can be more effective in increasing correct litter disposal than non-specific instructions. The studies also suggest that anti-littering signs can be more effective if they are worded politely and placed in close proximity to litter bins and recycling containers.

Feedback was shown to be an effective strategy for reducing household energy use in the studies examined in the narrative review (Abrahamse et al, 2005, 3 B). Furthermore, the research suggests that the more frequently feedback is provided, the more effective it is. It was difficult to assess whether it is more effective to provide feedback in terms of monetary savings (as opposed to environmental benefits) since the studies that examined this did not report any significant differences in this respect.

Reducing the amount of effort involved in recycling programmes can also increase effectiveness, according to research examined in one of the narrative reviews (Schultz et al,

1995, 3 B). Removing the effort associated with sorting waste was examined in one study which compared participation rates in a community-wide ‘commingled’ kerb-side recycling programme (ie. one where participants can mix all recyclables together in a single collection bin to be sorted at a materials recovery facility) with those of a voluntary waste separation programme. Over 90% of households participated in the commingled programme at least once in five consecutive occasions compared to only 40% in the voluntary waste separation programme. Kerbside collection schemes were also found to have higher participation rates than those that required people to transport their recyclable materials to a central drop-off facility.

One study included in a narrative review (Porter et al, 1995, 3 B) found that written prompts encouraging people to recycle were more effective in higher than lower income households. Another study in this review found that the involvement of block leaders in a kerbside recycling programme proved to be more effective at increasing participation in areas with reportedly higher levels of income and education suggesting that it had more success with people of higher socioeconomic status.

4.6 Evidence summaries

4.6.1 Recycling

There is some evidence that an awareness of the need to recycling and knowledge of recycling programmes are very strong predictors of recycling behaviour. There is also evidence that the use of prompts can increase recycling behaviour, as the studies that examined this strategy tended to report consistent positive effects. Commitment strategies also produced consistent positive improvements in recycling.

There is some evidence that increasing the frequency of the collection of recyclables and scheduling the kerb-side collection of recyclables to coincide with regular waste collection can have small moderating effects on recycling. When comparisons were made, these strategies were shown to be less effective than other strategies like offering monetary rewards or getting people to make a commitment to recycle.

There is some evidence that monetary rewards can improve recycling behaviour, as the studies that examined this as an intervention strategy reported consistent positive effects. When compared to other interventions strategies, reward-based strategies produced greater improvements in recycling behaviour though changes tended to be fairly short-term and participation in reward-based interventions was usually low. Providing people with feedback about their performance in recycling was found to be a promising strategy for promoting recycling but further research is needed.

There is some evidence from a meta-analysis of environmentally responsible behaviours that the most effective strategies for increasing recycling are providing incentives, using social norms, getting people to make a commitment, setting goals and manipulating situational factors.

4.6.2 Energy conservation

Getting people to make a commitment was also an effective strategy in getting people to reduce their energy use. Longer-term effects were seen in one study (six months). Monetary

rewards again had an overall positive effect in promoting energy conserving behaviours. Although goal setting could be effective in getting people to reduce their energy use, it more effective if combined with feedback on how people were doing in terms of meeting their goals.

Providing people with tailored information about their energy use – through, for example, home energy audits – tended to show more positive effects than other more general information strategies like mass media campaigns, especially in achieving behavioural change. Modelling and demonstrating appropriate energy saving behaviours resulted in improvements in knowledge and behaviour in one study. Providing people with feedback about their energy use was also generally effective in getting them to adopt more energy saving behaviours.

There is some evidence from a meta-analysis of environmentally responsible behaviours that the most effective strategies for conserving energy are providing incentives, using prompts and getting people to make a commitment.

4.6.3 Litter reduction

Prompting strategies were again shown to have consistent positive effects on littering behaviour. Both community involvement and modelling strategies were also effective in getting people to dispose of litter correctly. Removing prior litter was also found to be an effective strategy in nine studies.

Environmental design strategies, like increasing the proximity of litter bins and improving the way they are labelled and decorated were also shown to have positive effects on littering behaviour. Reward-based interventions were effective in the studies that examined them. Only two studies examined the effects of feedback on littering and both reported positive results.

4.6.4 Responsible environmental behaviours

Getting people to make a commitment and goal setting were the interventions identified through meta-analysis to have the strongest relationships with environmentally responsible behaviours, suggesting that they are likely to produce the best results. In contrast, providing incentives and ‘changing the situation’ (which refers mostly to environmental changes like increasing the proximity of recycling containers) had the weakest relationships with environmentally responsible behaviours. This is surprising in that rewards and incentives were consistently shown by reviews addressing the other areas (recycling, energy conservation and litter reduction) to have positive effects (though these were notably usually short-term), and interventions that involved altering the environment were shown to have moderate effects in the other reviews.

4.7 Gaps in the evidence base

Again, the remit of this work was to examine *reviews* of pro-environmental interventions rather than examine data at a primary level. Though this approach has many benefits, it also has a number of limitations. In this case, there were very few relevant reviews (only six) on the topic, limiting the amount of evidence on which to draw conclusions. Broadening the research to examine primary-level data may have allowed us to examine a wider range of intervention types and environmental topics.

Of the six included reviews, two were low-quality meta-analyses and the remaining four were narrative reviews. Under normal circumstances, the four narrative reviews would have been excluded for not meeting the quality criteria for the review. For example, very few of them provided sufficient detail about the methods used to search for and select evidence and none undertook quality appraisal of any kind. However, because of the relative paucity of good quality reviews on this topic, these narrative reviews were included in the hope that they would provide useful insights in terms of changing environmental behaviours. The relatively poor quality of these reviews should be borne in mind when considering the weight of evidence.

The quality of reporting in the reviews was variable. Usually, very limited information was provided about the included studies and the interventions that they described. For example, in terms of the studies, information was often patchy or missing on the following: geographical origin, study sample, data collection methods, precise outcome measures, and the results of statistical tests. The methods used by the studies themselves were also at times called into question, for example, relying on self-reported measures in behaviour, focusing on very specific populations or settings, or examining only very short-term changes. Information about the interventions themselves was also patchy, with limited detail, for example, on the specific approaches adopted by the intervention, the use of delivery agents, and the duration of the intervention.

The six reviews addressed a range of environmentally friendly behaviours including recycling, energy conservation and litter reduction. Recycling appears to have been subject to a greater amount of research than both energy conservation and litter reduction. The absence of evidence on other types of pro-environmental behaviours including composting, 'green' shopping and environmentally friendly travel (eg. walking or using public transport as opposed to driving a car) was disappointing. Encouragingly, the reviews addressed a whole range of different intervention approaches including prompting, commitment, and more straightforward informational strategies, as well as efforts to manipulate people's surroundings to make it easier and more convenient for them to engage in environmentally friendly behaviours. The majority of interventions involved implementing changes at either an individual level (eg. making a commitment to recycle more newspaper at home) or community level (eg. working with others in the community to tackle dog litter). Evidence on wider population-level interventions was very limited, as was data on mass media and educational initiatives.

As with the evidence on road safety, the literature was again dominated by North American studies though most of the interventions examined by the reviews were fairly generic and should transfer well to a UK setting. Although the interventions examined in the reviews addressed a range of different target populations including residents of different kinds (eg. homeowner, residents of apartment complexes, people living in mobile home parks), little rationale was provided for focusing on these groups and none of the studies (or the reviews) appeared to systematically examine differences in how target groups respond to environmental interventions. There was virtually no data on differences between socio-economic groups. The choice of setting also often appeared incidental though there was some variation. For example, interventions targeting recycling behaviour were often based within residential communities of some kind, although some studies examined interventions that took place in colleges, school and workplaces. There was less variation, in terms of setting, among energy conservation interventions which almost always took place in a home setting.

No studies appeared to implement energy conserving interventions in other settings like workplaces, for example.

It would have been helpful to learn more about the cost-effectiveness of the different interventions. Only studies that examined reward-based interventions appeared to address this issue.

5.0 EVIDENCE TABLES

5.1 Road Safety

Evidence Tables for Question 3.2. What is the evidence for effectiveness of interventions in terms of changes in road safety-related knowledge, attitudes, behaviours and other road safety outcomes?

Author, Date and Title	Review Type and Quality	Study Population	Review Objective	Results	Applicability to the UK
[1] Aeron-Thomas AS, Hess S 2005	Systematic review (non-RCT) Level: 2 Review quality: + No. of studies 10	All road users	To quantify the impact of red-light cameras on the incidence and severity of road crashes and casualties, and the incidence of red-light violations.	Studies were grouped according to the extent to which they adjusted for regression to the mean and spillover effects, giving the following result for total crashes and types of crashes: Total casualty crashes risk ratio 0.84 (95% CI 0.76, 0.93 - 5 studies) Right angle casualty crashes risk ratio 0.76 (95% CI 0.58, 0.99 - 3 studies) Rear end casualty crashes risk ratio 0.87 (95% CI 0.63, 1.19 - 3 studies) Total crashes (including damage only) risk ratio 0.85 (95% CI 0.73, 0.99 - 7 studies) Red-light violations risk ratio of 0.53 (95% CI 0.17, 1.16 - 1 study)	Study countries: Australia Singapore USA Relevance score: B
[2] Bunn F, Collier T, Frost C, Ker K, Roberts I, Wentz R 2003	Systematic review (non-RCT) Level: 2 Review quality: - No. of studies 16	Pedestrians and/or drivers	To evaluate the effectiveness of area-wide traffic calming in preventing traffic related crashes, injuries, and deaths. (Area-wide traffic calming measures designed to discourage the use of residential streets for through travel).	The pooled rate ratio from eight studies for crashes resulting in death was 0.63 (95% CI 0.14, 2.59); however, the results should be interpreted with caution since there were few events. Sixteen studies reported the number of road traffic crashes resulting in injuries (fatal and non fatal) with a pooled rate ratio of 0.89 (95% CI 0.80, 1.00). Nine studies reported the total number of road traffic crashes, with a pooled rate ratio of 0.95 (95% CI 0.81, 1.11). Thirteen trials reported the number of pedestrian-motor vehicle crashes, with a pooled rate ratio of 1.00 (95% CI 0.84, 1.18). Two trials examined residents' perceptions of safety before and after the schemes; in one, almost 80% of those who responded (response rate of 43%) supported the council's policy of improving residential safety by reducing the volume of through traffic; however, only 64% supported the permanent installation of the trial scheme. In the other study the majority of residents who responded (65%) felt that the level of safety had remained constant or diminished.	Study countries: Australia Germany Netherlands UK Relevance score: A
[3] Duperrex O, Roberts I, Bunn F 2002	Systematic review (RCT) Level: 1 Review quality: ++ No. of studies 15	Children Mentally handicapped	To quantify the effectiveness of pedestrian safety education programmes in preventing pedestrian-motor vehicle collisions.	Eight studies of 'direct education': One study of training in real traffic situations found that the proportion of routes chosen by primary school children as safe scored (σ) 0.13 (0.20) pre-intervention, 0.72 (0.28) immediately post-intervention, and 0.50 (0.36) after nine weeks. For children trained using a tabletop model of road layouts, scores were 0.07 (0.16), 0.70 (0.30), and 0.54 (0.34) respectively. After eight months the figure for both trained groups was 0.38 (0.23) compared to 0.12 (0.15) in the control – WMD 0.26 (95% CI 0.9, 0.43). Measurements were made for four tasks. Task 1 (speed and time variables are fixed; children operate on distance variable (complex case of unequal speeds) found that the proportion of those giving a wrong answer decreased from 78% to 25% (control 80% to 62%); n = 69. For Task 2 (speed and time variables are fixed; children operate on distance variable (simple case of equal speeds): the proportion giving a wrong answer dropped from 36% to 6% (control 29% to 9%); n = 69. For Task 3 (speed and distance variables are fixed; children operate on time variable (complex case of unequal speeds): the proportion giving the wrong answer reduced from 54% to 10% (control 47% to 35%), n = 69. For Task 4 (speed and distance variables are fixed; children operate on time variable (simple case of equal speeds): the proportion	Study countries: Australia Canada England Germany Japan Scotland USA Relevance score: A

			<p>giving the wrong answer decreased from 27% to 0% (control 20% to 7%), n = 69. The overall RR was 1.27 (95% CI 1.07 to 1.50).</p> <p>Following the Safety City education programme, the intervention group improved mean score on a safety knowledge test (maximum score 16 points) from 4.31 to 6.21 (control group changed from 4.27 to 5.63). SMD 0.23 (95% CI -0.07 to 0.52); WMD 0.58 (95% CI -0.16 to 1.32). The mean change (σ) between pre- and post-tests was 1.9 (2.7) for intervention group; control 1.4 (3.5).</p> <p>A study with 30 "mentally retarded" institutionalised adults measured target behaviours (proper pavement behaviour, recognition of an intersection, crossing the street) at a city intersection, and reported the results classroom versus control: RR 1.91 (95% CI -1.23 to 2.98) and independence training versus control: RR 1.43 (95% CI -0.89 to 2.30).</p> <p>A study comparing the effects on children's observed crossing behaviour of a detailed caution, a simple caution and no caution found results for safe behaviour of detailed caution vs no caution: RR 2.43 (1.13 to 5.24); Simple caution vs no caution: RR 1.83 (0.81 to 4.15)</p> <p>A Canadian study compared three simulation games targeting attitude, behaviour and both. The three intervention groups achieved higher mean scores on the transfer of learning test than the control group, with a maximum score of 31(σ): attitude simulation game 8.7 (3.1); behaviour simulation game 10.4 (2.1); attitude and behaviour simulation game 10.1 (2.3); control 7.9 (3.7). Post test transfer scores were: attitude game vs No training: SMD 0.23 (95% CI -0.26 to 0.73); WMD 0.80 (95% CI -0.89 to 2.49); Behaviour game vs No training: SMD 0.83 (95% CI 0.31 to 1.35); WMD 2.50 (95% CI 0.99 to 4.01); Attitude and Behaviour game vs No training: SMD 0.71 (95% CI 0.20 to 1.22); WMD 2.20 (95% CI 0.66 to 3.74). The means of the behaviour tests were (max score 5): attitude simulation game 4.9 (0.2); behaviour simulation game 4.3 (0.8); attitude and behaviour simulation game 4.5 (0.7); control 4.0 (1.1). The post-test Behaviour Scores were: Attitude game vs No training: SMD 1.13 (95% CI 0.62 to 1.64); WMD 0.90 (95% CI 0.52 to 1.28); Behaviour game vs No training: SMD 0.31 (95% CI -0.17 to 0.79); WMD 0.30 (95% CI -0.16 to 0.76); Attitude and Behaviour game vs No training: SMD 0.54 (95% CI 0.05 to 1.02); WMD 0.50 (95% CI 0.06 to 0.94). The attitude scores were: attitude simulation game 1.9 (0.7); behaviour simulation game 1.8 (0.6); attitude and behaviour simulation game 2.0 (0.7); control 1.3 (0.7). Post-test Attitude Score were: Attitude game vs No training: SMD 0.85 (95% CI 0.35 to 1.35); WMD 0.60 (95% CI 0.27 to 0.93); Behaviour game vs No training: SMD 0.76 (95% CI 0.26 to 1.26); WMD 0.50 (95% CI 0.19 to 0.81); Attitude and Behaviour game vs No training: SMD 0.99 (95% CI 0.48 to 1.50); WMD 0.70 (95% CI 0.36 to 1.04).</p> <p>One primary school study found that for children trained in a real traffic environment, the proportion of routes classified as safe was: pre training 0.10, post training 0.35, nine weeks post training 0.34. For children trained with the tabletop model, the proportions were: pre training 0.14; post training =0.37; nine week post training 0.37; For untrained children, the proportions were: pre training 0.04; post training 0.12; nine week post training 0.12.</p> <p>A similar study using a tabletop model only found that for the trained children, the proportion of routes classified as safe was pre training: 0.15; post training 0.43 and nine week post training 0.35. For the children who were not trained the proportions were 0.16; 0.13; 0.16.</p> <p>Seven studies of 'indirect education': One study of a road safety education package (contents not specified) for class teachers found that the</p>	
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				<p>pupils' knowledge scores (σ) after the intervention were 83.3% (10.6) compared to 35.7% (25.3) for the control group.</p> <p>One study assessing the effectiveness of a booklet in improving parental road safety education and road supervision found the following outcomes: Hold hands - Road safety booklet after an interview versus Interview only: RR 0.72 (0.52 to 0.99); Hold hands - Road safety booklet with a letter versus No intervention: RR 1.13 (0.90 to 1.43); Walk / stay on pavement - Road safety booklet after an interview versus Interview only: RR 0.74 (0.44 to 1.24) walk / stay on pavement - Road safety booklet with a letter versus No intervention: RR 1.24 (0.87 to 1.76); Look / watch out for cars - Road safety booklet after an interview versus Interview only: RR 1.66 (0.78 to 3.57); Look / watch out for cars - Road safety booklet with a letter versus No intervention: RR 1.33 (0.82 to 2.18).</p> <p>A study training parent volunteers found that the proportions of children aged 3 to 4 years old who stopped at the kerb without being distracted were: pre intervention 4%; post intervention 83%; and nine weeks post intervention 20% for the intervention group and 5%; 43% and 15% respectively for the control group. The proportion of children aged 3 to 4 years old who stopped at the kerb whilst being distracted were pre 8%; post 76%, and nine week post 15%, (control 6%; 8% 8%). The proportion of children aged 5 to 6 years old who stopped at the kerb without being distracted were pre intervention 14%, post 82%, nine week post 31% (control 9%, 56%, 29%). The proportion of children aged 5 to 6 years old who stopped at the kerb whilst being distracted were pre 16%, post 80%, nine week post 21%, (control 11%, 13%, 10%).</p> <p>A study of the Beltman programme reported outcomes for children's behaviour of crossing using crosswalks' as reported by parents as: Beltman programme versus No training: RR 2.26 (1.20 to 4.24); (Beltman+Booster) versus No training: RR 1.18 (0.59 to 2.40); (looking before crossing the road) Beltman programme versus No training: RR 1.40 (0.87 to 2.25) ; (Beltman+Booster) versus No training: RR 1.74 (1.15 to 2.65). In a 20 item multiple choice questionnaire the pre-intervention results were (σ) Beltman 13.22 (3.06), Beltman+Booster 13.40 (3.10) and control 13.74 (3.11), six months after the intervention 18.06 (1.92), 18.27 (1.74) and 16.31 (2.58) respectively.</p> <p>A study of traffic education materials by class teachers found that the mean test scores in the class that used book one (infants) was 28% (6) before 34% (10) after the intervention (control 28%, 30%). In the class that used book two (lower juniors) the mean score was 32% before and 45% after the intervention (control 32%, 33%). In the class that used book three (upper junior and middle) the mean score was 28% before and 35% after the intervention (control 29% and 31%). Mastery was defined as achieving at least 80% on the test, and post intervention in the group that used book one this was 27% (control 9%); book two 42% (control 13%), and book three 39% (control 17%). The difference in the books was in age ranges that they were aimed at, no further information of their content is given.</p> <p>Two primary school studies in Glasgow examined training in real traffic environments, with the outcomes being the child's perception of a safe place to cross. For the trained children, the proportion of routes classified as safe was: pre intervention 7%; post intervention 26% and nine week post 21% (control group 8%, 15%, 19%). The second, similar study found similar results.</p> <p>The authors comment that, despite the generally positive results across the studies, behaviour changes observed in simulated traffic environments may not translate to real traffic situations.</p>	
[4] Ehiri JE, Ejere HOD,	Systematic review (RCT + non- RCT)	Low-income parents with children 4 to 8	To assess the effectiveness of interventions intended	<p>All five studies reported outcomes for frequency of booster seat use (observed or reported) post intervention. Meta-analysis found that there was a significant increase in booster seat use when any intervention was compared to no intervention. (RR 2.18; 95% CI 1.12 to 4.23; n = 3,070). Combined</p>	Study countries: Australia Canada

