The effectiveness of road safety education

Nina Dragutinovic & Divera Twisk

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A literature review

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SWOV Institute for Road Safety Research
P.O. Box 1090
2260 BB Leidschendam
The Netherlands
Telephone +31 70 317 33 33
Telefax +31 70 320 12 61
E-mail info@swov.nl
Internet www.swov.nl

Summary

This literature review of traffic education programmes addresses the current practice in evaluation research, the effectiveness of programmes and their constituting components and the differences and similarities with other fields of education. The study leads to a number of conclusions which can be divided into three categories and are listed below.

Conclusions about evaluation studies:
- Although a large number of road safety education programmes exist, the number of programmes that is followed by thorough and "by the book" evaluations, is rather limited.
- Very few studies use crashes as an evaluation criterion: most use intermediate variables such as knowledge, attitudes and (self-reported) safe behaviour.
- The vast majority of evaluated road safety programmes have children who are not yet in their teens as their target group, and focus on the pedestrian role.
- Evaluations have mainly been done in high income western countries; the findings cannot be generalized for developing countries.

Conclusions about comparisons with health promotion education:
- Traffic safety education has similar patterns as health promotion education.
- Shortage of systematic evaluation studies hampers the progression towards effective programmes.
- As in traffic safety education, primarily intermediate variables are used: variables related to a healthy lifestyle rather than to the frequency of behavioural afflictions.

Conclusions about effective components:
Because of the relatively large number of evaluation studies, this study has primarily analysed the "effective components" of road safety programmes for children.
- Road safety education should start as early as the age of 4-5 and needs to be continued through primary and secondary school.
- Individual training is superior to group training. Group training should focus on interactions between children.
- Adult-led learning and peer collaboration are powerful instruments because of the influence of social interaction on learning (model behaviour).
- Small stages of practical training are effective to form a concept based on action. Both, practice and developmental theories support this statement.
- Classroom instruction enriched with good demonstrations of model behaviour (e.g. by means of video, table-top models, etc) is slightly less effective than behavioural training.
- Computer-supported practical training (for small groups of children interacting with each other) is effective.
- No difference in effects on knowledge between training methods such as play-mat models, board game and illustrated posters.

Contents

1. Introduction

Objectives of the study
This literature review addresses the question of how effective traffic education is, and which features characterize 'good' programmes. In this report, questions are answered on the characteristics of 'good' evaluation studies, the inherent complexity of the research field, and the lessons to be learned. To place the findings into perspective, comparisons will be made with other fields in which education is used as a preventive measure, such as the field of public health. These comparisons allow us to answer the question to what extent the observed patterns are only typical for road safety, or whether the patterns are related to more general issues in 'the effectiveness of education as a preventive measure'.
The review has been conducted as part of the EVEO, Study of the Effects of Education, project in which a large number of educational programmes will be evaluated. Within this project, the purpose of the review is to assess essential features of evaluation designs in traffic education, the effect criterion to be used and the characteristics of potentially effective programmes.

Background
In spite of the significant improvements in road safety achieved in the last 25 years, the current number of deaths and injuries (and associated social and economic costs) is still unacceptably high. Only in the year 2000, , over 40 000 were killed and more than 1.7 million people injured in road crashes in the EU. Having in mind the magnitude of these numbers, the European Commission has set as a safety goal to reduce the number of road deaths by half in the period 2001-2010 (European Commission, 2001).
Road safety measures, aimed at achieving this safety goal by preventing traffic crashes and reducing their severity, are traditionally referred as the three E's: Enforcement measures, Engineering measures and Education measures. From the experiences of the best performing countries, it has becomes evident that for road users in general, and for children in particular, a holistic approach is needed in which the three E's are combined (OECD, 2004).

However, with respect to the effectiveness of road safety education relatively little is known, whereas the effects of police enforcement and infrastructural measures are well documented (Goldenbeld, 2004; Ogden, 1996).
This despite the fact that it has convincingly been demonstrated that education is needed for the successful performing of even simple activities like walking, writing, or using the toilet. In contrast, safe participation in traffic is a complex task requiring skills like rule application, speed estimation and prediction, and it is self evident that extensive practice is needed to acquire these skills (Rothengatter, 1981). In addition, crash statistics show that the adoption of any new traffic role leads to subsequent increase in crash rates (Vlakveld, 2004), indicating a poor performance of novices. Although the role of traffic education is not necessarily under discussion, the knowledge about the effectiveness and the characteristics of `good` programmes is still insufficient. Moreover, the scarce evaluation studies have also demonstrated that educational programmes may have negative effects on safety, leading

to more casualties instead of less. Again, this finding emphasizes the need for evaluation studies.

1.1. Focus of the report

Range of studies
"Road safety education covers all measures that aim at positively influencing traffic behaviour patterns, with an emphasis on:

1. Promotion of knowledge and understanding of traffic rules and situations
2. Improvement of skills through training and experience
3. Strengthening and/or changing attitudes towards risk awareness, personal safety and the safety of other road users" (untitled, ROSE 25, 2005).