<p>Magnussen L, Emusu D, King W, Osberg JS</p> <p>2006</p>	<p>Level: 1&2</p> <p>Review quality: ++</p> <p>No. of studies 5</p>	<p>years old enrolled day centres</p> <p>Rural school children 4 to 7 years old enrolled in schools (and parents)</p> <p>Families with children aged 0 to 6 years belonging to vulnerable groups (minorities, low income) and attending public hospitals</p> <p>Children aged 0 to 12 years</p> <p>Parents of children under 15 years</p>	<p>to increase acquisition and use of booster seats in motor vehicles among four to eight year olds.</p>	<p>results from two studies showed a beneficial outcome in favour of education, RR 1.32; 95% CI 1.16 to 1.49 (n = 563). Combined results from two studies show a beneficial effect for combining distribution and education compared to no intervention RR 2.34; 95% CI 1.50 to 3.63 (n = 380). Combined results from the three studies indicate a beneficial effect of incentive + education in increasing booster seat use compared to no intervention RR 2.75, 95% CI 2.41 to 3.13 (n = 1898). One study compared enforcement of booster seat law with no intervention and showed no marked difference in use of booster seats RR 1.04; 95%CI 0.91to 1.20 (n = 520).</p> <p>One study showed that 173/231 (75%) of participants in the education-only arm used booster seats at two weeks compared to 161/268 (60%) of participants in the no intervention group. Another study also showed that participants in the education arm of the study were more likely to purchase booster seats 12/32 (38%) than were those in the control group 1/32 (3%) at 30 days. Combined results from both studies showed a beneficial outcome in favour of education, RR 1.32; 95% CI 1.16 to 1.49 (n = 563).</p> <p>In one study 42/195 (22%) participants in the education plus free provision arm had obtained child safety seats at three months compared to 7/132 (5%) in the no intervention group. A similar study with slightly more participants found that 20/30 (67%) in the combination group use of booster seats at six months (52%) compared to participants in the control group but the difference was not large, RR 1.28; 95% CI 0.80 to 2.04. However, the combined results from both studies showed a beneficial effect for combining distribution and education compared to no intervention RR 2.34; 95% CI 1.50 to 3.63 (n = 380).</p> <p>In one study more participants in a group receiving education and incentives 11/32 (34%) had purchased booster seats at one month compared to 1/32 (3%) in the no intervention group. In another study 184/705 (26.1%) participants in the combined education and incentives group used booster seats compared to 215/1065 (20.2%) in the no intervention group. However another study showed no difference in the use of booster seats at six months among participants in the treatment arm 20/41 (48.8%) and participants in the no intervention group 12/23 (52.2%). The combined results from the three studies indicate a beneficial effect of incentive + education in increasing booster seat use compared to no intervention RR 2.75, 95% CI 2.41 to 3.13 (n = 1898).</p> <p>Only one study compared enforcement of booster seat law with no intervention. This study showed no marked difference in use (observed) of booster seats among the intervention 158/252 (63%) and control groups 161/268 (60%), RR 1.04; 95% CI 0.91 to 1.20 (n = 520).</p>	<p>Israel USA</p> <p>Relevance score: B</p>
<p>[5]</p> <p>Grossman DC, Garcia CC.</p> <p>1999</p>	<p>Systematic review (RCT + non-RCT)</p> <p>Level: 1&2</p> <p>Review quality: -</p> <p>No. of studies 18</p>	<p>Children under 5 years old, and their parents</p>	<p>To review the effectiveness of non-legislative community and clinical programmes to increase the rate of child motor vehicle occupant restraint use among children under the age of 5 years by: Curricula targeted at children in preschool Counselling or education sessions with parents Demonstrations of</p>	<p>All of the eighteen studies that met criteria for inclusion were categorized in three groups: Day care centre car seat education programmes (n = 5) Community-based campaigns promoting car seat utilization (n = 2). Infant car seat loan programmes during the peripartum period (n = 11).</p> <p>Three of the day care centre programmes consisted of a formal curriculum targeted at children and their families, and two used an incentive reward system to promote car seat use. Three of the five were uncontrolled pre/post evaluations, and two were controlled trials in which the centre, not the child, was the unit of assignment to the study group. Gains in observed seat belt use among intervention groups in these studies ranged from an absolute increase of 12 to 52 percentage points immediately after the intervention. However, gains appeared to be short-lived, as the two programmes with follow-up observations conducted one month or later showed absolute net gains from baseline of 8 to 14 percentage points. Three of five programmes did not conduct any observations after the immediate post-intervention measurement so their long-term effectiveness could not be measured.</p>	<p>Study countries: Canada New Zealand. USA</p> <p>Relevance score: B</p>

			<p>correct car seat usage to parents</p> <p>Distribution of educational materials (pamphlets, posters, films)</p> <p>Home visits by designated health care personnel</p> <p>Health care provider messages during clinic visits</p> <p>Mass media campaigns including print, billboard, and television advertising</p> <p>Incentive programmes with prizes or other rewards</p> <p>Car seat loaner or rental programmes</p> <p>Coercive programmes with negative reinforcement (excluding police or legal interventions) for unrestrained children</p> <p>Institutional policies providing guidelines for parents to follow (e.g., day-care policy that all children coming to day-care must be in a car seat).</p>	<p>One community-based campaign was based on a lottery reward system to families that were observed to have seat belts fastened. Information about the rewards was advertised in newspapers and radio advertisements. This programme resulted in an absolute gain from a baseline of 9.6 percentage points ($P < 0.05$) in car seat use immediately following the campaign. A follow-up observation 7 weeks later showed a net gain in seat use of 4.8 percentage points ($P < 0.05$). A similar media campaign in Montreal that did not use incentives or rewards resulted in long-term (6 month follow-up) gains in car seat use of 13.7 percentage points ($P < 0.0001$). The intervention seemed to have an effect only on younger children, since absolute gains for the 5-11-year-old group amounted to only 1.4% (note that this age group was outside the review parameters, but results were presented as the study also covered the 0 to 5 age range).</p> <p>The eleven studies of car seat loan programmes in the peripartum period varied considerably in the study design, intervention, and observed outcomes. Most of these studies involved one or more of the following interventions: receipt of a free or loaner car seat; brief encounter with a physician, nurse, or film stressing importance of car seat use; receipt of pamphlets and other written materials promoting car seat use; booster messages of well child visits; and a home visit. Eight of the eleven studies used control groups. Often there were significant baseline demographic differences between groups that should have led the authors to adjust the results. In many cases, these imbalances resulted from the assignment of small numbers of clinics or hospitals, rather than a larger number of individual patients, to intervention arms. Two of the best designed and executed studies were controlled clinical trials in which the patient, rather than a hospital or community, was the unit of assignment and in which partial blinding was accomplished. One of these studies showed few important differences between the control and experimental groups in car seat use either at hospital discharge or at 2- to 4-month follow-up clinic visits. The only one of the three different intervention groups to result in even a modest absolute difference (5% to 7%) in the rate of car seat use, compared to controls, offered free car seats with demonstration; the others offered seats at cost. The second well-designed study involved a three part intervention of post-partum education and follow-up "booster" sessions during well child care visits to paediatricians. Car seat use at the 2-month visit (end of intervention) showed a difference of 21% between the experimental and control groups, but the magnitude of this difference did not persist at the 4-month (14%) and 15-month (16%) observations. Other studies in this category that had a weaker study design showed a range of 8% to 49% increase in use at the end of the intervention, but those few studies conducting longer term post-intervention measurements found increased car seat use rates of 6% to 27%.</p>	
<p>[6]</p> <p>Hartling L, Wiebe N, Russell K, Petruk J, Spinola C, Klassen TP</p> <p>2004</p>	<p>Systematic review (non-RCT)</p> <p>Level: 2</p> <p>Review quality: +</p> <p>No. of studies 12</p>	<p>Young drivers</p>	<p>To examine the effectiveness of Graduated Driver Licensing (GDL) systems in reducing crash rates of young drivers.</p>	<p>Six studies presented comparable data for all crash types; these included driver-involved fatal, injury, and property-damage only (PDO) crashes. For 16 year-olds, the reductions in per population crash rates for the first year post-GDL ranged from 26 to 41% (four studies).</p> <p>Crash rates per licensed driver (three studies) were similar (19 and 31%) with the exception of one study (79%).</p> <p>The reductions for sixteen year olds having crashes one year after GDL was brought in were: North Carolina, 28% in one study and 19% in a second; Nova Scotia 34%; Maryland 41; Michigan 26%; Kentucky 36%; Ontario 79%.</p> <p>The reductions for all teenagers having crashes one year after GDL were: Nova Scotia (aged 16-17) 20%; Kentucky (aged 16-19) 6%; Ontario (aged 16-19) 25%, and in a second study 31%.</p>	<p>Study countries: Australia New Zealand USA</p> <p>Relevance score: B</p>

				<p>The reductions for crashes involving injuries for sixteen year olds one year after GDL were: North Carolina 36%; New Zealand 43%; Nova Scotia 34%; Maryland 16%; Michigan 28%; California 4% and in a second study an increase of 3%; Florida 10%; Kentucky 35%.</p> <p>The reductions for crashes involving injuries for all teenagers one year after GDL were: New Zealand (aged 15-19) 25%; Nova Scotia (aged 16-17) 14%; Florida (aged 15-17) 8%; Kentucky (aged 16-19) 11%; Ontario (aged 16-19) 27%; Quebec (ages not stated) 14%.</p> <p>Two studies reported on crashes involving sixteen year olds that caused someone to be hospitalized, both in New Zealand, with reductions one year after GDL of 41% and 27%.</p> <p>Four studies that reported on post GDL crashes involving sixteen year olds that caused someone to be hospitalised found reductions of: New Zealand (aged 15-19) 32% (adjusted 28%); a second New Zealand study 26% (adjusted 20%) and a third New Zealand study 18% (adjusted figure not stated); South Australia (aged 16-19) 23% (adjusted 19%).</p> <p>No significance data given.</p>	
<p>[7] Ker K, Roberts I, Collier T, Beyer F, Bunn F, Frost C 2003</p>	<p>Systematic review (RCT) Level: 1 Review quality: ++ No. of studies 24</p>	<p>Motor vehicle drivers (including motorcyclists) of all ages and driving experience that hold a valid driving licence</p>	<p>The evaluation of post licence driver education for the reduction of traffic crashes.</p>	<p>Nineteen trials reported traffic offences: pooled relative risk (RR) = 0.96 (95% CI 0.94, 0.98 – trial heterogeneity was significant $p < 0.00001$) - this may have been caused by selection bias.</p> <p>Fifteen trials reported traffic crashes: pooled RR = 0.98 (95% CI 0.94, 0.98 – trial heterogeneity was not significant $p = 0.75$).</p> <p>Four trials reported injury crashes: pooled RR = 1.12 (95% CI 0.88, 1.41 – trial heterogeneity was significant $p < 0.00001$).</p> <p>Of the nineteen trials compared the effectiveness of any form of driver education with no education in reducing traffic offences, 18 investigated remedial driver education - pooled relative risk 0.96 (95% CI 0.94, 0.98 - trial heterogeneity was significant $p < 0.00001$) and one advanced driver education - relative risk 0.98 (95% CI 0.93, 1.03).</p> <p>Nine trials compared the effectiveness of correspondence driver education with no education in reducing traffic offences. The pooled relative risk was 0.98 (95% CI 0.97, 0.99 - trial heterogeneity was not significant $p = 0.46$). For the eight trials of remedial driver education by correspondence, the pooled relative risk was 0.98 (95% CI 0.97, 0.99- trial heterogeneity was not significant $p = 0.36$) and for the one trial of advanced driver education by correspondence the relative risk was 0.98 (95% CI 0.93, 1.03).</p> <p>Eleven trials compared the effectiveness of remedial driver education compared group driver education with no education in reducing offences. The pooled relative risk was 0.95 (95% CI 0.92, 0.97 - trial heterogeneity was significant $p = 0.0098$). All 11 trials were of remedial driver education.</p> <p>Seven trials compared the effectiveness individual driver education with no education in reducing offences. The pooled relative risk was 0.95 (95% CI 0.91, 1.00 - trial heterogeneity was significant $p < 0.00001$). For the one trial of advanced driver education by correspondence, the relative risk was 0.98 (95% CI 0.93, 1.05).</p>	<p>Study countries: Sweden USA</p> <p>Relevance score: B</p>

				<p>Fifteen trials reported traffic crashes: pooled RR = 0.98 (95% CI 0.94, 0.98 – trial heterogeneity was not significant p=0.75). Thirteen of the trials were of remedial driver education pooled RR 0.98 (95% CI 0.96, 1.01 – trial heterogeneity was not significant p=0.63). Two of the trials were of advanced driver education pooled RR 0.99 (95% CI 0.93, 1.05 – trial heterogeneity was not significant p=0.56).</p> <p>Seven trials compared the effectiveness of correspondence driver education with no education for reducing crashes, pooled relative risk 0.98 (95% CI 0.95, 1.01 – trial heterogeneity was not significant p=0.56). Six of the trials were for remedial driver education, pooled relative risk was 0.97 (95% CI 0.93, 1.02 – trial heterogeneity was not significant p=0.55). The one trial of advanced driver education by correspondence, relative risk was 0.98 (95% CI 0.93, 1.05).</p> <p>Ten trials compared the effectiveness of group driver education with no education for reducing crashes. The pooled relative risk was 0.97 (95% CI 0.93, 1.02 - trial heterogeneity was not significant p=0.82). For the eight trials of remedial group driver education the pooled relative risk was 0.98 (95% CI 0.93, 1.02 - trial heterogeneity was not significant p=0.69) and for the two trials of advanced group driver education the pooled relative risk was 0.92 (95% CI 0.73, 1.17 - trial heterogeneity was not significant p=0.64).</p> <p>Six trials of remedial driver education compared individual driver education with no education. The pooled relative risk was 0.99 (95% CI 0.96, 1.03 - trial heterogeneity was not significant p=0.41).</p> <p>Four trials reporting injury crashes presented data suitable for the meta-analysis and compared the effectiveness of driver education with no education. The pooled relative risk was 1.12 (95% CI 0.88, 1.41 - trial heterogeneity was significant p=<0.00001). For the three trials of remedial driver education the pooled relative risk was 1.17 (95% CI 0.89, 1.54 - trial heterogeneity was significant p=<0.00001) and for the one trial of advanced driver education the relative risk was 0.94 (95% CI 0.74, 1.20).</p> <p>One trial compared correspondence remedial driver education with no education, and found the relative risk of an injury crash was 0.94 (95% CI 0.81, 1.09).</p> <p>Three trials compared injury crashes for group driver education with no education. The pooled relative risk was 1.02 (95% CI 0.93, 1.13 - trial heterogeneity was not significant p=0.57); for the two trials of remedial group driver education the pooled relative risk was 1.04 (95% CI 0.94, 1.16 - trial heterogeneity was not significant p=0.47) and for the one trial of advanced group driver education the relative risk was 0.94 (95% CI 0.74, 1.20).</p> <p>One trial compared injury crashes for individual remedial driver education with no education. The relative risk was 1.18 (95% CI 1.00, 1.38).</p>	
[8] Klassen TP, MacKay JM, Moher D, Walker A, Jones AL 2000	Systematic review (RCT + non-RCT) Level: 1&2 Review quality: - No. of studies 32	Children and adolescents aged 0 to 17 years Parents/care-givers of children	Community based interventions that are aimed at reducing unintentional injuries to children by changing social norms about what is acceptable behaviour relating to safety.	<p>An intervention comprising home-based education with parent facilitation of learning reduced running ahead for 3½ to 4 year olds from 82.3 to 74.3 (p<0.01), although there was no change in parent supervision behaviours (p>0.05).</p> <p>School based education for children aged 4 to 6, with instruction by a parent and an assistant, improved road crossing on quiet streets, between parked cars and at junctions; there was no difference if the training was provided by a parent or an assistant.</p> <p>Following an intervention comprising school-based behavioural and attitudinal simulations for 5 year olds, the intervention groups did marginally better on measures of attitude and behaviours for actions taken</p>	Study countries: Australia Canada Japan Netherlands New Zealand Sweden UK USA

			<p>during a quasi-real-life traffic set up.</p> <p>A school-based education intervention for children aged 4 to 6 found no differences in observed behaviours regardless of the presence or absence of a running motorcycle or of detailed versus vague verbal instructions.</p> <p>A school-based education intervention to increase bicycle helmet take-up found no change, but education with financial incentives resulted in a 22% take-up of helmets ($p < 0.05$). However, a similar study found no effect for education/incentives interventions ($p < 0.05$).</p> <p>An education-only intervention had no effect on helmet use. Helmet use jumped from 11.4% to 37.5% when education was coupled with legislation ($p < 0.0001$). A similar study found that helmet use went from 8% to 19% for education-only and from 4% to 47% for education plus legislation ($p < 0.0001$).</p> <p>An intervention comprising school-based parent/public education (for 5 to 14 year olds) with financial incentives found no significant difference in helmet use for the lower income group, but in higher income group helmet use increased from 4% to 36% ($p < 0.001$). A similar study looking only at low income groups found no difference ($p > 0.05$) between the control group and the intervention group. A third study (5 to 12 years old) found that in low income groups helmet use increased from 3.1% to 25.8% (control 4.1% to 15.2%), and in high income groups from 10.9% to 33.7% (control 2.8% to 11.8%)</p> <p>A school based intervention to increase bicycle helmet use for 5 to 15 year olds found that with financial incentives helmet use increased from 5.5% before education, to 10.5% after 12 months and 15.7% after 16 months ($p < 0.001$). Another study found that education with incentives saw an increase of helmet use from 8.5% to 32% ($p < 0.01$).</p> <p>A school based education programme saw an increase of helmet use for 11 to 13 year olds from 3.5% to 3.3% ($p < 0.01$)</p> <p>A study examining hospital admissions (inpatient) for bicycle injuries after a school education programme with economic incentives aimed at parents/public found a decrease of 3.1% in the target group and reductions of 2.9%, 2.2%, 3.4% and 1.1% in the control groups (no significance given).</p> <p>A peer and health professional education intervention for 13 to 15 year olds found no effect on self-reported risk taking behaviours ($p > 0.05$)</p> <p>An intervention to increase child restraint in cars using pre-school education and parent activities/training found an increase in use from 22.9% to 44.3% ($p < 0.001$). An evaluation of 'good' and 'poor' education programmes was evaluated for impact on low and high income groups (7 year olds), and found a rise in the control group from 48% to 55%; in the low income good programme group from 13% to 25%; in the low income poor programme group from 15% to 16%; in the high income good programme group from 49% to 50%; and a drop in the high income poor programme group from 68% down to 55%. The only significant increase was for the low income good programme group ($p = 0.01$).</p> <p>A comparison of a coercive strategy with a pre-school education intervention to increase child restraint use among parents of 3 to 5 year olds found that restraint use increased from 59.9% to 62.8% for the coercive strategy and from 60.6% to 75.0% for the education intervention ($p = 0.009$). An intervention consisting of coercive strategy, parent and pre-school education (2 to 6 year olds) found an increase in restraint use from</p>	<p>Relevance score: A</p>
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				<p>54% to 75% (control group 20% to 30%, $p < 0.05$).</p> <p>An emotionally charged educational programme for high school students found an increase in knowledge from 7.6% to 8.4% ($p < 0.01$) but no significant increase in seatbelt use (target group from 22.3% to 29%, control 42% to 49%, $p > 0.05$).</p> <p>Education as part of the high school physics course (15-17 year olds) aimed at increasing knowledge of seatbelt use and seatbelt behaviour found an increase in knowledge from 67% to 94%, dropping to 89% two years later ($p < 0.00$), and an increase in behaviour (seat belt use) from 70% to 83% (80% two years later), $p = 0.01$.</p> <p>Education within the high school (14 year olds) curriculum aimed at increasing knowledge of drink driving, reducing the rate of riding with a driver who has been drinking, increasing perceived ability to resist pressure, or changing alcohol consumption, found an increase in knowledge from 13.5% to 17.21 ($p < 0.000$), but no significant effect on behaviour ($p > 0.05$). A similar intervention for 15 year olds found an increase in knowledge regarding drink-driving from 63.4% to 72.3%, changing to 71.8% two years later ($p < 0.01$), but no significant effect on behaviour ($p > 0.05$).</p>	
[9] Kwan I, Mapstone J 2002	<p>Systematic review (RCT)</p> <p>Level: 1</p> <p>Review quality: ++</p> <p>No. of studies 37</p>	Pedestrians and cyclists	<p>To quantify the effect of visibility aids vs no visibility aids, and of different visibility aids, on the occurrence of pedestrian and cyclist-motor vehicle collisions and injuries; and to quantify the effect of visibility aids vs no visibility aids, and of different visibility aids, on drivers' detection and recognition responses.</p>	<p>No trials assessing the effect of visibility aids on the occurrence of pedestrian and cyclist-motor vehicle collisions and injuries were found.</p> <p>Fluorescent materials in yellow, red and orange colours improve detection and recognition in the daytime.</p> <p>For night time visibility, lamps, flashing lights and retro-reflective materials in red and yellow colours increased detection and recognition</p> <p>Retro-reflective materials arranged in a 'bio-motion' configuration enhanced recognition.</p> <p>Day time visibility aids Fluorescent colours vs non-fluorescent colours Viewed against a dark and light background non-fluorescent colours were not easier to detect: fluorescent colours detection distance 62m, non-fluorescent 64m. Two reviews found that fluorescent orange colours detection distance was better than other fluorescent colours (63m vs 62m and 300m vs 242m). Another review found that fluorescent yellow/orange was the best colours (184m vs 170m for detection, and 134m vs 120m for recognition) Three reviews found that non-fluorescent yellow has a better detection distance than dark blue (66m vs 63m; 214m vs 203m; 174m vs 160m). One trial found similar reaction times for fluorescent orange compared to other fluorescent colours (2.8 sec vs 2.8 sec) One trial found for non- fluorescent white and yellow had the shortest reaction times compared to grey (3.3 vs 5.8) Fluorescent colours had a greater detection and recognition frequency when compared with non-fluorescent colours (85% vs 65% and 49% vs 48% respectively).and fluorescent yellow had a higher detection rate, but not recognition rate when compared with other fluorescent colours (88% vs 81% and 51% vs 56% respectively). Non-fluorescent yellow-orange had a higher frequency of detection but not recognition when compared with other non-fluorescent colours (75% vs 60% and 45% vs 46% respectively).</p> <p>Night-time visibility aids</p>	<p>Study countries: EU Finland USA</p> <p>Relevance score: B</p>

				<p>A rectorised jacket yielded a greater visibility distance when compared with non-rectorised jackets (234m vs 118m).</p> <p>Under high beam, low beam and glare situation, retrorreflective tags worn by pedestrians yielded a greater detection distance when compared with no retrorreflective tags (220m vs 104m)</p> <p>A white jacket yielded a greater visibility distance when compared with a black jacket (138m vs 97m).</p> <p>Under both full and dipped headlights, rector tapes yielded a greater detection distance when compared with grey black cloths (223m vs 38m) and light grey cloth yielded a greater detection distance when compared with grey black cloths (80m vs 38m).</p> <p>A flashlight held by a pedestrian yielded a greater detection and recognition distance when compared with no light (420m vs 68m and 96m vs 32m respectively).</p> <p>Pedal reflectors and lights together yielded a shorter reaction time when compared with no light nor reflectors (1.06 sec vs 1.25 sec). A reflective helmet did not yield a longer detection nor recognition distance when compared with a non-reflective helmet (228m vs 237m and 206m vs 216m respectively)</p> <p>A flashing light held by a pedestrian yielded a greater detection and recognition distance when compared with reflectorised accessories (420m vs 207m and 96m vs 92m respectively).</p> <p>Biomotion retro-reflectors yielded a greater recognition distance when compared with no biomotion retro-reflectors (209m vs 157m and 209m vs 185m respectively), however biomotion retro-reflectors yielded a longer recognition time when compared with no biomotion retro-reflectors in two trials (4.3 sec vs 3.7 sec and 2.4 sec vs 1.4 sec respectively).</p>	
[10] McArthur DL, Kraus JF 1999	<p>Systematic review (RCT + non-RCT)</p> <p>Level: 1&2</p> <p>Review quality: ++</p> <p>No. of studies 3</p>	Drivers arrested for DWI (driving while impaired, ie. drink driving)	To determine if, for DWI offences, administrative per se laws (suspended without prosecution and within hours of offence) are more effective than other forms of sanctions.	<p>Studies reported:</p> <ul style="list-style-type: none"> - a combined odds ratio of 0.78 for subsequent drunk driving offences (95% Confidence level 0.76-0.79) - an OR of 0.65 for subsequent traffic crashes (95% Confidence level 0.63-0.67) - and an OR of 0.73 for subsequent alcohol-related crashes (95% Confidence level 0.70-0.77) <p>Three of the states (North Dakota, California and Nevada) had positive results for at least one year following the initial license suspension; however two states did not (Mississippi and Louisiana).</p>	<p>Study countries: USA</p> <p>Relevance score: B</p>
[11] Pilkington P, Kinra S 2005	<p>Systematic review (non-RCT)</p> <p>Level: 2</p> <p>Review quality: ++</p> <p>No. of studies 14</p>	Drivers	To assess whether speed cameras reduce road traffic collisions and related casualties.	<p>All but one of the studies showed effectiveness of cameras up to three years or less after their introduction; one study showed sustained long-term effects (one study looked at 4.6 years after introduction, the others three years or less).</p> <p>Reductions in outcomes across studies ranged from 5% to 69% for collisions, 12% to 65% for injuries, and 17% to 71% for deaths in the immediate vicinity of camera sites. The reductions over wider geographical areas were of a similar order of magnitude.</p>	<p>Study countries: UK</p> <p>Relevance score: A</p>
[12]	Systematic review	Non drivers	To quantify the effect	In a trial of male learner drivers the proportion of participants who had at least one crash since being	Study countries:

<p>Roberts I, Kwan I and the Cochrane Injuries Group Driver Education Reviewers</p> <p>2001</p>	<p>(RCT)</p> <p>Level: 1</p> <p>Review quality: +</p> <p>No. of studies 3</p>	<p>between 15 and 24 years old</p>	<p>of school-based driver education on licensing and road traffic crashes.</p>	<p>licensed was 42% for students who received school-based driver education; compared to 42% in the control group (RR 1.01, 95% CI 0.83 to 1.23).</p> <p>In a trial of high school students, 87% in the driver education group had been licensed since course completion compared to 84.3% in the control group (RR 1.04, 95% CI 1.02 to 1.05). The number of students involved in one or more crashes was 27.5% in the driver education group and 26.7% in the control group (RR 1.03 (95% CI 0.98 to 1.09).</p> <p>In a trial of secondary school students, the number of days from trial enrolment to licensing was 111 days in males receiving driver education compared with 300 days in males who did not receive driver education (t=7.19, p<0.001). In females the number of days from trial enrolment to licensing was 105 days in females receiving driver education compared with 415 days in females who did not receive driver education (t=9.88, p<0.001). The number of students who were involved in crashes was 16% in students who received driver education compared to 14.5% in the control group (RR 1.10, 95% CI 0.76 to 1.59).</p>	<p>Australia New Zealand USA</p> <p>Relevance score: B</p>
<p>[13]</p> <p>Segui-Gomez M</p> <p>1999</p>	<p>Systematic review (non-RCT)</p> <p>Level: 2</p> <p>Review quality: +</p> <p>No. of studies 6</p>	<p>Children under 14 years</p>	<p>To evaluate interventions that promotes the use of rear seat among children riding in motor vehicles. (Legislation and education).</p>	<p>Two studies evaluating the effectiveness of educational campaigns found increases in the proportion of children riding in the rear seats, but only in one study were the increases statistically significant (from 86% to 91%). Four remaining studies reported changes in seating location as a side effect of legislation requiring child restraint use among children travelling in the front seats. In two of these four studies, the percentage of children riding in the rear seats significantly increased from 49% to 62% and from 88% to 98%. In the remaining two studies there were small, but not statistically significant, changes in the proportion of children riding in the rear seats, with percentages remaining around 60% and 85%.</p>	<p>Study countries: Australia Denmark UK USA</p> <p>Relevance score: B</p>
<p>[14]</p> <p>Spinks A, Turner C, McClure R, Acton C, Nixon J</p> <p>2005</p>	<p>Systematic review (non-RCT)</p> <p>Level: 2</p> <p>Review quality: +</p> <p>No. of studies 7</p>	<p>Children aged 0 to 14 years</p>	<p>To evaluate community based programmes to promote use of bike helmets for under 14 year olds.</p>	<p>An advertising campaign (mass media, press conferences, posters, brochures, stickers) found that observed helmet use rose from 5.5% to 15.7% in two years (control 1.0% to 2.9%).</p> <p>Lobbying to reduce helmet cost, distributing discount coupons to subsidise cost and recruitment of prominent sports figures to promote use found a reduction in head injuries admitted to Accident & Emergency of 66.6% for 5 to 9 year olds and 67.6% for 10 to 14 year olds.</p> <p>Legislation increased observed helmet use from 4% to 47%. Another study noted an observed use of 85% (no control data presented).</p> <p>A primary school educational programme found self-reported helmet use of 37.2%, increasing to 67.6% when helmets were provided free to the poorer students (control groups 17.9% and 21.5%).</p> <p>A helmet use promotion campaign at public events, backed up with public service announcements, increased observed helmet use from 8% to 19% (control group decreased from 19% to 4%)</p> <p>An intervention that included establishing an interest group (doctors, police, journalist, lawyers, businessmen and school principals) along with a mass media campaign saw a rise of 0.75% to 50.2% in observed helmet use. A similar scheme, with a community based organising committee coordinating the intervention programme (posters, role playing, increasing helmet availability, awards for helmet use) found an increase from 1.3% use to 32.5% (14.3% for control).</p>	<p>Study countries: Australia Canada Sweden UK USA</p> <p>Relevance score: A</p>