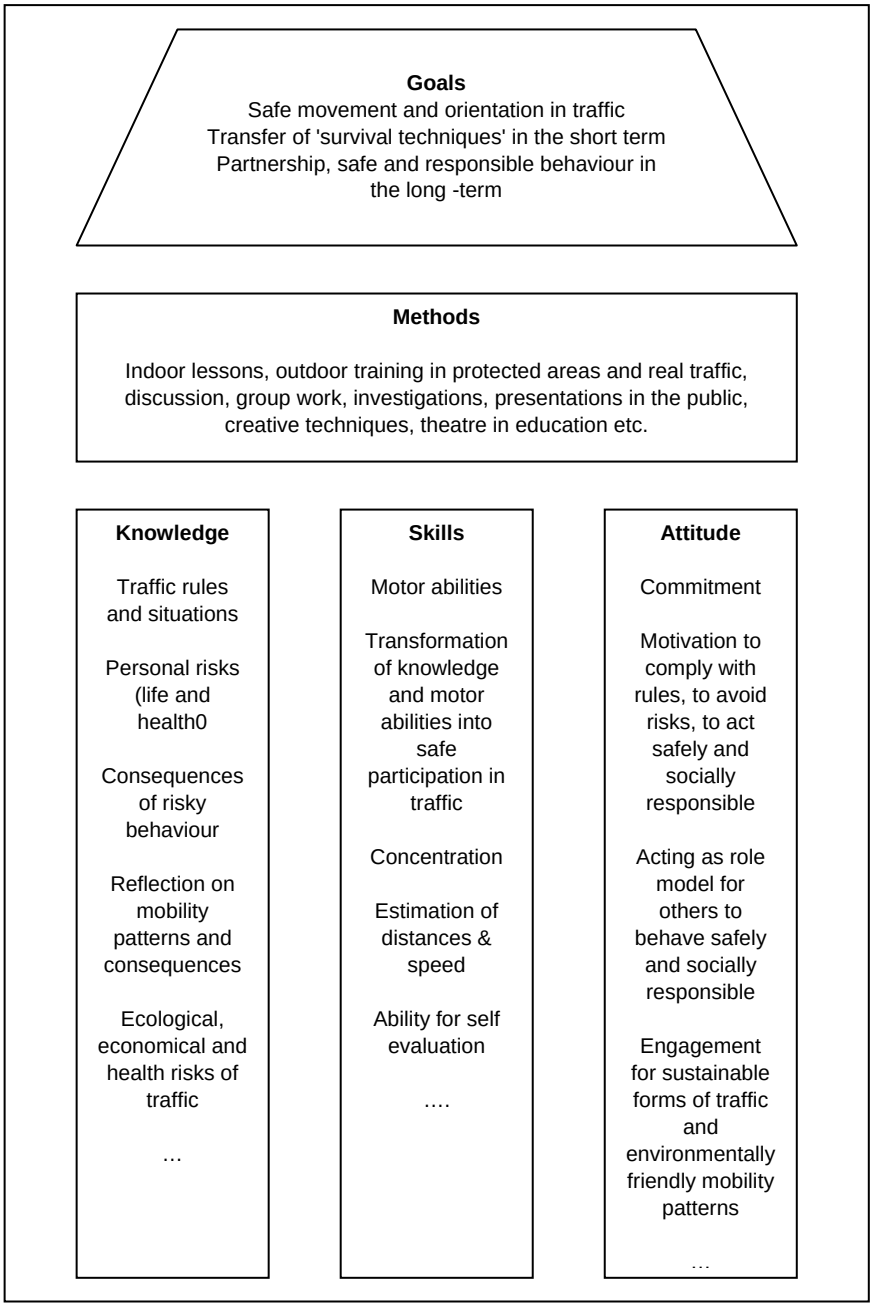

Figure 1. *Definition of Road Safety Education (source: Rose 25)*

Traffic education as a measure is used for all kinds of road user groups and for all sorts of road safety issues. It ranges from training young moped riders to 'driver improvement' of convicted drivers. However, to find out if road safety education is effective and which are the effective programme components, a focus is needed on age groups and problem behaviour for which a large number of educational programmes has been developed and some evaluation studies are also available. Educational programmes for children between 5 and 12 meet these criteria; therefore this report focuses on programmes for this age group. Road safety education programmes which are carried out in schools, as well as outside schools, are included.

The high availability of programmes for this age group follows from these facts:

- Children are recognized as a vulnerable group regarding road safety.
- Children represent a group that is easy to reach by education. In reality this is the group that is also the most exposed to road safety education.
- In most countries, road safety education for children is part of the national curriculum, although organization of road safety education in schools can differ considerably between different countries.

For the comparison of road safety education with education in other fields, we have focussed on studies that review the educational practice in health education like drug and alcohol use prevention, AIDS-risk reducing programmes, mental health promotion, etc.

1.2. Selection of the studies

The search for road safety education programmes to be included in this report was limited to the programmes aimed at children, and discussed in literature published in the last ten years (since 1993). The main selection criterion for road safety education programmes to be investigated was that they had to be coupled with evaluation data (of some kind) in order to make the assessment of their effectiveness possible.

The educational programmes in other fields than road safety were not the primary concern in this study. Therefore, we did not use the individual programmes, but instead we used several *review* articles (about the effectiveness and evaluation practice in fields of prevention of drug and alcohol use prevention, AIDS- risk reducing and mental health promotion) to learn about the good practice evaluation and characteristics of effective educational programmes.

1.3. The structure of the report

Chapter 2 of the report discusses the main objectives of road safety education. After presenting some technical issues in evaluation ,and some more general evaluation frameworks, the chapter concludes with the description of a methodological guideline especially dedicated to the evaluation of road safety education interventions.

Chapter 3 is dedicated to the most important facts and tendencies found in studies of child development which are significant for road safety education.

It is argued that road safety education programmes have to be based on the available theoretical knowledge about child development.

Chapter 4 gives an overview of practises of road safety education in schools in some European countries as well as in Australia and New Zealand. The effectiveness of the reviewed road safety education programmes is discussed in the light of Wolf's evaluation framework (Wolf, 1987). Because several educational programmes in the form of traffic clubs were available and because of the similarities within this group of programmes, the traffic clubs are discussed as a separate category from the rest of the reviewed road safety education programmes. For the explanation of traffic clubs see *Section 4.3.* The chapter about the effectiveness of road safety education programmes ends with the road safety education programme of Tolmie et al. (2003) that according to us represents an example of road safety education programme that is successful in meeting the requirements for well-planned, well-developed, well-implemented and effective programme. A more detailed assessment of the other evaluated programmes is given in the *Appendix*.

An overview of educational practise in other prevention fields such as the field of drugs and alcohol abuse, promotion of mental health and the reduction of AIDS-risk is given in the *Chapter 5* where the possible parallels between road safety education and education in these other prevention fields are discussed.

Chapter 6, finally, presents the conclusions about the current state of road safety education programmes and the possible ingredients of potentially effective road safety education programmes.

2. Evaluation of education programmes

2.1. Introduction

Rossi and Freeman (1993) define evaluation as the systematic application of social research procedures for assessing the conceptualization, design, implementation and utility of social intervention programmes. Evaluation should be integrated in every phase of a programme. In the development phase of the programme, evaluation gives information about changes and improvements which are necessary. After a programme has been developed and implemented, evaluation can establish the effectiveness of that programme.

There is a vast body of literature on evaluation, embracing various evaluation models, approaches and techniques. To discuss them all is beyond the scope of this report and therefore only a few generally recognized issues, functions and evaluation frameworks will be presented in this chapter.

2.2. Objectives of road safety education

Specification of goals and objectives is very important for both the education programme itself and for the evaluation of the programme.
The objective of road safety education can be defined as achieving an optimal use of the transportation system with optimal safety for all road users (OECD, 1986). The ultimate goal of each road safety education programme is to reduce the number of crashes and casualties. Therefore, the crash reduction could also be considered as the ultimate evaluation criterion for the effectiveness of road safety education programmes.

However, formulating the goal of road safety education in such a broad manner seems not to be very useful and moreover, there are some difficulties with this evaluation criterion:

- Traffic crashes are relatively infrequent events and evaluation based on reduction of the number of crashes requires large amounts of data over a long period of time, both not easily available. Data about crashes is often incomplete, and is therefore sometimes not valid or reliable enough.
- Road crashes are influenced by many factors, most of them difficult to control or completely uncontrollable. If there is a decrease in the number of crashes, it is not simple to establish which of the factors, or which combination of the factors has been 'responsible' for the reduction.
- A person can be at fault or not at fault in a crash. If the person who is involved in a crash is at fault, it cannot be concluded that the crash was caused by his insufficient training. It is possible that he has sufficient competencies due to road safety education, training, and experience, but that at the time of crash his capabilities were insufficient because of tiredness, distraction or some other factor.
- If education is considered to be a long lasting or rather a life-long process (Betuw & Vissers, 2002), it is difficult to judge the grand total effect of road safety education independently of other road safety measures which have been effective during these long-lasting processes.