				<p>An implementation of the WHO safe communities model found a 3.1% decrease in bicycle related injuries using hospital discharge data as the outcome measure.</p> <p>School-based educational talks with age-specific information backed up with true case scenarios and videos of brain injured children reduced the injury rates for children admitted to A&E from 21.6% to 11.6, with self-reported helmet use rising from 11% to 31%</p> <p>Enactment of legislation making helmet use compulsory, backed up with practical courses on helmet use and distribution of helmets, reduced serious head injury by 73%, minor head injury by 52%, and injury that did NOT include head injury by 42%</p> <p>Enactment of legislation making helmet use compulsory plus enforcement (police could impound bikes if helmet not being worn), with helmet giveaways backed up by an educational programme increased observed helmet wearing from 0% to 45% (5 to 12 year olds), and 0 to 18% (13 to 15 year olds).</p> <p>Awareness campaigns via conferences, mass media events and a 'be bike smart week', with a resource book and posters with major sports figures increased observed helmet use from 0% to 45% in four years, rising to 67% after legislation. Head injury admissions decreased from 71 to 50, and down to 24 after legislation.</p> <p>Bicycle safety education as part of the school curriculum, backed up with discounted helmets, found an increase in use from 8.5% to 32%.</p>	
<p>[15] Turner C, McClure R, Nixon J, Spinks A 2005</p>	<p>Systematic review (non-RCT) Level: 2 Review quality: - No. of studies 8</p>	<p>Children aged 0 to 16 years</p>	<p>The objective is to review community-based programmes that promote car seat restraints in children 0–16 years of age, using legislation, targeted education and mass media to educate children to wear seatbelts.</p>	<p>An intervention comprising legislation, targeted education and mass media education to increase restraint use in cars for children aged 0 to 5 showed an odds ratio (pre vs post) of 2.78; however another study using a similar intervention (children aged 1 to 5) did not show any significant results. A similar third study (children aged 5 to 16) showed that the relative risk post education was 0.45, although for the control group this was 0.47.</p> <p>An intervention comprising legislation, targeted education and mass media education to increase booster seat use in cars for 4 to 8 year olds found a post-intervention rate of 26.2% compared with 13.3% pre-intervention (control 20.2, 17.3 p = 0.008).</p> <p>An intervention comprising legislation, targeted education and mass media education to increase restraint use in cars for children aged under fifteen showed a mean incidence (per 1000) of hospitalisation for children involved in motor-vehicle accidents (MVA) of 0.170 compared to 0.206 for the control.</p> <p>A targeted education intervention found 20% use of child restraints pre-intervention increasing to 72% post (3 years), but control group use was 69%. No significance data given.</p> <p>An intervention comprising legislation, targeted education and mass media education to increase restraint use in cars as observed at elementary schools found a rise to 62.4% during the campaign from a baseline of 18.1% .</p> <p>An intervention comprising legislation, targeted education and mass media education to increase child restraint use in cars using injury and death data as outcomes showed a relative risk (pre/post) of 0.67 (95% CI, 0.28, 0.60).</p>	<p>Study countries: Sweden USA Relevance score: B</p>

<p>[16]</p> <p>Vernick JS, Li G, Ogaitis S, MacKenzie EJ, Baker SP, Gielen AC</p> <p>1999</p>	<p>Systematic review (RCT + non-RCT)</p> <p>Level: 1&2</p> <p>Review quality: -</p> <p>No. of studies 9</p>	<p>High school pupils aged 15 to 17 years</p>	<p>The objective was to seek evidence in the research literature to determine if: high school-aged persons who enrol in a driver education course have fewer motor vehicle - related crashes or violations, or are more likely to obtain a drivers license, than those who do not enrol in driver education courses and that if the availability of high school driver education courses is associated with lower community rates of motor vehicle crashes among young drivers.</p>	<p>Using the data from the four RCT studies, the following results were obtained:</p> <p>The relative risk (RR) of obtaining a licensing after training depends on the type of training offered: for Safe Performance Curriculum (SPC), RR = 1.05 (95% CI 1.03, 1.06); Pre Driver Licensing (PDL), RR = 1.02 (95% CI 1.01, 1.04). However these data were reanalysed giving: SPC RR = 1.16; PDL RR = 1.10 (no CI given, but significance of $p \leq 0.01$ was given).</p> <p>Violations and crashed were also analysed for the SPC and PDL, and then reanalysed a further two times, giving the results: Violations SPC, 1.05 (95% CI 1.01, 1.10), 1.08 ($p \leq 0.01$), 1.01 (95% CI 0.87, 1.16); Crashes SPC, 1.07 (95% CI 1.01, 1.14), 1.11 ($p \leq 0.01$), 1.02 (95% CI 0.88, 1.17); Violations PDL, 1.03 (95% CI 0.98, 1.07), 1.04 (no significance data given), 0.97 (95% CI 0.84, 1.12); Crashed PDL, 0.99 (95% CI 0.93, 1.05), 1.01 (no significance data given), 1.00 (95% CI 0.86, 1.05).</p> <p>Three other programmes were evaluated using RCTs, with the following results: Shepparton On Road (SOR), violations RR = 1.33 (95% CI 1.03, 1.73), crashes RR = 1.12 (95% CI 0.89, 1.41); Shepparton Off Road (SFR), violations RR = 1.01 (95% CI 0.75, 1.36), crashes RR = 1.00 (95% CI 0.78, 1.28); Royal Auto Club of Victoria (RAC) violations RR = 1.04 (95% CI 0.79, 1.37), crashes RR = 0.92 (95% CI 0.73, 1.18).</p> <p>Using data from the five ecological designs, the following results were obtained:</p> <p>Receiving driver education was not associated with lower fatal crash involvement per licensed driver but was associated with increased licensure of teen drivers, (no significance data given).</p> <p>For every 100 students enrolled in driver education, an average of 42 additional 16-17 year olds were licensed (95% CI 20, 64).</p> <p>Approximately 27% reduction in crashes for school systems that eliminated driver education, compared with virtually no change for those that retained it (no significance data given).</p> <p>Where there are state laws mandating driver education for licensure before age 18, then there is an increase licensure rate of 15-17 year olds RR 1.10 (95% CI 1.04, 1.16).</p> <p>Controlling for licensure rates, state driver education laws where driver education for licensure before age 18 is required are associated with lower fatal crash involvement rates in single vehicle, RR 0.84 (95% CI 0.80, 0.88), and multi-vehicle crashes, RR 0.84 (95% CI 0.80, 0.88).</p>	<p>Study countries: Australia (USA)</p> <p>Relevance score: B</p>
<p>[17]</p> <p>Willis C, Lybrand S, Bellamy N</p> <p>2004</p>	<p>Systematic review (RCT + non-RCT)</p> <p>Level: 1&2</p> <p>Review quality: +</p> <p>No. of studies 14</p>	<p>Drivers prosecuted for driving while intoxicated (DWI) offences</p>	<p>To systematically assess the effectiveness of ignition interlock programmes on recidivism rates of drink drivers, by examining rates of recidivism while the ignition interlock device was installed in the vehicle and after</p>	<p>In the RCT study, recidivism was lower in the intervention group while the device installed (RR 0.36 95% CI 0.21, 0.63). However, once the device was removed the RR rose to 1.33 (95% CI 0.72, 2.46), therefore the results from the post-interlock severely affect the overall effectiveness of the interlock, when both the interlock and post-interlock periods are combined.</p> <p>In all 13 non-randomised controlled trials, interlock participants had lower recidivism than the controls, with nine of the trials being statistically significant, but this effect was not seen after the interlock was removed. The RR for the three trials of first time (or not stated) offenders with the interlock fitted the recidivism rate was 0.05 (95% CI - 0.01, 0.18); 0.20 (95% CI - 0.14, 0.29) and 0.23 (95% CI - 0.01, 3.75) with the recidivism rates post intervention being 0.91 (95% CI - 0.59, 1.39); 1.37 (95% CI - 0.21, 1.56) and 0.70 (95% CI - 0.32, 1.53) respectively. The RR during the interlock period or the other two trials for</p>	<p>Study countries: Canada Sweden USA</p> <p>Relevance score: B</p>

			removal of the device.	<p>first time (or not stated) offenders where not post intervention figure were not given 0.80 (95% CI – 0.42, 1.53) and 0.33 (95% CI – 0.15, 0.73). Of the eight studies that looked at repeat offenders six also gave post interlock figure, the pre interlock RR was: 0.11 (95% CI – 0.05, 0.23); 0.19 (95% CI – 0.12, 0.30); 0.38 (95% CI – 0.20, 0.71); 0.60 (95% CI – 0.35, 1.04); 0.34 (95% CI – 0.22, 0.53) and 0.25 (95% CI – 0.14, 0.43) with post intervention RR: 0.96 (95% CI – 0.69, 1.32); 0.38 (95% CI – 0.27, 0.52); 1.07 (95% CI – 0.53, 1.20); 0.94 (95% CI – 0.73, 1.20); 1.93 (95% CI – 1.02, 3.66) and 2.06 (95% CI – 1.63, 2.60). The two other studies that only reported during interlock figures 0.53 (95% CI – 0.19, 1.48) and 0.27 (95% CI – 0.12, 0.57).</p> <p>The two controlled trials that reported the combined effect of the time period of when the interlock installed and the period after removal found that the interlock did not reduce recidivism (no statistical data provided).</p>	
[18] Zwerling C, Jones MP 1999	<p>Systematic review (non-RCT)</p> <p>Level: 2</p> <p>Review quality: ++</p> <p>No. of studies 6</p>	Young drivers (up to the age of 25 years)	This study aimed to determine whether low blood alcohol concentration (BAC) laws among younger drivers reduce motor vehicle injuries.	<p>Comparing drivers under 18 years to those 18 or over with a 0.02 BAC for first year drivers, night time injuries reduced by 17%, but this was not significant.</p> <p>A Zero BAC for first year drivers saw a net reduction of injuries of 18% for drivers ages 17 to 20 years, but does not state that this was not significant, so the assumption is that it is significant.</p> <p>16-year-olds compared to 21- to 25-year-olds, with a 0.05 BAC for first year drivers saw a net injury reduction of 28% for males, but no reduction for females, but does not state that this was not significant, so the assumption is that it is significant. A 0.02 BAC for first-year drivers found a 12% reduction in injuries for males and 24% net reduction for females when 17 to 20-year-olds were compared to 21 to 25 year-olds, but does not state that this was not significant, so the assumption is that it is significant.</p> <p>A study of a Zero BAC for first-year drivers saw a 4% reduction in serious injuries (someone killed or hospitalised) at night, comparing first year drivers to more experienced drivers, but this was not significant. Teenage drivers compared to older drivers in the same location, and same aged drivers at a different location, had a 22% net reduction in fatal crashes (young to older drivers) and a 13% reduction for a comparison of the same age groups, but this was not statistically significant.</p> <p>A 0.02 BAC for drivers under 21 years of age found a reduction of either 11% or 33% in "had been drinking" crashes (depending on model chosen; both were statistically significant), when teenage drivers were compared to older drivers.</p> <p>Restricted BAC laws for younger drivers were associated with a 17% reduction in single vehicle, night time fatalities for young drivers ($p < 0.001$) when drivers 15 to 20 years of age were compared to similar age drivers in comparison communities.</p>	<p>Study countries: Australia USA</p> <p>Relevance score: B</p>

5.2 Pro-Environmental Behaviour

Evidence Tables for Question 4.1. What is the evidence for effectiveness of interventions in terms of changes in pro-environmental knowledge, attitudes, behaviours and other related outcomes?

Author, Date and Title	Review Type and Quality	Study Population	Review Objective	Results	Applicability to the UK
[4] Abrahamse, Wokje; Steg, Linda; Vlek, Charles; Rothengatter, Talib 2005	Narrative review (non-RCT) Level: 3 Review quality: Unscored No. of studies 38	Residential households.	Aims to evaluate the effectiveness of interventions aiming to encourage households to reduce energy consumption.	<p>The review calculated and reported effects sizes were possible, and these are provided here where the results of individual studies are reported.</p> <p>Three studies examined the effects of getting people to make a commitment to conserve energy. All three showed that commitment could be successful in reducing household energy use. For example, one study reported that households that had signed a public commitment to conserve energy (a publication in a leaflet) showed a lower rate of increase in energy use (gas and electricity consumption) than households in the control group. Effects were maintained six months after the intervention. Further details of the results of this study are not provided and there is no reported effect size. Some research directly compared the efficacy of giving households a small request to fill out a questionnaire, with a bigger request to sign a commitment to conserve energy, with a combination of both types of requests, and noted that households in all three treatments groups saved more energy than households in the control group (see Section 4.5.1). In a later study by the same author, two additional treatment conditions were added for comparison: providing households with a reward (based on the amount of energy that they saved) and a combination of all interventions (ie. a small request to complete questionnaire + a bigger request to make a commitment to conserve energy + information about conserving energy + a reward). The study found that households in the commitment group and the combined intervention groups showed the biggest reductions in energy use. However these effects were only observed during the first week of the intervention. One study showed that getting people to make a public commitment to conserve energy proved to be a more effective strategy than getting them to make a private commitment.</p> <p>Two studies examined goal setting which was effective, especially if combined with feedback on performance in relation to the set goal. One study reported that, when setting goals, individuals who received a more difficult goal combined with feedback conserved the most energy (15.1%, $d=0.97$) – when compared with groups that were just allocated a goal (no feedback) or received no treatment. Differences between the two treatment groups were not significant. Another study applied a combination of goal setting with feedback in relation to washing clothes in a washing machine. The study used a laboratory setting to provide participants with a goal and feedback in terms of how much energy they were using. Individuals who received both a goal and feedback saved more energy per washing trial than individuals that received only feedback. There were no significant differences between individuals who had set their own goal and those that had been assigned a goal.</p> <p>Three types of ‘information’ were examined in the review: workshops, mass media campaigns, and tailored information (home audits). Only one study examined the use of workshops and found that participation in a three hour workshop led to improvements in knowledge about energy conservation and stronger intentions to save energy. However no changes in actual behaviour were reported. No specific data are provided. Three studies examined the use of mass-media campaigns designed to promote energy conservation. Again, improvements in knowledge or</p>	<p>Study countries: Not specified.</p> <p>Relevance score: B</p>

				<p>attitudes were reported but there was no clear evidence that they were capable of producing changes in energy related behaviours. Again, full details of the results of these studies are not provided and effect sizes are not reported. Several studies examined the effects of home energy audits which provide very tailored, personalised information about energy use. Though the results were somewhat mixed, overall, some studies did report positive effects on household energy use and 'the extent to which efficiency actions were taken'. For example, one study showed that households that had received a home energy audit providing detailed information about their use of heating and air conditioning, subsequently used 21% less energy than the control group. No follow-up measures were taken and no effect size is reported for this study.</p> <p>The effects of modelling appropriate energy conserving behaviours was examined by one study. In this case, the intervention comprised television programming that depicted a variety of energy saving behaviours. This was accompanied by a booklet featuring cartoon images of similar behaviours. The study found that energy consumption reduced significantly in the intervention group (by 10%) when compared with the control group. Improvements in energy related knowledge were also seen in the intervention group but not in the control group. However again effects were not maintained at follow-up (one year). No treatment effect size is reported.</p> <p>Feedback was shown to be an effective strategy for reducing household energy use. Limited detail on the results of these studies is provided in the review. One study showed that daily feedback on the costs of electricity use produced a decrease of 4% among intervention households compared with baseline measures. This group also conserved more electricity than the control group. No other data (eg. treatment effect size) are provided. Comparative feedback (ie. that compares an individual's performance on energy saving relative to the performance of others) was not shown to be any more effective than individual feedback. The more frequently feedback is provided, the more effective it is (see Section 4.5.9). It was difficult to assess whether it is more effective to provide feedback in terms of monetary savings (as opposed to environmental benefits) since the studies that examined this did not report any significant differences in this respect.</p> <p>The effects of reward-based interventions were also examined. Overall, rewards had a positive impact on energy savings - all of the relevant studies reported significant differences between households who received a reward and those that did not. However, as with the recycling reward-based studies, the effects of reward-based interventions were relatively short-term.</p>	
[1] Hornik, Jacob; Cherian, Joseph; Madansky, Michelle; Narayana, Chem 1995	Meta-analysis (non-RCT) Level: 2 Review quality: - No. of studies 67	Not specified.	Aims to examine the effects of internal and external factors on propensity to recycle.	<p>The meta-analysis used the Hunter-Schmidt technique. The authors identified three common dependent variables used in the literature: consumer attitudes towards recycling, behavioural intentions and actual recycling behaviour. As the average correlations for these variables were not significant when compared, the meta-analysis treated them as one entity called 'propensity to recycle'. This could be based on either self-report or measures of actual behaviour.</p> <p>Internal facilitators were the best predictors of recycling behaviours. Propensity to recycle was quite strongly related to consumer awareness and knowledge about recycling. Knowledge about recycling had the highest correlation with propensity to recycle ($r = 0.541$) and was statistically significant very often (in 87% of studies). Commitment to recycle was also fairly strongly related to propensity to recycle ($r = 0.425$) and was found to be significant often (in 86% of studies).</p> <p>The second best set of predictors was external incentives which were shown to be reliably related</p>	Study countries: Not specified. Relevance score: B