Because of all these issues, there are very few education programmes that have been evaluated for their effects on the number of road crashes. In the sample of road safety education programmes reviewed in this report, there was only one programme (see Traffic clubs) that used the reduction in crash rate as an evaluation criterion.

It is necessary to formulate other, less general goals of road safety education than the reduction in the number of road crashes and casualties. Such a more explicit definition of programme objectives may contribute to the success of a programme in two ways:

- Clear objectives help a programme to be a focused one.
- Clearly stated objectives make an evaluation of the programme possible.

Rothengatter (1981) suggests that the evaluation criteria for road safety education should be defined in terms of *educational objectives* of the program. The aim of the programme is translated into educational objectives which describe what the programme has to achieve. From this perspective an effective programme is a programme which achieves the educational goals that were defined at the start of the programme.

2.3. Validity of educational objectives

Educational objectives can be defined in terms of knowledge, skills, or attitudes required for safe behaviour in traffic. Unfortunately, the problem is that many road safety programmes do not always define educational objectives precisely enough and do not always demonstrate that there is a connection between these objectives and the ultimate goal of road safety education.

The *validity* of the formulated educational objectives is one of the major factors influencing the effectiveness of the programme. In order to be valid, educational objectives have to clearly contribute to the formulated general goal of an educational program. However, there is still no general agreement about the validity of various educational objectives.

Crash analysis studies and empirical traffic behaviour can be used to determine the situations and behaviours that are critical to safe traffic participation. Rothengatter suggests that a way of setting concrete objectives may be to provide a detailed analysis of the task and to break the task down into component skills and strategies that are required for dealing with the various problems encountered in traffic. According to Rothengatter, it is the formal analysis of the tasks that can be used to determine the educational objectives which have to be achieved.

Primary and secondary objectives of the educational programme can be distinguished. Primary objectives are those objectives, which are directly related to the ultimate goal of road safety education: the reduction of the number of crashes. Secondary objectives are those that have only a facilitating role in the process of achieving the ultimate goal. For road safety education programmes, the primary objective would be to change road behaviour while the secondary objective would be change (i.e. increase) in knowledge about traffic, change in attitudes towards safety (developing positive attitudes toward safety) or development of new traffic skills.

Additional problem with this "primary-secondary" dimension of educational objectives is that researchers do not always agree that changes in knowledge or attitudes can really lead to changes in behaviour, and even agree less that these changes can lead to the reduction in the number of traffic crashes.

It could be said that in historical perspective, each of these groups of educational objectives had its own period of dominance. Sometimes, these groups of educational objectives are referred to as four major approaches to road safety education: knowledge enhancement, rule learning, development of appropriate attitudes and development of skills. However, it is more about which of these four approaches are emphasized in certain education interventions, because each of these four different approaches has values of its own. However, if it is possible to clearly establish the ‘safe behaviour’, then acquiring such behaviour can be considered as the most relevant and valid educational objective.

2.4. How to evaluate road safety education programmes?

If the aim of a road safety educational programme is to improve road safety of the target group, then it is important to know which educational programmes are effective. Effectiveness of an educational programme is assessed through an evaluation process. Results of evaluation are not just important for the development of a programme and for demonstrating its effectiveness, but are also important for defining proof-based policy decisions. Although there is general agreement about the significance and necessity of evaluation, and although the theoretical literature shows an increasing interest for evaluation, the current evaluation practice embraces a diversity of approaches and weaknesses.

2.5. Effectiveness of education

Professional educators must evaluate their work in order to obtain directions for improving it and to document its effectiveness (Stufflebeam, 1987) Thus, it is the *evaluation* that should provide us with an answer if a certain education programme is effective. Unfortunately, 'the educational reality' is much more complicated. According to Stufflebeam ((1987) "In evaluations, as in many professional endeavours, many things can and often do go wrong: they are subject to bias, misinterpretation, and misapplication, and they may address the wrong question and/or provide erroneous information. Indeed, there have been strong charges, that evaluation, in general, has failed to render worthy services…".
Regarding road safety education, difficulties in assessments of effectiveness of certain educational programmes do not solely lie in the limitations of the evaluation. More frequently, evaluation data about a particular road safety education programme do not exist at all. The statement that '"there is a lack of tested teaching material for integrating road safety into the National Curriculum" (Department of transport, London 1995) or the finding of Clayton et al. (1995.) that the last major evaluated safety education package for 8-11 year olds was produced nearly twenty years ago (the programme called Children and Traffic) are just some of the illustrations of the problem of the scarce evaluation of road safety education programmes.

Nevertheless, it is evident lately that educational programmes are experiencing increasing demands from various stakeholders to conduct evaluation studies to account for their services, to demonstrate their effectiveness, and for their further improvement. It seems there is a rising consciousness about the importance of evaluation issues not only for road safety, but also for educational programmes in general (Pawson & Myhill, 2001). At the same time, it is also evident that to perform a good evaluation is a more than challenging task.

2.6. Technical issues in evaluation

Concerning the theoretical issues of evaluation, a significant body of literature exists. Therefore, only some of the most frequently met terms and views regarding evaluation are discussed in this report.

When discussing evaluation of road safety education programmes, Rothengatter (1986), distinguishes formative and summative evaluation:

Formative evaluation
Formative evaluation refers to the collection and analysis of data before and during the development or redevelopment of a programme with the aim to optimize the programme.

1. *Process evaluation* aims to assess the educational process (e.g. acceptance and use of programme materials and methods). Typical questions that are addressed in process evaluation regard the attractiveness, usefulness, and ease of use of the programme materials and methods. Process evaluation can be carried out with assessment methods like questionnaires, record sheets, diaries, classroom observations, interview surveys, etc. The last two methods require a lot of manpower and that is why they are applied only on a limited scale. These methods are most useful in the early stages of programme development for modification or adaptation of the programme.
2. *Product evaluation* aims to establish which factors in the educational process determine the possible effects of the programme. The first requirement for the product evaluation is that the objectives of the programme have to be formulated on a sufficiently concrete level to allow meaningful measurement. Product evaluation is particularly useful to establish the comparative effectiveness of different teaching methods. The criteria that can be used in product evaluation are tests of traffic knowledge, understanding, risk perception, psychomotor or cognitive skills, attitudes towards safety, and behavioural capabilities in simulated or real traffic conditions.

Summative evaluation
Summative evaluation aims to establish the extent to which the programme achieves its goals, i.e. meets its stated objectives. Summative evaluation refers to collection and analysis of data about the operational programme in order to determine the effects of the programme, the costs, and possible unintended side effects. Data collection is focused on the implementation of the programme and outcome measures. Outcomes are the changes that result from the programme and should be related to the programme goals. Although a safer behaviour should be the primary outcome of road safety education programmes, a programme should be evaluated on a wide range of outcomes and therefore multiple measures of changes in attitudes,

knowledge and skills should be used. In order to achieve goals of summative evaluation, two requirements must be met:

1. The road safety education programme to be evaluated must be implemented on a sufficiently large scale;
2. The evaluation must be carried out on a sufficiently large scale.

Summative evaluation serves to provide data for decisions regarding continuation or implementation of a particular road safety programme while product evaluation serves to provide information about the further programme development. Although different in their aims and interests, the summative and the formative product evaluation can use quite similar methods.

With regard to the enormous number of different educational programmes (not just in road safety education but in other fields as well), the amount of time, effort and money invested in them, and the various institutions/organizations and people involved in educational programmes, there is a recognized need for the development of a common evaluation methodology in order to ensure progression in the quality of educational programmes. The 'Evaluation Pyramid' (Davis et al. 2000) of such very general guidance that could be used to support improvement of educational programmes. It illustrates various domains in intervention development, types of evaluation activities and functions of each of those types in supporting improvement of those interventions. Originally developed for the AIDS prevention programmes, the evaluation pyramid can be useful for other fields of educational interventions too.

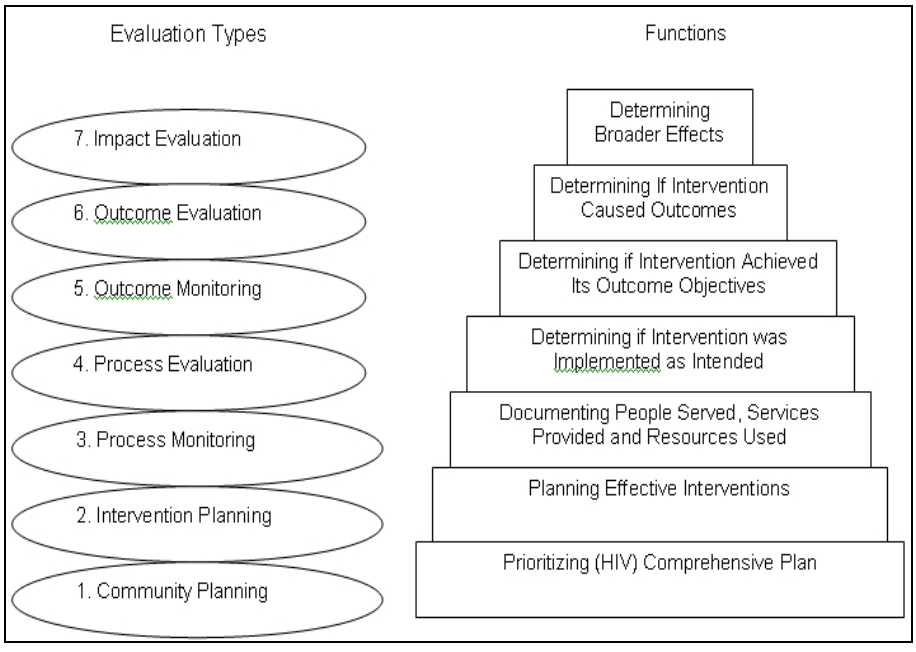

Figure 2.1. *Evaluation pyramid (Davis et al. 2000)*

Community Planning is the first step in developing effective programmes, aiming to satisfy needs of a specific community.

Intervention Planning defines goals, expectations and implementation procedures for an intervention.

Process Monitoring documents the implementation of programme activities such as targeted population served, services that were provided, resources used to deliver those services.

Process Evaluation assesses the implementation of programme activities such as an intervention's conformity to programme design, how it was implemented and the extent to which it reaches the intended audience. According to Steckler & Linnan (2002) it is precisely the process evaluation which is the missing component in the evaluation of public health interventions. Not knowing the degree to which a studied intervention was implemented as designed, may result in conclusions being drawn from outcome evaluations of programmes that have been improperly implemented. Steckler & Linnan define seven components of process evaluation:

1. Context (environmental influences of intervention implementation);
2. Reach (proportion of targeted participant population);
3. Dose delivered (intervention units provided by service providers);
4. Dose received (intervention units received by service participants);
5. Fidelity (Adherence to intervention delivery protocol);
6. Implementation (composite rating of the execution and receipt of the intervention);
7. Recruitment (participant identification and engagement).

Outcome Monitoring assesses the progress of clients or a programme toward outcome measures (measurable objectives) stated in programme goals.
Outcome Evaluation ascertains efficacy of the intervention or effectiveness in producing the desired cognitive, belief, skill or behavioural outcomes within defined population.

Impact Evaluation assesses the effects beyond the outcome of a particular intervention and is usually done, not for individual interventions, but to determine the combined effect of multiple programmes.

2.6.1. *Wolf's evaluation framework*

In order to be included in this review, the road safety education programmes at least needed to be coupled with some kind of evaluation data. Nevertheless, the approaches to evaluation as well as the quality of performed evaluation differed significantly. Therefore, in order to ‘equalize’ the quality of evaluation data, the effectiveness of included road safety education programmes was additionally assessed by applying the framework for evaluation proposed by Wolf (1987).

Wolf's framework for evaluation studies seemed applicable in this case because in his framework, Wolf tries to accommodate a variety of viewpoints about educational evaluation. Wolf's framework can serve as a useful vessel in planning and conducting evaluation studies. According to this model, there are five main categories of information which needs to be collected when evaluating education programmes. Each of these categories is necessary, although in itself not sufficient for a comprehensive evaluation. The

importance of each category depends on the educational programme to be evaluated, but the proposed framework would prevent failing to gather information that may be important. The five categories of information are:

1. *Initial status of learners* - Who they are, how proficient they are with regard to what they are supposed to learn. If learning is some kind of change in proficient behaviour, it is necessary to gather evidence of performance at least at two points in time, at the beginning and at some later time.
2. *Learner performance after period of instruction* - Education is about bringing about changes in learners, so it is critical to determine whether the learners have changed in the desired ways. After which period of time the learner performance should be measured depends on who is going to use this information. For the developers of the programme, it might be interesting to know how effective a particular unit of instruction is, so learner performance might be measured directly after this unit. On the other hand, those that must decide about implementation of the programme on a national level, for example, may be exclusively interested in the final performance of the learners. Regarding the proper timing for assessing the effectiveness of road safety education, there is no general agreement on time intervals to measure performance; not for short, nor, even less, for long-term effects of road safety education programmes.
3. *Execution of treatment* - Information about whether treatment was carried out, if so, to what extent. This class of information generally serves to identify which programme is going to be evaluated, because the implemented programme can differ significantly from the designed or intended programme.
4. *Costs* - As is the case for education in general, costs did not receive adequate attention in the evaluation of road safety education programmes. Nor were costs included in our assessment of the effectiveness of the selected road safety education programmes. The reason for this decision was very simple: related costs were not reported in any of the analysed programmes.
5. *Supplemental information* - This last category of information, consists of three subclasses of information:
   - Reactions, opinions and views of learners, teachers and others associated with the programme to find out how the educational programme is viewed by various groups,
   - Learners performances not specified in the objectives of the programmes,
   - Side effects of educational programmes.

2.7. Guidelines for evaluation of road safety education programmes

The researcher planning to conduct an evaluation is confronted with the variety of approaches, methods, and techniques which are currently being used for the evaluation of road safety educational programmes (and also for programmes in other educational fields).