				<p>to propensity to recycle. Perceived social influence was very often significant (in 90% of studies) and predicted recycling behaviour well. Monetary rewards were also a significant moderate predictor of recycling behaviour ($r = 0.327$) and this correlation was also often significant (in 84% of studies).</p> <p>The third most predictive set of variables was internal incentives (such as personal satisfaction and ecological concern). Of these, personal satisfaction gained from recycling was the best predictor of recycling behaviour ($r=0.370$) and was significant in 76% of studies. These were followed by external facilitators. Of the external facilitators, the strongest predictor was frequency of collection ($r = 0.290$). Both container proximity and distribution of materials for recyclables had only small positive correlations ($r = 0.186$ and $r = 0.173$ respectively).</p> <p>The review also examined methodological factors that may explain any lack of consistency across studies. Correlations were regressed on both methodological variables and recycling variables. The analysis showed that mode of data collection and sample size had statistically significant coefficients. When actual measures of recycling behaviour were used, as opposed to self-report, the magnitude of correlation was higher. Sample size did not hugely effect the size of the correlation. A whole range of recycling variables were statistically significant including monetary incentives, perceived social pressure, personal satisfaction, knowledge about recycling, commitment to recycle, and frequency of collection. Knowledge, commitment and perceived social pressure reported the highest coefficients.</p> <p>The regression explains about 53% of the variance in the transformed regressions. Nearly 20% is variance accounted for by sample, size, mode of data collection and year of publication. The remainder (34%) is explained by recycling variables. So although the method variance is sizeable, the biggest proportion of variance is actually due to the recycling variables. The significance of the method variance provided sufficient impetus to search for moderating variables. Separate moderator analyses were conducted for all predictors of recycling behaviour for which variance explained by sampling error was less than 75%. If there were three or more correlations, the analysis proceeded to examine the effects of sample, size, mode of data collection, and year of publication. A moderating effect was found on perceived social influence: a higher correlation was obtained when studies used actual measures of behaviour than for studies which relied on self-report measures ($r=0.507$, $r=0.341$ respectively). Time of research also moderated the predictions based on monetary rewards. The subgroup correlations varied from $r=0.3888$ between 1968-1981 to $r=0.197$ between 1982-1992; the former correlation was significant.</p>	
[5] Huffman, K T; Grossnickle, W F; Cope, J G; Huffman, K P 1995	Narrative review (non-RCT) Level: 3 Review quality: Unscored No. of studies 59	Target groups were not homogeneous and target group rationale was not provided.	This review aims to evaluate antecedent or consequence strategies designed to encourage litter reduction.	<p>Effects sizes and significance results were not provided in this review.</p> <p>Twelve experiments examined the effects of prompts on littering behaviour. Overall, the interventions had a positive impact with studies reporting reductions in the percentage of people who littered and reductions in the amount of litter dropped or found. For example, one study set in a university cafeteria used written prompts and reported a 33% reduction in the percentage of people who littered. In another study set in a school, the use of verbal prompts increased the percentage of pupils that did not litter by between 40 and 60%. The findings from all but two of the prompting studies also suggest that prompts involving specific instructions can be more effective in increasing correct litter disposal than non-specific instructions (see Section 4.5.9).</p>	<p>Study countries: Not specified.</p> <p>Relevance score: B</p>

				<p>Thirteen studies examined the effects of community-involvement and modelling (which were grouped together in the review). The community involvement interventions usually involved some kind of active participation by residents in cleaning up and maintaining their local neighbourhood, and found generally positive results. For example, one study looked at community groups who tackled dog litter by patrolling the streets asking dog owners to clean up after their dogs. The intervention successfully reduced the amount of dog litter by 88% but the study suffered from several methodological problems.</p> <p>The modelling interventions reported in the review involved someone demonstrating an appropriate litter-related behaviour. Overall, the research suggests that modelling can be helpful in reducing litter. One study looked at the effects of showing an experimental confederate either picking up litter or walking right past it in two different settings. The study found that littering rates were less in the modelling condition in both study settings. Only a 6% increase in the amount of litter was seen among those that saw the confederate pick up the litter compared to an increase of 23% in the 'walk-by' group. Another successful intervention involved providing dog owners with instructions about how to clean up after their dog and a demonstration in how to correctly use a plastic bag for collecting dog litter. This was examined in two studies. Both studies reported positive effects in terms of reducing dog litter (pick-up levels were reported as 87-89%), with these effects being sustained at one month in one study and 13 months in the other. Though the results of these studies are positive, the review authors note that it is somewhat difficult to generalise results due to the fairly specific nature of the studies.</p> <p>Nine studies examined the effects of 'prior littering' and found that more littering occurred in an already littered area, suggesting that the removal of prior litter can be an effective strategy. Twelve studies examined the effects of 'environmental-design' interventions (like waste receptacles). Overall, the studies show that these kinds of interventions can be effective in reducing litter. For example, one study found that an increase in the presence of ashtrays reduced the amount of cigarette litter found on the ground in a university setting (no specific data are provided). They also generalise well to a range of different settings and situations.</p> <p>Thirteen studies that looked at rewards and penalties, and all showed positive results; reductions in the amount of litter dropped/found and increases found in the number of litterbags used were among the kind of changes reported. For example, one study in the US paid children 10 cents for returning a bag full of litter collected in a theatre and reported a 57% reduction in the amount of litter found. Again, effectiveness is often countered by the costs of implementing the intervention.</p> <p>Feedback was only examined in two studies. One study published information in a local newspaper about the amount of litter found in a certain area and compared it to the amount found the previous day. The amount of litter in these areas following the newspaper appeal reduced, however these effects were not maintained. The second study examined the effects of providing feedback to elementary school children about the cleanliness of the school playground. The study reported a 75% reduction in litter, with effects sustained six months later. Together, these findings suggest that feedback may be a promising approach for tackling litter problems.</p>	
[6] Osbaldiston,-Richard	Meta-analysis (non-RCT) Level: 2	Community residents, students, a 'general or mixed	The meta- analysis had several aims, the second of	The two treatments with the largest effect sizes were making a commitment and setting goals. Twelve studies that used making a commitment as the exclusive primary focus and four additional studies that combined making a commitment with some other kind of treatment as the primary focus. For these 16 studies, the mean weighted effect size was $Md = 0.55$, 95% $CI = 0.39, 0.72$	Study countries: Not totally explicit. Of the 133 treatments included in the review.

2005	Review quality: - No. of studies 62	population', and employees.	which was to "evaluate the effectiveness of interventions (on responsible environmental behaviour)". In addition, it sought to "evaluate theories of behaviour change", "identify behaviours that are most amenable to change", and "test moderators and identify areas for future research". The review covers a range of responsible environmental behaviours including water, gas and energy conservation, recycling, littering, efficient transportation and 'lawn walking'.	<p>(for both fixed and random effects models). There were two studies that used goal setting as the primary focus and six additional studies that combined setting goals with some other treatment as the primary focus of the study. For these eight studies, the mean weighted effect size was $Md = 0.49$ 95% CI = 0.25, 0.73 (for both fixed and random effects models).</p> <p>The two treatments with the smallest effects sizes were 'changing the situation' and providing incentives. This result is surprising given that both of these treatments have internal validity – and because they were shown to have fairly positive results in the other reviews. Both of these treatments did have positive significant effects, meaning that they were effective, they were just not as effective as some of the other treatments examined in the analysis.</p> <p>Recycling had the greatest effect sizes when the treatments were using incentives, establishing social norms, making commitment, setting goals and manipulating situational conditions. For energy conservation, the most effective treatments were using incentives, using prompts and making commitment. For these data, the minimum significant difference between effect sizes is 0.25 assuming the median sum of weights is 118. Providing incentives and making commitment are the only treatments that are relatively effective for both recycling and energy conservation. Although the omnibus test is significant for water conservation, efficient transportation and litter reduction, because these behaviours are included in only a few studies no contrasts were computed.</p> <p>The review also examined which behaviours were most amenable to change. The author's hypothesis that recycling and litter reduction should have higher effect sizes than energy and water conservation and efficient transportation was not supported. There were too few studies on water conservation, efficient transport and litter reduction to allow any inferences to be drawn.</p> <p>Analyses to examine whether increased levels of social interaction in interventions to increase environmentally responsible behaviours increased their efficacy were not significant.</p> <p>The possible moderating effects of six methodological variables were examined. The variables were: study population, intervention setting, research design, metric of the effect size, statistics used to calculate the effect size, and the nature of the control group. Though the hypotheses for population and setting were supported, none of the other factors played a significant role.</p>	118 were tested in the USA and 'most of the remainder came from Europe'. Relevance score: B
[2] Porter, B E; Leeming, F C; Dwyer, W O 1995	Narrative review (non-RCT) Level: 3 Review quality: Unscored No. of studies 31	Although target groups and rationale were not clearly summarised, references were made to grocery store customers, adult residents of households, office	This review aims to evaluate interventions aimed at encouraging recycling.	<p>Treatment and follow-up effect sizes, where available, are summarised in tabular form in the review. These are provided here in cases where results from individual studies are reported.</p> <p>Overall, the results from nine studies showed that using prompts be an effective strategy for increasing recycling behaviour as six of the seven studies that examined this reported a positive change, with the remaining study reporting mixed results. Improvements were usually seen in terms of improved participation in recycling programmes or increases in the amount of recyclable materials collected.</p> <p>One prompting study involved getting influential individuals within small residential communities to deliver 'personalised, persuasive appeals' and kerbside recycling bags to a small selection of</p>	Study countries: Not specified. Relevance score: B

		employees, college students, and elementary school students.	<p>their neighbours. The study found that participation in the recycling programme increased by 25% more among households that received the intervention, compared with those that received no intervention at all. The reported treatment effect size is 25%. No other statistics are reported. Another study, set in a grocery store, reported that several prompting techniques, including providing people with a leaflet and public feedback on their purchase of returnable bottles, produced an overall increase of 25% in the purchase of returnable soft drinks containers, again with a reported treatment effect size of 25%. No other statistics are reported. However, overall improvements from prompting interventions were 'short-lived' suggesting that their ability to encourage longer-term changes in recycling behaviour may be limited. The most effective types of prompts were those involving some kind of face-to-face prompting from other residents within the community. In one study, well known and highly involved individuals from within a community were labelled as 'block leaders' and asked to tell their neighbours about the kerbside recycling programme and encourage their involvement. They also used prompts to remind their neighbours to participate. Over a seven-month period, the involvement of these individuals significantly increased participation in the kerbside programme above baseline measures; people who were contacted by a block leader recycled more often than groups that received only an informational brochure or nothing at all. However, the difference was 'practically small'. Combining both verbal and written prompts produces the best results; one study showed that participation rate a kerb-side recycling programme increased by 3% when written and oral prompts were combined, compared with the very little change seen for written prompts and control groups. Another study reported that combining both verbal and written prompts was more effective than either type of prompt when implemented alone. This time, individuals in the combined intervention group reported a greater number of visits to a city recycling centre. However, this finding is based on self report.</p> <p>In one study, written prompts encouraging people to recycle were more effective in higher than lower income households. In another study, the involvement of block leaders in a kerbside recycling programme proved to be more effective at increasing participation in areas with reportedly higher levels of income and education suggesting that it had more success with people of higher socioeconomic status.</p> <p>Five experiments examined the effectiveness of encouraging people to make a commitment to recycling, and all five showed that they could increase recycling. Similarly, all five studies that examined commitment strategies showed that they could improve recycling behaviour - both increases in participation rates in recycling programmes and in the weight of paper recycled were reported. Moreover, three of the five studies measured effects on <i>both</i> frequency of participation and the amount of material recycled and, interestingly, reported more consistent effects for the participation measure. Four of the studies examined follow-up effects up to three weeks after the commitment was made and found that recycling behaviour was persistent in all cases. For the three studies that focused on changes in 'percentage participation' in recycling, the reported treatment effect sizes are: '14%/week' (for an intervention using both 'written communication' and 'persuasive communication'), 27% (for an intervention using written commitment strategies - a follow-up effect size of 33% was also reported for this study), and 58% (for a study using an individual-level commitment strategy - a follow-up effect size of 31% was also reported). The two studies that focused on the improvements in the weight of paper recycled (in lbs) had reported treatment effects sizes of '89/week' and '3/collection', and reported follow-up effect sizes of '55/week' and '3/collection' respectively. No other statistics are reported.</p>	
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			<p>Three of the five studies measured effects on <i>both</i> frequency of participation and the amount of material recycled and reported more consistent effects for the participation measure. Four studies examined follow-up effects up to three weeks after the commitment was made and reported persistent effects on recycling. Written commitment strategies were at least as effective as reward-based strategies in the research that directly compared them. Though both group and individual-based commitments can be effective, one study of college students showed that individual commitments produced the largest effects both in terms of frequency of participation in recycling programmes and the amount of paper recycled. The effects on participation were sustained among those in the individual commitment group at three week follow-up.</p> <p>Two studies examined goal setting. Both reported positive findings. One study showed that goal setting by the school principal had a positive effect on the weight (in lbs) of newspaper recycled at an elementary school – however participation rates were still fairly disappointing, remaining at around 5% or less during the intervention period. The study had a reported treatment effect size of ‘186/session’ and reported follow-up effect size of ‘90/session’. A second study examined the effects of goal setting on the frequency of aluminium cans recycled by college students (weekly mean). The study found that individuals that had been given a recycling goal recycled, on average, around 12 more cans during the two week intervention than individuals who were not given a goal. The study had a reported treatment effect size of ‘12/week’. A follow-up effect size was not reported. It is worth noting however, that almost all participants recycling at least one can meaning that the observed effect was in fact attributable to an increase the volume of cans per ‘participation’ as opposed the increases in the participation rate itself. Despite problems with methodology goal setting may be a promising strategy for getting people to recycle.</p> <p>Six studies examined ‘environmental alteration’ interventions. Four involved increasing the proximity of containers to potential recyclers (by adding more containers to a particular area). This was consistently shown to increase recycling behaviour both in terms of increasing participation and increasing the amount of materials recycled. In one worksite study, office employees recycled more paper during a ten week period when they were provided with extra waste bins. Employees who were required to take their recyclables to a centrally located container recycled 9% less paper The reported treatment effect size was 9%, no follow-up effect size is reported). In another study, the distribution of recycling containers increased participation levels by around 13%, compared with individuals who did not receive any containers but were frequently ‘prompted’ to recycle . Encouragingly, these improvements in participation were maintained during an eight-14 week follow-up period. The reported treatment effect size for this study was 13%, no follow-up effect size is reported. Scheduling kerb-side collections of recyclables to coincide with the collection of regular waste also proved to be an effective strategy, increasing participation in a recycling programme by 5% in one study, for example (reported treatment effect size 5%, no follow-up effect size is reported).</p> <p>Eleven experiments examining the effects of consequence strategies on recycling behaviour. Nine looked at the impact of providing rewards. Two of the nine studies examined the effects of issuing rewards that were contingent upon recycling behaviour. One found that offering a reward was a more effective strategy for increasing the weight (in lbs) of newspaper recycled than simply providing information about a recycling programme. In this case, the school recycled an average of 17 times more newspaper (measured in lbs) when hamburger vouchers were given to classes with high recycling rates, compared with classes that were simply provided with information about recycling. The study had a reported treatment effect size of ‘2,377/week’. No follow-up</p>	
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			<p>effect size or other statistics are reported. The second of these studies showed that offering children prizes (toys) in a trailer park setting increased newspaper recycling by 95% (compared with baseline measures) during an eight-13 week period. Changes were measured in terms of the weight of newspaper recycled (in lbs) and the study had a reported treatment effect size of '169/week' and a reported follow-up effect size of '12/week'. The remaining seven reward studies evaluated the use of lotteries to encourage recycling. All seven showed a consistent positive effect on recycling. The reported treatment effect sizes for these studies were as follows:</p> <ul style="list-style-type: none"> • In a study comparing the use of variable versus consistent contingency for earning lottery tickets on the weight of paper recycled (in lbs), the reported effect size was 314/week and reported follow-up effect size was 53/week. • In a study comparing the use of a lottery, immediate reward and group reward on percentage participation, the lottery intervention was shown to be the most effective strategy, with a reported treatment effect size of 17%. • In a study comparing an individual lottery strategy with a group contest on the weight of paper recycled (lbs), the lottery was the more effective strategy with a reported treatment effect size of 112/week. No follow-up effect size is reported. • A study comparing the effects of individual lottery, immediate reward and other interventions found that the lottery reported the best improvements in percentage participation in recycling, with a reported treatment effect size of 11%. No follow-up effect size is reported. • A study comparing the effects of a lottery intervention, with a contest contingency and the use of prompts reported increases in the number of recycled cans (weekly mean). The reported treatment effect size was 238/week. No follow-up effect size is reported. • A study comparing the use of a lottery with a range of other intervention strategies including goal setting and feedback combined, reported that the lottery had the best impact on percentage participation, with a reported treatment effect size of 10%. No follow-up effect size is reported. • A study comparing the effectiveness of an individual lottery with a group reward found the best improvements in the weight of paper recycled (lbs) in the lottery condition. The study had a reported treatment effect size of '174/day' and follow-up effect size of '1/day'. <p>Five experiments examined the effectiveness of using both lotteries and contests in promoting recycling, and these strategies were shown to be similarly effective.. Lottery prizes produced greater improvements in recycling behaviour than cash or other rewards (both in terms of participation and the amount of materials collected/recycled) (see Section 4.5.3). One study compared the relative efficacy of a lottery prize with three other conditions: the market rate for the amount of paper recycled, informational prompts only, and no treatment at all. The study showed that, although all treatment groups produced higher frequencies of participation than the control group, the biggest improvements were seen in the lottery prize group where participation increased by 14%. It is worth noting, however, that differences in the amount of paper collected by the different groups were not significant.</p> <p>One study that compared the relative efficacy of rewards with simply providing information about a recycling programme (See Section 4.5.7). The study found that offering a reward was a more effective strategy for increasing newspaper recycling than simply providing information about a recycling programme; the school recycled an average of 17 times more newspaper when hamburger vouchers were given to 'high-recycling' classes compared with classes that were just</p>	
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				<p>provided with information about the programme. Another study compared the effectiveness of using a lottery with prompting and goal setting plus feedback in workplace setting, and found that the lottery interventions produced higher participation rates in aluminium can recycling and a greater quantity of can recyclables brought from home than the other intervention strategies.</p> <p>One study examined penalties in the form of legislation. This study evaluated the New York bottle law which requires payment of a deposit on the purchase of recyclable containers such as glass bottles and aluminium cans. The evaluation research revealed a sharp 26% decline in the number of recyclable containers found in New York once the law was introduced – no such decline was observed in New Jersey which did not have an equivalent law in place. Encouragingly, this effect was maintained one year on. Outcomes were measured in terms of the frequency of returnable litter. The reported treatment effect size for the study is 127 pieces of litter from baseline and the reported follow-up effect size is 151 pieces of litter from baseline. A single study focused on using feedback as the primary strategy for increasing recycling. This study found that recycling was effective in increasing paper recycling by approximately 77% above baseline measures. This effect was also maintained to some extent at follow-up though this was fairly short-term (1week). The study had a reported treatment effect size of ‘7/day’ (measured in terms of the weight of paper recycled in lbs) and a reported follow-up effect size of ‘4/day’. No other statistics are reported. Feedback was shown to be less effective than setting goals, but only in one study (see section 4.5.7).</p>	
<p>[3] Schultz,-P.-Wesley; Oskamp,-Stuart; Mainieri,-Tina 1995</p>	<p>Narrative review (non-RCT) Level: 3 Review quality: Unscored No. of studies 28</p>	<p>Target groups included apartment residents, household residents, college students, retirement residents, school children and office employees.</p>	<p>To examine the impact of situational factors on recycling.</p>	<p>The review calculated and reported effect sizes where possible, and these are reported here where the results of individual studies are given.</p> <p>Twelve studies looked at the effects of prompts. Three of the twelve studies showed that one single prompt alone is capable of increasing participation in recycling. All three studies focused on kerb-side recycling and usually written prompts. Full details of the results (in terms of percentage change) are not provided though effect sizes estimates were calculated and reported for two of the studies: $d' = 0.28$ and $d' = 4.7$. Several of the other prompting studies showed that combining different types of prompts can enhance effectiveness (see section 4.5.1). Studies tended to have a very short-term focus, however, five studies examined the effects of prompts over periods of four months or longer. These studies showed that prompting produced sustained effects on recycling in kerb-side and community-based interventions (with the exception of a study set in college dorms). Four studies observed sustained effects. Most of the prompting studies examined either kerbside collection or community drop-off programmes, though one study examined an intervention implemented in apartment complexes and three others examined interventions undertaken with college students or staff. Prompting worked well in the kerbside collection and community drop-off campaigns but two of the three studies in college settings were the only studies not to show positive effects of prompting on recycling. All of the studies that drew direct comparisons between prompting and other strategies (with one exception) found that the use of prompts alone was less effective than other strategies including providing feedback and offering rewards.</p> <p>Seven studies examined the effects of getting people to make a commitment to recycle. Increases in participation rates in both kerbside programmes and specially organised collections were observed – not only during the treatment period but also at various stages of follow-up (though the longest follow-up period was notably only four weeks). For example, one study reported that getting people to make a group commitment to increase their recycling resulted in improvements</p>	<p>Study countries: Not specified. Relevance score: B</p>

			<p>from baseline in the amount of paper recycled. These improvements were maintained at 4-week follow-up. No specific data are provided. Five studies that compared the efficacy of commitment strategies with other approaches showed that, in general, commitment strategies produced more sustained effects on recycling behaviour than rewards, prompts, or simply providing information (see Section 4.5.7). Getting people to make a written commitment to recycle was more effective than providing an informational prompt alone at increasing participation in a household recycling programme and the amount of paper recycled. Two studies found that written commitment produced greater increases in both kerbside participation and the amount of recyclables collected, and that individual commitments produced greater participation in a recycling event held at a college than did group commitments.</p> <p>One study compared the relative efficacy of prompting and getting people to make a commitment to recycle, as well as a combination of both strategies. The biggest improvement in recycling was seen in the written commitment group where household participation in a kerbside recycling programme increased by 19%. This was compared with increases of 15% in the prompting alone group and 18% in the combined intervention group. Differences between treatments groups were not significant.</p> <p>Four experiments examined the effectiveness of using social norms to encourage recycling. Three of the four showed that leveraging peer support can help establish community recycling norms, leading to sustainable increases in recycling behaviour. For example, one study - again involving block leaders - produced a weekly participation rate in a kerbside recycling programme of 25.5%, compared with a rate of only 11.5% in areas that did not have a designated leader (no effect sizes are reported). Two goal setting studies were examined and both noted positive effects on recycling through they focused on fairly specific populations (school and college students). Two studies compared the effects of personal contact through a 'block leader' with information alone and found that the areas with designated block leaders participated significantly more in kerbside recycling (58% of households recycled at least once during the post-treatment phase) than areas that simply had information about the scheme left at their door (38%).</p> <p>Three experiments examined the effects of bin proximity on recycling participation. These studies consistently showed that the closer individuals were to recycling facilities, the more likely they were to recycle. For example, one study reported an increase of 47% in participation in a drop-off newspaper recycling programme among residents of a 'mobile home park' following the placement of six additional recycling bins in the area. No treatment effect size is reported. This strategy, though only examined by three studies, was shown to work across a range of settings including offices and in residential areas. One study also examined the effects of the collection method on participation rates in recycling programmes. A kerb-side collection programme had an estimated 49% participation rate compared with only around half that (25%) in communities with a drop-off location. No treatment effect size is reported. These results suggest that removing the need for people to transport recyclable materials to a central location may increase recycling participation rates. Similarly, removing the effort associated with sorting waste was also examined in the review, though only by two studies. In one, participation rates in a community-wide commingled kerb-side recycling programme and a voluntary waste separation programme were compared. Over 90% of households participated in the commingled programme at least once in five consecutive occasions compared with only 40% in the voluntary waste separation programme. No other data on this study are reported. However, the other study that examined this issue reported no difference in the estimated average participation rates from programmes that</p>	
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			<p>required separation and those that did not. Detailed results from this study are not reported in the review.</p> <p>Eight studies examined the effects of rewards on recycling behaviour. All eight reported significant increases in the amount of waste recycled. Lottery prizes produced stronger effects than small cash incentives, and individual rewards produced better increases than group ones (see Section 4.5.3). Rewards were also shown to produce greater improvements in recycling behaviour than several other intervention strategies in the studies that directly compared them, however improvements were usually short-term (see Section 4.5.7). However, overall, improvements from reward-based interventions tended to be relatively short-term and the review highlighted some uncertainty about the generalisability of using rewards across different types of recycling behaviour (eg. recycling aluminium cans versus newspapers).</p> <p>The impact of providing people with feedback on recycling was examined in four studies included in the review. Two reported significant increases in recycling ($d=0.25$ and $d=2.47$). In these studies feedback was provided through posters; in one case group feedback was given on the weekly weight (in lbs) of paper collected by college students. More research is needed.</p>	
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Appendix 6.1: Background references

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Appendix 6.2: Road safety search strategies.

Database: MEDLINE; **Host:** OVID technologies; **Years Covered:** mid-1960's to date; **Years Searched:** 1995-2006; **By:** MCC on 11th April 2006; **Results Downloaded:** 2842

1. (pedestrian\$ or rider\$ or pillion\$ or cyclist\$ or passenger\$ or driver\$).ti,ab.
2. (improv\$ or enhanc\$ or protect\$ or educat\$ or training).ti,ab.
3. (novice or dangerous\$ or careless\$ or speed\$ or drink\$ or drunk\$ or hazard\$ or distract\$ or error\$ or risk\$ or behavio\$ or lapse\$ or violation\$).ti,ab.
4. Drinking/ or Alcohol Drinking/
5. Alcoholism/
6. Fatigue/
7. (fatigue or tired\$ or (near adj1 miss\$)).ti,ab.
8. or/2-7
9. 1 and 8
10. (traffic or transport or automobile\$ or vehicle\$ or bus or buses or car or cars or lorry or lorries or taxi or taxis or cab or cabs or motorcycle\$ or bike\$ or bicycle\$ or truck\$ or driving or walking).ab,ti.
11. Automobile Driving/
12. Bicycling/
13. Walking/
14. transportation/ or motor vehicles/ or automobiles/ or motorcycles/ or off-road motor vehicles/ or railroads/
15. or/10-14
16. Safety/
17. safe\$.ti,ab.
18. 16 or 17
19. (improv\$ or enhanc\$ or increas\$).ti,ab.
20. 15 and 18 and 19
21. 1 and 18 and 19
22. (road\$ or highway\$ or street\$ or carriageway\$ or freeway\$ or motorway\$ or cycle\$ or pavement\$ or sidewalk\$ or lane\$ or buslane\$).ti,ab.
23. (railway adj1 crossing\$).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
24. 22 or 23
25. 24 and 18 and 19
26. condition\$.ti,ab.
27. 24 and 19 and 26
28. Accidents/ or Accidents, Traffic/
29. "Wounds and Injuries"/pc [Prevention & Control]
30. Death/
31. Mortality/
32. Morbidity/
33. (accident\$ or collision\$ or crash\$ or injur\$ or mortality or morbidity or death or fatality or kill\$).ti,ab.
34. or/28-33
35. 34 and (24 or 15 or 1)
36. Accident Prevention/
37. (preventing or prevention or reduction or reducing or decrease or decreasing or minimi\$e or minimi\$ing).ti,ab.
38. 36 or 37
39. 35 and 38
40. Automobile Driving/
41. driving.ti,ab.
42. 40 or 41
43. 3 or 4 or 5 or 6 or 7
44. 42 and 43 and 38
45. ((road\$ or highway\$ or street\$ or carriageway\$ or freeway\$ or motorway\$ or cycle\$ or pavement\$ or sidewalk\$ or lane\$ or buslane\$ or railway crossing\$) adj4 (danger\$ or hazard\$)).ti,ab.
46. (traffic adj calming).ti,ab.
47. ((improv\$ or enhanc\$ or increas\$) adj (street adj (light or lighting))).ti,ab.
48. (speed adj (cameras or bumps or humps or management or zone or limit\$ or restriction\$)).ti,ab.
49. (traffic adj club\$).ti,ab.
50. Seat Belts/

51. ((seat or safety) adj belt\$.ti,ab.
52. ((child\$ or car\$) adj seat\$.ti,ab.
53. (crash adj barrier\$.ti,ab.
54. (road\$ adj (planning or layout\$ or design\$ or marking or sign\$)).ti,ab.
55. (shared adj space\$.ti,ab.
56. ((Think or Th!nk) adj campaign\$.ti,ab.
57. (horse adj sense).ti,ab.
58. (cycle adj smart).ti,ab.
59. (home adj zone\$.ti,ab.
60. ((highway or motorway) adj1 code\$.ti,ab.
61. or/45-60
62. Head Protective Devices/
63. helmet\$.ti,ab.
64. 62 or 63
65. (rider\$ or cyclist\$.ti,ab.
66. 65 and 64
67. ((driver\$ or driving) and (mobile adj1 phone\$)).ti,ab.
68. 61 or 66 or 67
69. 9 or 20 or 21 or 25 or 27 or 39 or 44 or 68
70. limit 69 to (humans and english language and yr="1995 - 2006")
71. review.ti,ab.
72. review.pt.
73. (meta adj (analysis or analyses)).ti,ab.
74. (metaanalysis or metaanalyses).ti,ab.
75. meta-analysis.pt.
76. synthes\$.ti,ab.
77. metasynthes\$.ti,ab.
78. (metaethics or (meta adj ethics)).ti,ab.
79. (metaevaluation or (meta adj evaluation)).ti,ab.
80. (metaethnograph\$ or (meta adj ethnograph\$)).ti,ab.
81. (metaresearch or (meta adj research)).ti,ab.
82. (metasummar\$ or (meta adj summar\$)).ti,ab.
83. (metatheoretical or (meta adj theoretical)).ti,ab.
84. (meta adj analytic).ti,ab.
85. (cochrane or medlars or medline or embase or cinahl or scisearch or psychinfo or psycinfo or psychlit or psyclit).ti,ab.
86. ((hand or manual\$ or database\$ or computer or computes or compuretis\$ or computerez\$ or electronic) adj search\$.ti,ab.
87. ((electronic or bibliographic\$) adj database\$.ti,ab.
88. (empirical adj (study or literature or studies or evidence)).ti,ab.
89. systematic.ti,ab.
90. overview\$.ti,ab.
91. (what adj works).ti,ab.
92. (scoping adj (study or studies)).ti,ab.
93. or/71-92
94. comment.pt.
95. editorial.pt.
96. letter.pt.
97. or/94-96
98. 93 not 97
99. 70 and 98

Database: Transport; **Host:** WebSPIRS, Ovid Technologies; **Years Covered:** 1968 to date; **Years Searched:** 1995-2006; **By:** PSB on 21st April 2006; **Results Downloaded:** 1032

Limits: Publication Year (PY) = 1995-2006; Language (LA) = English [†]	
#	Terms
1	review in TI,AB
2	(meta adj (analysis or analyses)) in TI,AB
3	(metaanalysis or metaanalyses) in TI,AB
4	meta analysis in DE
5	synthes* in TI,AB
6	metasynthes* in TI,AB
7	(metaethics or meta adj ethics) in TI,AB
8	(metaevaluation* or meta adj evaluation*) in TI,AB
9	(metaethnograph* or meta adj ethnograph*) in TI,AB
10	(meta research or meta adj research) in TI,AB
11	(metasummar* or meta adj summar*) in TI,AB
12	(metatheoretical or meta adj theoretical) in TI,AB
13	(meta adj analytic) in TI,AB
14	(cochrane* or medline or medlars or embase or cinahl or scisearch or psychinfo or psychlit or psyclit) in TI,AB
15	((hand or manual* or database* or computer or computers or computeris* or computeriz* or electronic*) near search*) in TI,AB
16	((electronic* or bibliographic*) near database*) in TI,AB
17	(empirical adj (literature or study or studies or evidence)) in TI,AB
18	systematic in TI,AB
19	overview* in TI,AB
20	(what adj works) in TI,AB
21	Think in TI, AB
22	(scoping adj (study or studies)) in TI,AB
23	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22
24	(Pedestrian* or Cyclist* or Driver* or Passenger* or Rider* or Pillion*) in TI,AB and #23
25	(Traffic or Transport or Automobile* or "Bus" or "Buses" or PTW* or Car or Cars or Lorry or Lorries or Vehicle* or Motor* or Taxi* or Cab or Cabs or Bicycle* or Truck* or Walk* or Driving) in TI,AB and #23
26	(Road* or Highway* or Street* or Carriageway* or Freeway* or Cycle* or Pavement* or Sidewalk* or Lane* or Buslane* or (Railway adj Crossing*)) in TI,AB and #23
27	(Behavio* or Violation* or Error* or Lapse* or Speed* or "Near Miss" or "Near Misses" or ((Dangerous or Careless or Drink or Drunk or Drug or Fatigue or Tired* or Novice) adj (Driving or Driver*))) in TI,AB and #23
28	((Speed adj (Hump* or Bump* or Zone* or Limit* or Restrict* or Camera* or Management)) or Light* or (Crash adj Barrier*) or Crossing* or Condition* or (Road adj (Design* or Layout* or Marking*)) or Gatso or (Safety adj (Camera* or Belt*)) or Reflect* or Warning* or (Shared adj Space*) or Safe* or (Seat adj Belt*) or ((Child or Car) adj Seat*) or (Child adj Restraint*) or (Traffic adj Calming) or Helmet* or Hazard* or Weather* or Improve* or Protect* or Prevent* or Decreas* or Reduc* or Educat* or "Accident prevention" or (Mobile adj Phone*) or (Traffic adj Club*) or (Think adj Campaign*) or "Horse Sense" or "Cycle Smart" or (Home adj Zone*) or (Transport adj Plan*) or (Highway adj code*) or DSA) in TI,AB and #23
29	(Accident* or Crash* or Collision* or Injur* or KSI or ((Killed near2 Serious*) adj Injur*) or RTA* or RTC* or Course* or Training or Death* or Morbidity or Mortalit* or Fatalit*) in TI,AB and #23
30	(#24 and #27) or (#24 and #28) or (#24 and #29) or (#25 and #27) or (#25 and #28) or (#25 and #29) or (#26 and #27) or (#26 and #28) or (#26 and #29)
31	(H16 OR H51 OR H52 OR U26 OR U46 OR R08 OR R12 OR I82 OR I85) in SC [†]
32	#30 AND #31