Evaluators first need to understand the programme they are evaluating. They need to understand the types of effects that can be expected from the programme within the time frame of the programme implementation and follow-up evaluation. Therefore, it is the programme itself that determines which evaluation model should be used. The evaluation model is often used

to show how the programme is expected to cause change (see Bartholomew et al. 2001).

In order to help road safety practitioners with evaluation of road safety education interventions, UK Department for Transport published the Guidelines for Evaluation Road Safety Education Interventions (Sentinella, 2004). According to the author, these guidelines should not be considered as prescriptive, but as a general overview of the evaluation process with examples of successful evaluation techniques that could be used in road safety education filed. It is a useful general framework that helps highlight important evaluation issues.

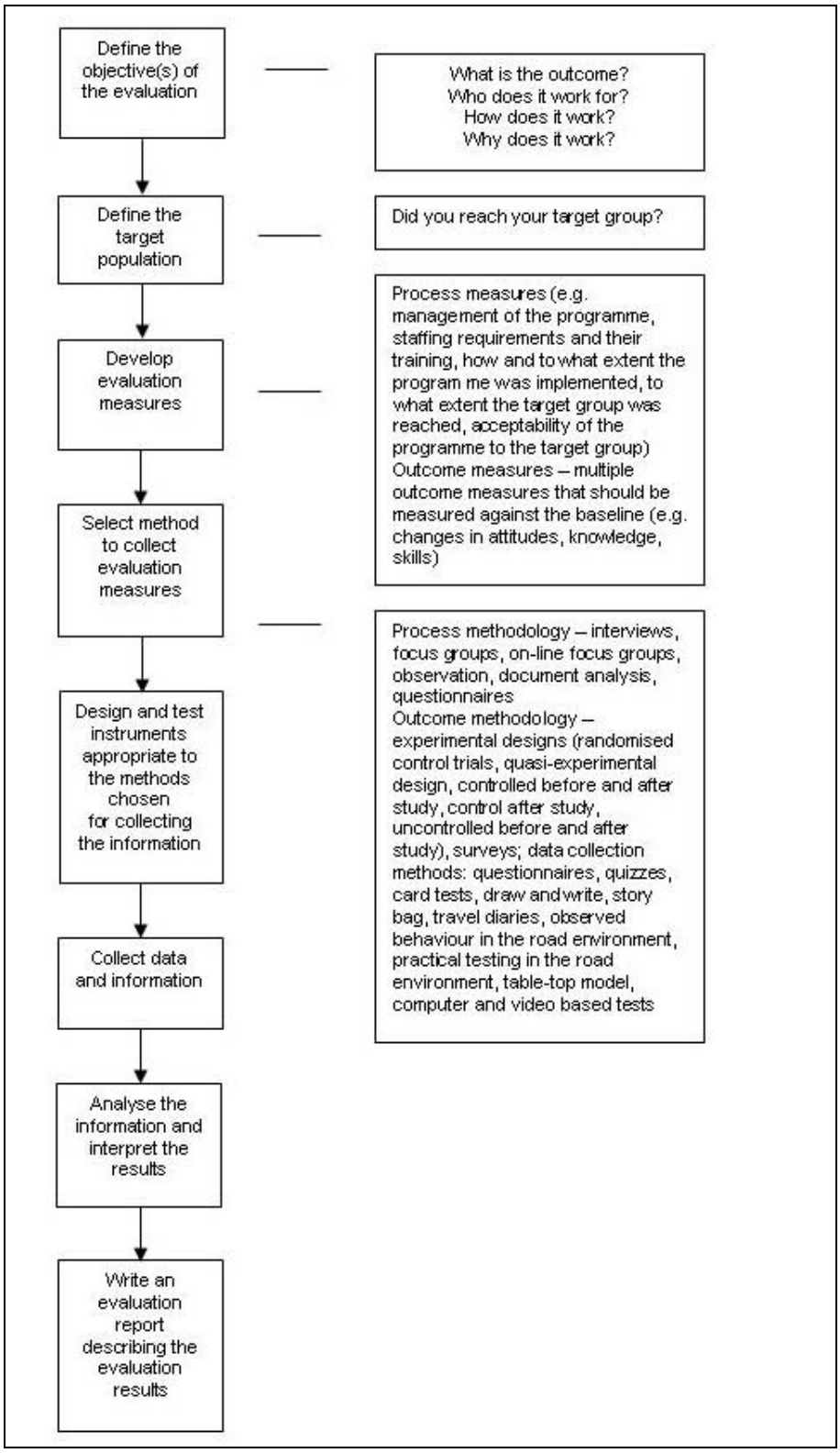

Figure 2.2. *Steps in evaluation (Sentinella, 2004)*

Figure 2.2 shows the proposed main steps to be followed when evaluating road safety education interventions, according to the TRL guidelines.

2.8. Implications for evaluation studies in the EVEO project

SWOV does research into the effects of traffic education in the EVEO project. From the material presented in this chapter, the following issues are relevant to the EVEO project:

- the success criterion for safety;
- the characteristics of a good educational program programme;
- the essential characteristics of 'good' evaluation studies.

Which success criterion for safety?
A major evaluation concern, in general, is the criterion of effectiveness. The considerations focus on two issues:

a. Absolute numbers of fatalities versus fatality rate;
b. Fatalities versus intermediate variables related to safety.

ad a: The choice between absolute numbers or rates reflects the basic objective of the measure. The 'absolute number' criterion aims solely to increase safety and may entail measures that reduce travel, or block access to the traffic system (e.g. delaying licensing of novice drivers). The second line of reasoning – the rate approach – states that safety should be expressed as a decrease in fatalities per distance driven. In the latter perspective, an increase in the absolute number of fatalities as a result of a higher mileage still leads to a positive evaluation of the outcome, whereas the decrease in fatalities due to a lower mileage is not considered to be a success. The two different approaches result in different assessments of the outcome of measures, as well as in different preferred measures. The two approaches also show that individual measures can be effective in two distinct ways: either by reducing exposure to risky travel by reducing mobility in risky condition, or by improving the general safety level of the traffic system, including novice driver performance. In the EVEO project we need to collect information on crashes as well as information on exposure to risk.

Not only the discussion about 'absolute frequencies versus fatality rate', but also the choice of fatalities as success criterion needs further discussion. As mentioned earlier, fatalities are rare outcomes of a complex system, and are largely an accidental result of a unique combination of circumstances. This implies that although fatality reduction is the ultimate goal of countermeasures, this criterion is not a reliable variable in evaluation studies. Only in situations in which data on large numbers of observations, over a longer period of time can be collected, the fatality criterion should be used. In all other cases, the use of intermediate variables is advisable. Intermediate variables should be valid, which implies that they should be chosen on the basis of an identified logical or evidence based relationship with crash risk. For example: because of the known relationship between alcohol use and crash rate, any measure that changes the level and frequency of the intermediate variable ' alcohol use in traffic' can be assumed to have an effect on crash rate as well.
As the projects that will be evaluated in the EVEO project, are relatively small in size (number of subjects are between 300 and 600), valid intermediate variables are used to estimate effectiveness.