†Full language limits was set to: (LA:TS = EGNLISH) or (LA:TS = EMGLISH) or (LA:TS = ENF) or (LA:TS = ENG) or (LA:TS = ENGISH) or (LA:TS = ENGLIH) or (LA:TS = ENGLILSH) or (LA:TS = ENGLISCH) or (LA:TS = ENGLISDH) or (LA:TS = ENGLISH) or (LA:TS = ENGLISHC) or (LA:TS = ENGLISJ) or (LA:TS = ENGLMISH) or (LA:TS = ENGLSIH)

‡**Subject Codes for SC Field:** H16 User Needs; H51 Safety; H52 Human Factors; I82 Accidents and the Road; I85 Road Safety Devices; R12 Safety; R08 Rail-Highway Grade Crossings; U26 Safety and Product Quality; U46 Center City Traffic Restraints

Database: Zetoc; **Host:** MIMAS, on behalf of British Library and JISC; **Years Covered:** 1993 to date; **Years Searched:** 1995-2006; **By:** PSB on 26th April 2006; **Results Downloaded:** 332 (without duplicates filtered out)

Limits: Publication Year = 1995-; Search: General Search (conferences & journals)

#	Filter	Terms
1	review	prevent* road accident*
2	review	prevent* traffic accident*
3	review	prevent* motor* accident*
4	review	prevent* transport* accident*
5	review	safe* pedestrian*
6	review	safe* cyclist*
7	review	safe* driver*
8	review	safe* passenger*
9	review	safe* rider*
10	review	safe* pillion*
11	review	danger* driv*
12	review	drink* driv*
13	review	drunk* driv*
14	review	speed* driv*
15	meta-analysis	prevent* road accident*
16	meta-analysis	prevent* traffic accident*
17	meta-analysis	prevent* motor* accident*
18	meta-analysis	prevent* transport* accident*
19	meta-analysis	safe* pedestrian*
20	meta-analysis	safe* cyclist*
21	meta-analysis	safe* driver*
22	meta-analysis	safe* passenger*
23	meta-analysis	safe* rider*
24	meta-analysis	safe* pillion*
25	meta-analysis	danger* driv*
26	meta-analysis	drink* driv*
27	meta-analysis	drunk* driv*
28	meta-analysis	speed* driv*
29	"meta analysis"	prevent* road accident*
30	"meta analysis"	prevent* traffic accident*
31	"meta analysis"	prevent* motor* accident*
32	"meta analysis"	prevent* transport* accident*
33	"meta analysis"	safe* pedestrian*
34	"meta analysis"	safe* cyclist*
35	"meta analysis"	safe* driver*
36	"meta analysis"	safe* passenger*
37	"meta analysis"	safe* rider*
38	"meta analysis"	safe* pillion*
39	"meta analysis"	danger* driv*
40	"meta analysis"	drink* driv*
41	"meta analysis"	drunk* driv*
42	"meta analysis"	speed* driv*
43	systematic	prevent* road accident*
44	systematic	prevent* traffic accident*
45	systematic	prevent* motor* accident*
46	systematic	prevent* transport* accident*
47	systematic	safe* pedestrian*
48	systematic	safe* cyclist*
49	systematic	safe* driver*
50	systematic	safe* passenger*
51	systematic	safe* rider*
52	systematic	safe* pillion*
53	systematic	danger* driv*

54	systematic	drink* driv*
55	systematic	drunk* driv*
56	systematic	speed* driv*

Appendix 6.3: Pro-environmental behaviour search strategies

Database: Environmental Sciences and Pollution Mgmt; **Host:** CSA Illumina; **Years Covered:** 1987 to date; **Years Searched:** 1995-2006; **By:** KA on 11th May 2006; **Results Downloaded:** 1803

Limits: Date Range 1995-2006, English Language only

SEARCH TERMS

- 1 kw=review
- 2 pt=review
- 3 kw=(meta within 1 (analysis or analyses))
- 4 kw=(metaanalysis or metaanalyses)
- 5 kw=synthes*
- 6 kw=metasynthes*
- 7 kw=(metaethics or meta within 1 ethics)
- 8 kw=(metaevaluation* or meta within 1 evaluation*)
- 9 kw=(metaethnograph* or meta within 1 ethnograph*)
- 10 kw=(metaresearch* or meta within 1 research*)
- 11 kw=(metasummar* or meta within 1 summar*)
- 12 kw=(metatheoretical* or meta within 1 theoretical*)
- 13 kw=(meta within 1 analytic)
- 14 kw=(cochrane* or medline or medlars or embase or cinahl or scisearch or psychinfo or psycinfo or psychlit or psychlit)
- 15 kw=((hand or manual* or database* or computer or computers or computeris* or computeriz* or electronic*) near search*)
- 16 kw=((electronic* or bibliographic*) near database*)
- 17 kw=(empirical within 1 (literature or study or studies or evidence))
- 18 kw=systematic
- 19 kw=overview*
- 20 kw=(what within 1 works)
- 21 kw=(scoping within 1 (study or studies))
- 22 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21
- 23 kw=environmentalis*
- 24 kw="environmental audit"
- 25 ab=(environmental within 1 engineer*)
- 26 kw=(environment* within 1 friendly)
- 27 (kw="the environment" within 2 (save OR conserv* OR protect* OR preserv* OR improv*))
- 28 (kw=green within 3 (business* OR practice OR behavio* OR process OR home))
- 29 ((ti=ecology within 3 (save OR conserv* OR protect* OR preserv* OR improv*)) OR (ab=ecology within 3 (save OR conserv* OR protect* OR preserv* OR improv*)))
- 30 ((ti=ecological within 3 (save OR conserv* OR protect* OR preserv* OR improv*)) OR (ab=ecological within 3 (save OR conserv* OR protect* OR preserv* OR improv*)))
- 31 ((ti=ecological within 2 (business* OR practice OR behavio* OR process OR home)) OR (ab=ecological within 2 (business* OR practice OR behavio* OR process OR home)))
- 32 kw=(eco within 1 (warrior or freak) ecowarrior or ecofreak)
- 33 (kw="the environment" within 2 (pollut* OR contaminat* OR harm* or damage* OR ecotoxic*))
- 34 kw=((eco within 1 friendly) or ecofriendly)
- 35 kw=((eco within 1 label*) or ecolabel*)
- 36 kw=ecocide
- 37 kw=((eco within 1 consumer) or ecoconsumer)
- 38 kw=(ecological within 1 footprint*)
- 39 kw=cfc
- 40 kw=chlorofluorocarbon*
- 41 kw=((greenhouse within 1 effect*) AND (prevent* OR reduc* OR stop* OR limit* OR lower* OR decreas*))
- 42 kw=((greenhouse within 1 gas*) within 2 (prevent* OR reduc* OR stop* OR limit* OR lower* OR decreas*))
- 43 ((ti=(fossil within 1 fuel*) OR ab=(fossil within 1 fuel*)) AND ((ti=green OR ab=green) OR (ti=ecological OR ab=ecological) OR kw=(environment* within 1 friendly)))
- 44 kw=(low within 1 emission*)
- 45 kw=unleaded

- 46 (ab=((chemical within 1 pollut*) AND (prevent* OR reduc* OR stop* OR limit* OR lower* OR
decreas*)) OR ti=((chemical within 1 pollut*) AND (prevent* OR reduc* OR stop* OR limit* OR
lower* OR decreas*)))
- 47 (kw=(climate within 1 chang*) within 2 (prevent* OR reduc* OR stop* OR limit* OR lower* OR
decreas*))
- 48 kw=((global within 1 warming) within 4 (prevent* OR reduc* OR stop* OR limit* OR lower* OR
decreas*))
- 49 kw=(ozone within 1 layer)
- 50 kw=(ozone within 1 hole)
- 51 kw=(ozone within 1 friendly)
- 52 kw=(ozone within 1 deplet*)
- 53 kw=(pro within 1 environment*)
- 54 kw=proenvironment*
- 55 kw=(environmental* within 1 responsibl*)
- 56 kw=(responsibl* within 1 consumer*)
- 57 kw=(sustainable within 1 behavio*)
- 58 (ab=(sustainable within 1 develop*) or ti=(sustainable within 1 develop*)) AND kw=(green OR
ecological OR (environment* within 1 friendly) OR recycl*)
- 59 (ab=(sustainable within 1 develop*) or ti=(sustainable within 1 develop*)) AND kw=(behavio* OR
knowledge OR attitud*)
- 60 ((ti=(natural within 1 resource*) within 3 (save OR conserv* OR protect* OR preserv* OR improv*))
OR (ab=(natural within 1 resource*) within 3 (save OR conserv* OR protect* OR preserv* OR
improv*)))
- 61 kw=thermostat*
- 62 kw=(insulat* within 1 (home* OR house* OR building*))
- 63 kw=doubleglaz*
- 64 kw=(double within 1 glaz*)
- 65 kw=(energy within 1 (light* OR bulb*))
- 66 kw=(solar within 1 panel*)
- 67 kw=allotment*
- 68 kw=refill*
- 69 kw=(recharge* within 1 batter*)
- 70 kw=recondition*
- 71 kw=((sav* or conserve*) within 2 (heat or energy or fuel))
- 72 kw=(public within 1 transport)
- 73 kw=(car within 1 pool*)
- 74 kw=(car within 1 shar*)
- 75 kw=bicycle*
- 76 (ti=(cycl* within 1 (path* OR route* OR lane* OR track*)) OR ab=(cycl* within 1 (path* OR route* OR
lane* OR track*)))
- 77 kw=(food within 1 (co-op* OR coop*))
- 78 kw="the environment" AND kw=(co-operativ* OR cooperativ*)
- 79 kw=(food within 1 mile*)
- 80 ((ti=(waste within 1 management) OR ab=(waste within 1 management)) AND ((ti=green OR
ab=green) OR (ti=ecological OR ab=ecological) OR kw=(environment* within 1 friendly)))
- 81 kw=(dustbin* or (dust within 1 bin*))
- 82 kw=(rubbish within 1 bin*)
- 83 kw=(waste within 1 (bin* or bucket* or basket*))
- 84 kw=(garbage within 1 (bin* or can*))
- 85 kw=trashcan*
- 86 kw=rubbish
- 87 kw=garbage
- 88 kw=trash
- 89 kw=scrap
- 90 kw=refuse
- 91 (ti=((separat* OR sort* OR save OR conserv* OR collect* OR dispos* OR recycl* OR reus* OR
biodegrad*) within 2 (waste or rubbish or litter or garbage or trash or scraps or refuse or compost or
humus)) OR ab=((separat* OR sort* OR save OR conserv* OR collect* OR dispos* OR recycl* OR
reus* OR biodegrad*) within 2 (waste or rubbish or litter or garbage or trash or scraps or refuse or
compost or humus)))

- 92 kw=((kerb* or curb* or house* or home* or domestic) within 3 recycl*)
- 93 kw=((scheme* or program* or project*) within 3 recycl*)
- 94 kw=(household within 1 waste)
- 95 kw=(kitchen within 1 waste)
- 96 kw=(garden within 1 waste)
- 97 kw=(organic within 1 waste)
- 98 kw=(alternative within 1 (energy or power or fuel))
- 99 kw=(renewable within 1 (energy or power or fuel))
- 100 kw=(solar within 1 (energy or power))
- 101 kw=((tidal or tide or wave) within 1 (power or energy))
- 102 kw=hydroelectric*
- 103 kw=(wind within 1 (power or mill* or turbine*))
- 104 kw=(geothermal within 1 (energy or power))
- 105 #22 AND (#23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 OR #71 OR #72 OR #73 OR #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82 OR #83 OR #84 OR #85 OR #86 OR #87 OR #88 OR #89 OR #90 OR #91 OR #92 OR #93 OR #94 OR #95 OR #96 OR #97 OR #98 OR #99 OR #100 OR #101 OR #102)

Database: PsycINFO; **Host:** WebSPIRS, Ovid Technologies; **Years Covered:** 1806 to date; **Years Searched:** 1995-2006; **By:** KA on 15th May 2006; **Results Downloaded:** 274

Limits: Date Range 1995-2006, English Language only

SEARCH TERMS

- 1 (review in TI,AB)
- 2 (review in SU)
- 3 ((meta adj (analysis or analyses)) in TI,AB)
- 4 ((metaanalysis or metaanalyses) in TI,AB)
- 5 (meta analysis in DE)
- 6 (synthes* in TI,AB)
- 7 (metasynthes* in TI,AB)
- 8 ((metaethics or (meta adj ethics)) in TI,AB)
- 9 ((metaevaluation* or (meta adj evaluation*)) in TI,AB)
- 10 ((metaethnograph* or (meta adj ethnograph*)) in TI,AB)
- 11 ((metaresearch or (meta adj research)) in TI,AB)
- 12 ((metasummar* or (meta adj summar*)) in TI,AB)
- 13 ((metatheoretical or (meta adj theoretical)) in TI,AB)
- 14 ((meta adj analytic) in TI,AB)
- 15 ((cochrane* or medline or medlars or embase or cinahl or scisearch or psychinfo or psychlit or psychlit) in TI,AB)
- 16 (((hand or manual* or database* or computer or computers or computeris* or computeriz* or electronic*) near search*) in TI,AB)
- 17 (((electronic* or bibliographic*) near database*) in TI,AB)
- 18 ((empirical adj (literature or study or studies or evidence)) in TI,AB)
- 19 (systematic in TI,AB)
- 20 (overview* in TI,AB)
- 21 ((what adj works) in TI,AB)
- 22 ((scoping adj (study or studies)) in TI,AB)
- 23 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22)
- 24 ((comment or editorial or letter) in DT)
- 25 (#23 not #24)
- 26 ((environment near3 (save or conserv* or protect* or preserv* or improv*))in TI,AB)
- 27 ((environment near (pollut* or contaminat* or harm* or damage* or ecotoxic*)) in TI,AB)
- 28 ((environmental* near3 (save or conserv* or protect* or preserv* or improv*))in TI,AB)
- 29 ((environmental* near (pollut* or contaminat* or harm* or damage* or ecotoxic*)) in TI,AB)
- 30 (environmentalis* in TI,AB)
- 31 ((environmental adj audit) in TI,AB)
- 32 ((environmental adj engineer*) in TI,AB)
- 33 ((environment* adj friendly) in TI,AB)
- 34 ((ecolog* near (save or conserv* or protect* or preserv* or improv*))in TI,AB)
- 35 ((ecolog* near (pollut* or contaminat* or harm* or damage* or ecotoxic*)) in TI,AB)
- 36 ((ecowarrior or ecofreak) in TI,AB)
- 37 (ecotoxicolog* in TI,AB)
- 38 (((eco adj label*) or ecolabel*) in TI,AB)
- 39 (((eco adj friendly) or ecofriendly) in TI,AB)
- 40 (ecocide in TI,AB)
- 41 (((eco adj consumer) or ecoconsumer) in TI,AB)
- 42 ((ecological adj footprint*) in TI,AB)
- 43 ((cfc or chlorofluorocarbon*) in TI,AB)
- 44 (aerosol* in TI,AB)
- 45 ((greenhouse adj effect) in TI,AB)
- 46 ((greenhouse adj gas*) in TI,AB)
- 47 ((fossil adj fuel*) in TI,AB)
- 48 ((low adj emission*) in TI,AB)
- 49 (unleaded in TI,AB)
- 50 ((chemical adj pollut*) in TI,AB)
- 51 ((climate adj chang*) in TI,AB)