What are the characteristics of a potentially effective programme?
The objective of EVEO is to study the effect of 'good' education programmes. As can be seen from the material presented in this chapter,

positive effects can only be expected from 'good' evaluation studies. From the material in this chapter we reached the following criteria for including a programme in the EVEO project:

- The behaviour/problem that is targeted in the education programme has a known relationship with safety: e.g. drink-driving;
- In the target group the unsafe behaviour is present, or may develop over time;
- Background information is available about the aetiology of the behaviour. E.g. is it because people are unaware of the danger related to the behaviour, do not know about other options, enjoy it, etc, and the capabilities of people to change. For instance, because of limitations in cognitive development - see also *Chapter 3*- the trainability of safe behaviour of very young children is low.

To assess the quality of implementation, the following criteria are relevant

- The programme is well established and has run for many years;
- The staff running the programme is enthusiastic and has positive experiences with the program.

What constitutes a good evaluation study?

Broadly, there are three approaches for the assessment of effects of countermeasures.

1. *Comparisons between groups* to which the countermeasure was either applied or not applied (control group). In this design, subjects should be randomly assigned to one of the groups, just to rule out that the groups differ, not because of the treatment, but because of personal characteristics of individuals that have chosen a particular group. This is of major importance for programmes in which individuals participate on a voluntarily basis. For instance, safety-training courses may attract individuals who are more safety oriented. This effect is called 'self-selection'.
2. *Time series*: comparing the situation before the introduction with the situation after the introduction. This is the best approach in assessing effects of compulsory measures. The strength of this approach is that a large number of observations is available, and subsequently the 'fatality criterion' can be used. The weakness is the control for effects that are caused by other simultaneous developments beside the countermeasure studied or beside the countermeasure in question.
3. *Cross- country comparisons*: comparing countries in which countermeasures were applied with countries in which the measures were not applied. For instance, countries differ in the magnitude of their school based traffic education. In the past attempts have been made to estimate the effectiveness of different licensing systems by comparing the safety levels of young drivers between countries (e.g. Lynam & Twisk, 1995, Leutzbach et al,1988; Sunflower6, 2005). However, so far these studies have not been successful. This is mainly due to the large number of other factors which might explain the differences. Examples of such alternative explanations are the infrastructure (e.g. the presence of protected pedestrian crossings), traffic intensity, and the level of separation between transport modes.

Because of the small sizes of the projects within the EVEO project, the between-group comparison is most appropriate. The random assignment to treatment conditions (treatment versus control group) is not feasible as most

projects are set within institutions (like schools) that offer the programme to their subjects on a compulsory basis. An alternative to randomization of participants is random assignment of schools to treatment conditions. This option is not preferred, as this would jeopardise the validity of the evaluation. After all, the success of a programme is strongly dependent on the quality of its implementation (including quality of the staff, experience with the programme etc.), and it requires an enormous effort to guarantee the required quality level, in a situation in which an organization is assigned to treatment condition.

There will be some control on the effect of self-selection by comparing the treatment and control groups on a pre-test, while causal relationships can be studied by comparing pre- and post test scores between treatment and control group.

3. Road safety education and development of children

3.1. Introduction

The target group of the road safety education programmes reviewed in this report are children and, to a lesser extent, adolescents. Therefore, the educational objectives of road safety educational programmes should take into consideration their characteristics, capabilities and limitations. In order to educate children to be safer road users, it is important to tune road safety education programmes to development of children. Therefore, this chapter will discuss several findings on child development that are significant for road safety education, more precisely for the development of pedestrian-related skills in children[1].

3.2. The development of pedestrian-related skills in children

Even crossing a simple road requires competence in a range of primary perceptual-motor and cognitive skills. It is important to know how these skills develop in childhood, and what the stages of this development are. In order to make a base for setting an educational programme or training, it is important to know which level of development in these skills can be found at a certain age.

In *Table 3.1* Foot et al. (1999.) give an outline of some of the fundamental skills that children need to acquire to cross a road safely:

Activity	Process
Detecting traffic presence	Visual search, conceptual understanding of traffic movement, selecting relevant from irrelevant stimuli
Recognizing safe/dangerous locations	Identifying potential sources of danger, avoiding distractibility
Visual timing	Time-to-contact judgments, distance and speed judgments, acceleration/deceleration judgments
Co-ordinating information	Dividing attention, integrating information from separate visual fields, memory and central processing
Co-ordinating perception and action	Relating time available to cross to time required to cross, knowledge of own movement capabilities

Table 3.1. *Skills necessary for road-crossing (Foot et al, 1999.)*

[1] The choice of pedestrian-related skills was influenced by the fact that most of the data to be found are about the development of pedestrian skills and on the other hand, children are most of the time engaged in traffic as pedestrians. This is also why most of the road safety education programmes for children are aimed at developing pedestrian skills.

3.2.1. *Looking behaviour*

The results obtained in studies of children's behaviour in real road situations are amazing when it comes to looking behaviour of children. In short, a majority of children do not look when crossing the street.

Zeedyk et al. (2002) found extremely poor performance of children of age 5-6 in looking for oncoming traffic when crossing the street. In every instance when children should have been expected to look for traffic on the main road, i.e. before reaching the kerb, while stopping at the kerb, in the midst of crossing the road, approximately 85% of the sample failed to do so. Even when children looked for oncoming traffic, the direction of their gaze was generally incorrect[2] and looking was usually limited to a single observation.

In a major study of the Scottish Development Department (1989) which involved over 10,000 observations, more than 50% of children in the age range 4-14 were estimated not to have looked for oncoming traffic before stepping into the road. In some cases, even when they gave the impression to look, children were actually going through a kind of a ritual of turning their heads from side to side, sometimes with such speed that it was obviously not possible for them to have registered anything. This could be an illustration of a tendency present in children to apply a rule they were taught, but actually not understanding it at all. West et al. (1998) suggest that in such cases it is not that children do not posses the skill, but they fail to apply it because of their impulsiveness and distractibility. If this is the case, it is important to help children to develop a sense of social responsibility.

3.2.2. *Perception of dangerous locations*

Young children are not successful in recognising which are the dangerous places to cross a road. Until the age of 9, children focus on a single factor when making judgements about the safety (i.e. the dangerousness) of a location, and that single factor is the presence of a vehicle. If a vehicle is present, the location is judged to be dangerous and if no vehicle can be seen, the location is judged to be a safe one. The problem with this type of judging is that 'no vehicle can be seen' for children also includes sites where seeing a vehicle is not possible, for example because of parked vehicles or because of any other obstacle that can block the child's view. It is precisely this attribute of a location that makes it a dangerous one. Only children above the age of nine recognize the danger of this type of situation and consequently use solve the problem by finding a clearer position to cross the road. According to Dunbar et al. (1999), road safety education should emphasise the development of skills involving the perception of danger and the control of attention because in general, children are less skilled than adults at applying their understanding of danger and danger is less noticeable for children.

In later research Dunbar et al. (2001) investigated attention switching and concentration, the two attention skills expected to be used by skilful pedestrians. They found that attention switching and concentration

[2] The study was done in UK where oncoming traffic comes first form the right side but children almost always looked to the left side first.

demonstrate substantial age-related variation, with younger children being much less effective than older ones. According to the authors, attention switching and concentration are two distinct skills. Although both develop with age, variations in concentration skill are apparently related to the individual differences in a cognitive style. Each of these skills was related to different aspects of road behaviour investigated in this study. Children who were more successful in attention switching were more likely to look at traffic when they were about to cross the road. Children who were less able to concentrate tended to be more impulsive and to cross the road in a less controlled manner. As an implication for road safety education, the authors state the findings of the Gopher review (cited in Dunbar et al. 2001) that attention skills of adults can be trained and brought under voluntary control. The results of Dunbar et al. (2001) suggest that attention switching and concentration generalize across domains. Therefore, it seems likely that computer games developed for improving these skills could influence the deployment of attention skills in practical environments. Nevertheless, at present, it is still not known to what extent such training interventions can promote these skills in children.

3.2.3. *Information processing*

As they grow older, children perform better when divided attention is required. In time, it is not the structure or capacity of the structure that changes, but the ways of using these capacities become more efficient. Children learn to encode information more efficiently, to develop strategies that allow better distribution of attention, and to process information faster.

Foot et al (1999) explored children's basic search strategies in an attempt to establish which features of the traffic environment children actually attend to. They compared 5-, 7-, 9-, and 11-year old children and adults for differentiating features of the traffic environment that are relevant to safe road crossing. It was found that it is difficult for young children (age 5 to 7) to distinguish between relevant features for the crossing task, such as approaching vehicles, nearby parked cars, other road obstacles or hazards, junctions, bends, and irrelevant features. Even when the task demands they give priority to relevant features, they fail to do so. Children do not know what they should be looking for in traffic and they cannot easily distinguish between visual and auditory features that are relevant or irrelevant for the road-crossing task. It is interesting that both Foot et al (1999) as Dunbar et al (2001) see the development of computer animations as a potentially helpful tool for assisting in teaching children what to attend to in traffic.

According to Whitebread & Neilson (1999) the development of cognitive skills depends on the construction of increasingly powerful and sophisticated cognitive strategies. In the case of road-crossing these strategies involve information sampling and decision-making. Three cognitive elements are significantly related to children effectively constructing and implementing pedestrian strategies:

- The meta-cognitive processes of becoming aware and in control of their own cognitive strategies;
- The sophistication of visual skills;
- Reflective, rather than impulsive cognitive style.

Beside general developmental trends, Whitebread & Neilson found that children's development of pedestrian skills is highly variable. They also found evidence relating to the differential crash rates between boys and girls in the primary school age range. According to the authors, boys appeared inclined to a higher 'risk-taking' style in relation to the pedestrian task by being more impulsive and quicker to make judgements about when it was safe to cross a road.

Developmental trends are also found regarding the understanding of the responsibility of the road user. Thornton et al. (1999) investigated criteria used by children aged 5 to 15 in deciding who has or has not behaved appropriately on the roads. They found that there are two clear qualitative developmental changes in how the responsibilities of the road user are represented. Children use two criteria: 'not to damage things' or 'not to make the kind of mistakes that might cause a crash'. The damage-avoidant interpretation, which is characteristic of a majority of 5-year-old children, assigns the blame to the road user who actually crashes into something, regardless of why it happens or which other events might have led up to the crash. At the age of eight, one quarter of the children is still entirely damage avoidant and only one fifth have become primarily error avoidant. To be error avoidant means assigning the responsibility to those road users who make errors, whether or not these errors lead to a crash or damage. The transition between these two criteria occurs relatively late in the development. Even at the age of 14, only half of children respond consistently in terms of error avoidance. This developmental tendency implies that young children have difficulties in understanding what is expected from them in terms of safe road behaviour. It is also difficult for them to accept that pedestrians and drivers share responsibilities for road safety, because in the eyes of children damage done by cars is so much greater than that done by pedestrians.

Educational programmes must not assume that children share the same views and interpretations with adults, even not the same meanings of simple concepts such as 'pedestrian', 'left' and 'right' or 'being careful' (Vinje, 1981). "The child's perspective has to be taken seriously" is the conclusion of Thornton's study. Road safety training should continue to focus on the development and application of roadside skills, but young children should also be trained in the basic concepts of error-avoidant road user behaviour so that they can perceive themselves as having a personal responsibility for maintaining safety.

3.3. **Adolescence**

Most of the data about development of skills or behaviours engaged in traffic is data about behaviour of younger children. It seems that road behaviour of adolescents stays out of the focus of researchers. There also seem to be far less educational interventions for adolescents than for younger children. On the other hand, crash data, for example in Great Britain (Department of the Environment Transport and the regions, 1999, Road accidents Great Britain 1998, The Casualty Report. London: The Stationery Office), shows that child pedestrian casualties peak at the age of 13 while cyclist casualties continue to rise to their peak at the age of 15. How do the adolescents behave in traffic? In recent research (Elliott & Baughan, 2003) on attitudes and behaviour of older children and adolescents (11-16 years old), a total of 2,433 pupils from eleven secondary schools located in England completed a

questionnaire in which respondents had to rate how often they carry out various actions as road users. Factor analysis showed that 43 items of the questionnaire clustered in three factors: unsafe road crossing, dangerous playing on the road, and planned protective behaviour. Statistically significant differences have been found in frequency of reported behaviours as a function of demographic variables such as age, sex and area. Younger respondents (11-12 year olds) reported more desirable road safety behaviour than older ones (13-16 year olds) for all three types of behaviour. Female respondents reported also more desirable road safety behaviour when compared to the behaviour of male respondents. In the case of planned protective behaviour the difference between females and males held only for respondents from schools in rural and small urban areas, while there was no such difference in urban schools. Children from rural areas more often reported playing on the road than children from urban areas. The ethnic group was one of the significant demographic variables where planned protective behaviour was concerned. Respondents in the black ethnic group reported planned protective behaviour less often than respondents from the white ethnic group. The respondents' beliefs regarding safety of their own behaviour were strongly associated with the three types of behaviour. It is suggested that adolescents have an accurate perception about the safety of their own behaviour as road users. Based on these results, authors argue that interventions which only provide adolescent road users with information about the safety of their behaviour might be ineffective in improving their actual road safety because adolescents who behave unsafely are already aware that their behaviour is unsafe. However, they still carry on behaving so.

3.4. Some implications from developmental psychology

The relevance of developmental theories' lies in giving theoretically well based directions for how to successfully organize road safety education programmes, taking into account the constraints the child's development impose on it. We already presented various results of some of the developmental studies significant for road safety education programmes. Below follow some more general directions which are significant for early road safety education intended for children ages 5 to 11, and primarily aimed at practical road safety skills for pedestrians.