- 52 ((global adj warming) in T1,AB)
53 ((ozone adj (layer or hole or friendly or deplet*)) in T1,AB)
54 ((environmental* adj responsibl*) in T1,AB)
55 ((responsibl* adj consumer*) in T1,AB)
56 ((sustainable adj behavio*) in T1,AB)
57 ((sustainable adj develop*) in T1,AB)
58 ((natural adj resource*) in T1,AB)
59 ((public adj transport) in T1,AB)
60 ((car adj (pool* or shar*)) in T1,AB)
61 (bicycle* in T1,AB)
62 ((cycl* adj (path* or route* or lane* or track*)) in T1,AB)
63 (thermostat* in T1,AB)
64 ((insulat* adj (home* or house* or building)) in T1,AB)
65 ((doubleglaz* or (double adj glaz*)) in T1,AB)
66 ((energy adj (light* or bulb*)) in T1,AB)
67 ((solar adj panel*) in T1,AB)
68 (allotment* in T1,AB)
69 (refill* in T1,AB)
70 (recharg* in T1,AB)
71 (recondition* in T1,AB)
72 (((save or conserve) near (heat or energy or fuel)) in T1,AB)
73 ((co-operativ* or cooperativ*) NEAR (green OR ecological OR (environment* adj friendly)) in T1,AB)
74 (food adj (co-op* or coop*) in T1,AB)
75 ((food adj mile*) in T1,AB)
76 ((waste adj management) in T1,AB)
77 ((dustbin* or (dust adj bin*)) in T1,AB)
78 ((rubbish adj bin*) in T1,AB)
79 ((waste adj (bin* or bucket* or basket*)) in T1,AB)
80 ((garbage adj (bin* or can*)) in T1,AB)
81 (trashcan* in T1,AB)
82 (recycl* in T1,AB)
83 (reus* in T1,AB)
84 (biodegrad* in T1,AB)
85 (compost* in T1,AB)
86 (humus in T1,AB)
87 ((kerb* or curb* or house* or home* or domestic) near3 recycl*) in T1,AB
88 ((scheme* or program* or project*) near3 recycl*) in T1,AB
89 ((separat* or sort* or save or conserv* or collect* or dispos* or recycl* or reus* or biodegrad*) near
((waste or rubbish or litter or garbage or trash or scraps or refuse) in T1,AB))
90 (((household or kitchen or garden or organic) adj waste) in T1,AB)
91 ((alternative adj (energy or power or fuel)) in T1,AB)
92 ((renewable adj (energy or power or fuel)) in T1,AB)
93 ((solar adj (energy or power)) in T1,AB)
94 (((tidal or tide or wave) adj (power or energy)) in T1,AB)
95 (hydroelectric* in T1,AB)
96 ((wind adj (power or mill or turbine)) in T1,AB)
97 ((geothermal adj (energy or power)) in T1,AB)
98 #25 AND (#26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36
OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR
#48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59
OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 OR
#71 OR #72 OR #73 OR #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82
OR #83 OR #84 OR #85 OR #86 OR #87 OR #88 OR #89 OR #90 OR #91 OR #92 OR #93 OR
#94 OR #95)

Database: Zetoc; **Host:** MIMAS, on behalf of British Library and JISC; **Years Covered:** 1993 to date; **Years Searched:** 1995-2006; **By:** KA on 23rd May 2006; **Results Downloaded:** 1026 (without duplicates filtered out)

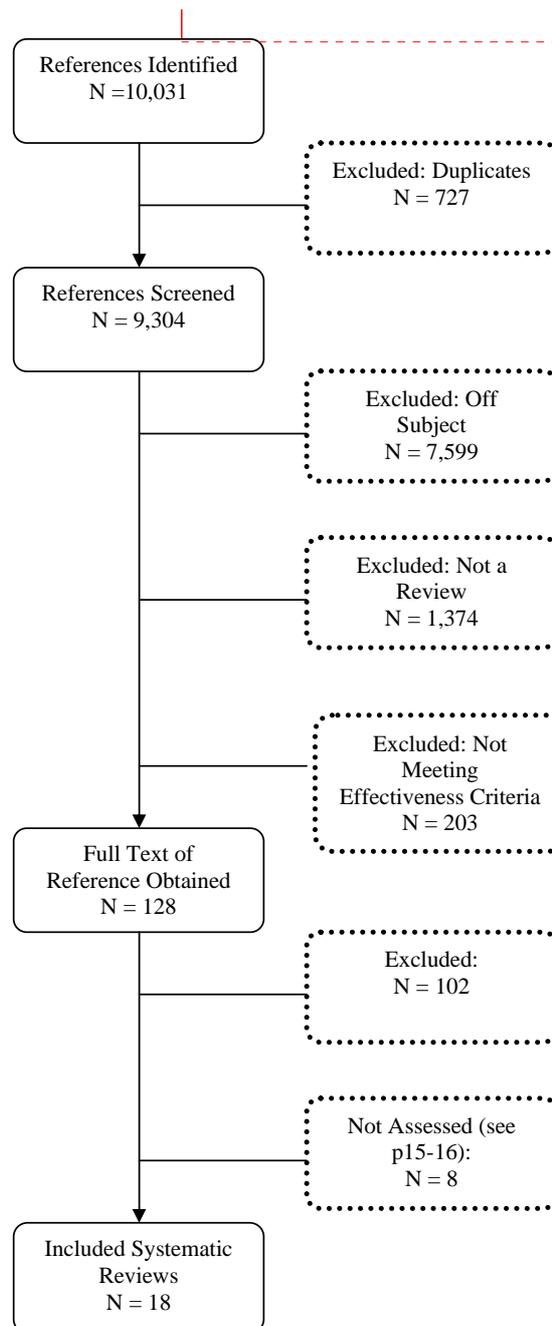
Limits: Publication Year = 1995-; Search: General Search (conferences & journals)

#	Filter	Terms
57	review (title field)	environment* friend*
58	review	pro-environment*
59	review	environmentalism
60	review	"eco friendly"
61	review	ecofriendly
62	review	ecological knowledge
63	review	ecological behavio*
64	review	ecological attitud*
65	review (title field)	recycle* environment*
66	review	recycle* home
67	review	recycle* domestic
68	review	kerbside
69	review	curbside
70	review (title field)	"waste management" (title field)
71	review	"waste management" recycl*
72	review	responsibl* consumer*
73	review	allotment*
74	review	compost* home
75	review	compost* domestic
76	review	"car share"
77	review	"car pool"
78	review	"greenhouse effect"
79	review	renewable energy (title field)
80	review	"renewable fuel"
81	review	sustainable behavio*
82	review (title field)	"sustainable development" (title field)
83	meta-analysis	environment (title field)
84	meta-analysis	environment* friend*
85	meta-analysis	pro-environment*
86	meta-analysis	environmentalism
87	meta-analysis	eco friendly
88	meta-analysis	ecofriendly
89	meta-analysis	ecological
90	meta-analysis	recycle*
91	meta-analysis	kerbside
92	meta-analysis	curbside
93	meta-analysis	"waste management"
94	meta-analysis	responsibl* consumer*
95	meta-analysis	allotment*
96	meta-analysis	compost*
97	meta-analysis	"car share"
98	meta-analysis	"car pool"
99	meta-analysis	"greenhouse effect"
100	meta-analysis	renewable energy
101	meta-analysis	renewable fuel
102	meta-analysis	sustainable behavio*
103	meta-analysis	"sustainable development"
104	"meta analysis"	environment (title field)
105	"meta analysis"	environment* friend*
106	"meta analysis"	pro-environment*
107	"meta analysis"	environmentalism
108	"meta analysis"	eco friendly
109	"meta analysis"	ecofriendly

110	"meta analysis"	ecological
111	"meta analysis"	recycle*
112	"meta analysis"	kerbside
113	"meta analysis"	curbside
114	"meta analysis"	"waste management"
115	"meta analysis"	responsibl* consumer*
116	"meta analysis"	allotment*
117	"meta analysis"	compost*
118	"meta analysis"	"car share"
119	"meta analysis"	"car pool"
120	"meta analysis"	"greenhouse effect"
121	"meta analysis"	renewable energy
122	"meta analysis"	renewable fuel
123	"meta analysis"	sustainable behavio*
124	"meta analysis"	"sustainable development"
125	systematic	environment (title field)
126	systematic	environment* friend*
127	systematic	pro-environment*
128	systematic	environmentalism
129	systematic	eco friendly
130	systematic	ecofriendly
131	systematic	ecological
132	systematic	recycle*
133	systematic	recycle* environment*
134	systematic	kerbside
135	systematic	curbside
136	systematic	"waste management"
137	systematic	responsibl* consumer*
138	systematic	allotment*
139	systematic	compost*
140	systematic	"car share"
141	systematic	"car pool"
142	systematic	"greenhouse effect"
143	systematic	renewable energy
144	systematic	"renewable fuel"
145	systematic	sustainable behavio*
146	systematic	"sustainable development"

Appendix 6.4: Summary of road safety search results

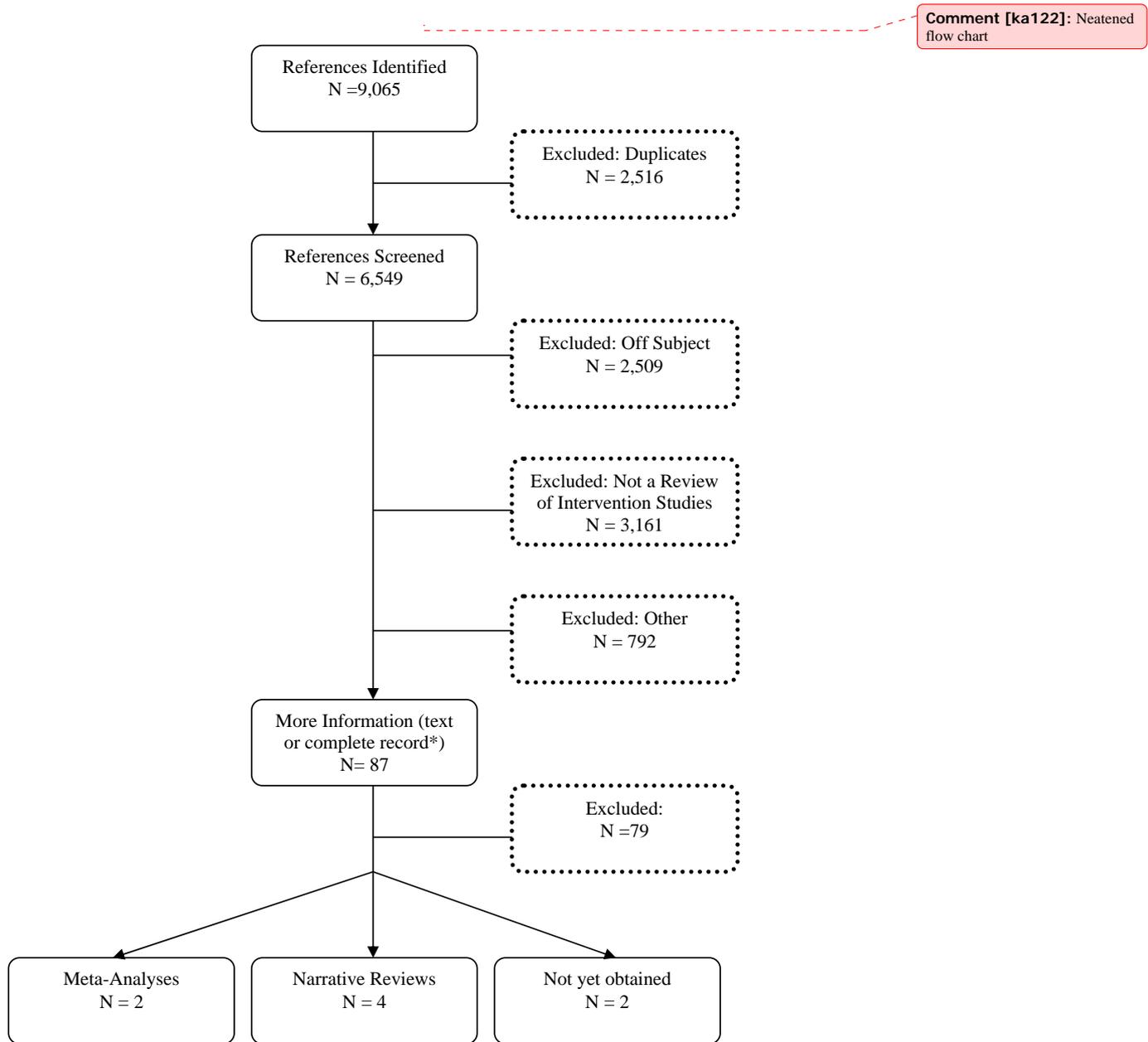
**Results of Electronic Database Searching for
Changing Road User Behaviour**



Comment [ka121]: Neatened flow chart

Appendix 6.5: Summary of pro-environmental search results

**Results of Electronic Database Searching for
Promoting Pro-Environmental Behaviour**



*Complete Record: Some records in the ORL software had incomplete titles/abstracts so the full record from bibliographic database was obtained to make an assessment.

Appendix 6.6: Sample critical appraisal checklist

Data Extraction Software

Owl Research Ltd

Overview

Does this paper address your topic area? Yes No Unsure

Selection Criteria

Does the paper have a clearly focused aim or research question? Yes No Unsure

Is the following discussed?

The population studied Yes No Unsure

The interventions given Yes No Unsure

The outcomes considered Yes No Unsure

Inclusion/Exclusion criteria Yes No Unsure

Types of study Yes No Unsure

Systematicity

Did the reviews include the following?

Relevant databases searched Yes No Unsure

Years searched Yes No Unsure

Were references from bibliographies followed up Yes No Unsure

Were experts consulted Yes No Unsure

Were grey literature searched Yes No Unsure

Were searched terms specified Yes No Unsure

Is the search strategy adequate Yes No Unsure

Is it worth continuing? Yes No Refer

Give reason

--

Quality

Did the author assess the quality (rigour) of the included studies Yes No Unsure

Was a rating system used Yes No Unsure

Was there more than one assessor Yes No Unsure

If the study was combined was it reasonable to do so Yes No Unsure

Consider whether the following are true

Are the results of the studies clearly displayed Yes No Unsure

Are the studies sufficiently similar in design Yes No Unsure

How were the variations between studies investigated?

Are there sufficient data to support the conclusions Yes No Unsure

Relevance to the UK

Can the results be applied/be generalisable to a UK population of population group Yes No Unsure

Can the intervention be applied to the UK Yes No Unsure

Is the paper focused on a particular target group (age, gender, etc) Yes No Unsure

Accept in evidence base

Accept for inclusion into RSI evidence base Yes No Refer

Comments

Appendix 6.7: Sample data extraction form

Data Extraction Software

Owl Research Ltd

Describe the study

- Systematic review of RCT
- Systematic review of RCT and non RCT
- Systematic review or meta-analysis of non RCT
- Narrative review of non RCT

Rationale

Review of parameters (if applicable)

What databases/sources were searched?

What years were searched?

Study selection criteria: Inclusion

Study selection criteria: Exclusion

Number of studies

Number of participants unknown

Describe the method of analysis (meta-analysis, etc)

Other Study Parameters

Geographical (country)

- Walking
- Cycling
- PTW (motorbike, etc)

- Car
- HGV or PSV
- Other

Review objective

Description of comparators

Method/mode of delivery

Providers/delivers of the intervention

Level of intervention

- Individual
- Community
- Population
- Other

Population

Who are the study population

Outcomes

Describe the outcomes

Results

Briefly describe the results for each of the main outcomes

Describe the conclusions

Does the paper demonstrate any evidence of harm of adverse effects associated with the intervention

UK

Are the results generalisable to the UK
 Yes No Unclear

Why?

Other

Does the authors identify any evidence gaps or make any recommendations for further research?

Is there any data on cost effectiveness presented?

Are there policy implications for the research?

Are there any practice implications for the work?

Second opinion?

Pass to other reviewer for second opinion

OK

Cancel

Appendix 6.8: Sample bias scoring form

Bias Scoring Software

Owl Research Ltd

Bias Scoring

1. Was there a focused aim or research question?
 2. Explicit inclusion/exclusion criteria?
 3. More than one selector/assessor?
 4. Provide details of databases searched?
 5. List years searched?
 6. Followed up references in bibliographies?
 7. Experts consulted for further scores?
 8. Grey literature searched/included?
 9. Specified search terms/ strategy?
 10. Not restricted to English language only?
 11. Quality assessed?
 12. Data supports conclusions?
-

Relevance to the UK scoring

A A1 B C D

- (A) Includes UK Studies
- (A1) Geographic origin of included studies is not explicit but are mostly likely to apply to UK settings
- (B) Non-UK studies of interventions that would most likely to equally apply to UK settings
- (C) Non-UK Studies that may have some application to UK settings, but should be interpreted with caution. There may be strong cultural or institutional differences that would have an impact on the effectiveness of the intervention if applied in the UK
- (D) Non-UK studies that are clearly irrelevant to UK settings
-

Comments

OK

Cancel

Appendix 6.9: References for included reviews

Road Safety

Aeron-Thomas AS, Hess S (2005). Red-light cameras for the prevention of road traffic crashes. *Cochrane Database of Systematic Reviews*, Issue 2. Art. No. CD003862. DOI: 10.1002/14651858.CD003862.

Bunn F, Collier T, Frost C, Ker K, Roberts I, Wentz R (2003). Traffic calming for the prevention of road traffic injuries: systematic review and meta-analysis. *Injury Prevention*, **9**(3): 200-204.

Duperrex O, Roberts I, Bunn F (2002). Safety education of pedestrians for injury prevention. *Cochrane Database of Systematic Reviews*, Issue 2. Art. No. CD001531. DOI: 10.1002/14651858.CD001531.

Ehiri JE, Ejere HOD, Magnussen L, Emusu D, King W, Osberg JS (2006). Interventions for promoting booster seat use in four to eight year olds traveling in motor vehicles. *Cochrane Database of Systematic Reviews*, Issue 1. Art. No. CD004334. DOI: 10.1002/14651858.CD004334.pub2.

Grossman DC, Garcia CC (1999). Effectiveness of health promotion programs to increase motor vehicle occupant restraint use among young children. *American Journal of Preventive Medicine*, **16**(1 Suppl):12-22.

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