3.4.1. *Practical training is the most effective*

The comprehensive review by Thomson et al. (1996) demonstrated that learning is a bottom-up process that starts with actions and moves towards concepts. Learning, especially in the early years, generally proceeds from behavioural knowledge (by seeing and doing things) to representational (or symbolic) knowledge. This trend should also be mirrored in education where training should progress from action to concept. This appropriate sequencing is the key of success of practical training methods. In the beginning these methods train children in particular actions within situations in which that behaviour must be used, or situations close enough. Once those actions are learned, they become the basis for more general concepts such as traffic movements and interaction between different categories of road users.

However, the implication of practical training being the most effective should not be understood as only putting an accent on skills. Skills alone are not

enough, just as neither knowledge or attitudes are enough. Even if children possess adequate skills, this does not guarantee they will behave safely as their behaviour is inconsistent. In order to behave more safely, children have to acquire complex strategies whose development is also related to the meta-cognitive process of awareness and control. They also need to develop appropriate attitudes towards road safety.

3.4.2. *Learning is domain-specific*

Road safety education has to take place under circumstances which are the same as, or closely related to, the ultimate context of use. Learning is context-dependent and not easily generalized so that cross-domain transfer seems to be limited. The younger the child, the more difficult the transfer of knowledge and skills to contexts that differ from the knowledge and skills that were first learned will be. Therefore, the younger the children, the more important it is that they have ample opportunity to interact with real objects and real environments. Therefore, using other contexts, like for example computer simulations, should serve as a supplement to a roadside training and not to be used stand-alone. Nevertheless, roadside training, off course, must never jeopardize children's safety.

3.4.3. *Age-related constraints significant for road safety education*

A significant factor is to determine an appropriate time for a certain skill to be trained. There are some new tendencies in understanding age-related issues. Previous assumptions about the rate of development that were mostly a consequence of rigid understanding of the Piagetian stage theory of a child's development seem to have been more and more abandoned. The results of the latest research in this field show that the bottom-age to begin with effective training could be as young as 5 years old. Children aged 5 upward have the capacity to be trained. Furthermore, it appears that the rate of development is not so constrained as previously thought and if approached correctly, it can even be accelerated. Nevertheless, it is clear that developmental trends exist in almost every function required for performing the pedestrian task with children approaching the adult level of performance around the age of 11 or 12.

One of the first goals of education for young children (age 4 or 5) should be to enable young children to learn and understand what to pay attention to and what to look for when faced with traffic. One of the most important practical questions is the proper age for children to travel to school alone. The results of recent studies show clear improvement in strategic thinking around the age of 7/8 and suggest that before this age children should be actively accompanied. This can also be the case at older ages, depending on local conditions and the child's capabilities.

3.4.4. *Interactiveness of learning*

Despite the differences between Piaget's theory and the developmental theory of Vygotsky (e.g. Piaget's theory appears to be more applicable in cases of conceptual development and Vygotsky's in case of actions learning) both of them emphasise the importance of social interaction.
Two interactive learning techniques such as adult-led learning and peer collaboration are especially useful in road safety education. Combined

complementary implementation of these two techniques seems to be the promising combination although when training involved specific computer simulations, adult guidance was more successful than peer led training. Therefore, programmes in which pedestrian behaviour for children is modelled by an adult and where discussion about road-crossing strategies with children is encouraged seem to be the promising ones. The younger the children, the more they learn through interactive rather than receptive experiences. The role of adults helping children in developing social skills is more significant when younger children are concerned. Furthermore, desirable attitudes (towards road safety) are not likely to be learned from instruction, rather they are learned from significant others (role models) who exhibit them.

3.4.5. *Emotional and moral development of adolescents*

Approximately from the age of 11 or 12 and upward, after the pedestrian skills required for safe behaviour in traffic have been acquired, the risk of road crashes could be expected to decrease. Nevertheless, crash data, pedestrian and cyclist crashes, not to mention teenage driver crashes, show that the teenage group is a high-risk group. What then should be the focus of road safety education for adolescents who have already acquired the necessary practical skills? The following findings about the emotional and moral development of adolescents, systemized by Arnett (2002), could be used when planning a curriculum on road safety education for adolescents:

- Adolescents are strongly influenced by what they think their peers and friends will think of them;
- In groups, when together, adolescent friends often generate a state of elation;
- Adolescents try to escape form the control of parents and other adults and find it interesting to experiment with what is explicitly forbidden by parents and other authorities;
- Adolescents underestimate the likelihood of negative events such as getting involved in a crash;
- Adolescents overestimate their own skills and competencies.
- Adolescents have strong mood swings;
- Male adolescents have a tendency to aggressiveness and sensation seeking, which is partly due to rising levels of testosterone in puberty.

These developmental characteristics of adolescents indicate that adolescent road safety education should primarily be directed at attitudes such as avoidance of risk taking, resistance to peer group pressure, no overestimation of one's own skills, etc.

3.4.6. *Social, political and cultural factors*

Not only developmental, but also other factors like social, political and cultural factors play an important role in road safety education. Various studies show the existence of ethnic differences in child pedestrian crash rates. This trend can be observed in many countries around the world. In the United States, the reported child pedestrian injury rate in black children is between two and three times the national average. This rate is even higher for Hispanic children relative to non-Hispanic whites (Rivara & Barber, 1985; Fingerhutt et al., 1988; King & Palmisano, 1992; Agran et al., 1996). In the UK it was found that non-white children suffered approximately twice as

many pedestrian accidents as white children (Christie, 1996) and Lawson and his colleagues (Lawson, 1990; Lawson & Edwards, 1991) reported that children of Asian origin suffer a pedestrian crash rate about twice that found for non-Asian children. The possible explanations for this over-representation of ethnic minority children in road crashes concern socio-economic factors (ethnic minorities typically live in relatively poor socio-economic conditions), parents' lack of familiarity with the traffic environment and traffic conditions in the host country, etc. Because the reasons for the higher crash rate for children from some ethnic minority backgrounds are not yet fully understood, further research in this area is needed to be able to come up with recommendations regarding road safety education.

3.5. Conclusions

Research on the development of children has led to important knowledge on how skills are developed, what the capabilities are of children of different ages, whether is possible to train certain skills, how we could enhance their development, etc.

Children do not know what they should be looking for in traffic and they cannot easily distinguish which visual and auditory signals are relevant or irrelevant for the road-crossing task. They do not share the same views and interpretations with adults and it is difficult for young children to understand what is expected from them in terms of safe road behaviour.

However, it is possible to train and help developing children's skills necessary for safe behaviour in traffic. The results of recent research in this field show that the bottom-age to begin with effective training of improving visual timing skills, improving the ability to find safe places to cross the road and even to reduce children's vulnerability to distraction and impulsive behaviour, could be as early as 5 years old (Thomson & Whelan, 1997; Thomson et al. 1996) Learning, especially in the early years, generally proceeds from behavioural knowledge (by seeing and doing things) to representational (or symbolic) knowledge. Learning is also context-dependent and therefore road safety education has to take place within circumstances that are the same or closely related to the ultimate context of use. However, skills alone are not enough for safe road behaviour. In order to behave more safely, children have to acquire complex strategies whose development is also related to the meta-cognitive process of awareness and control, and they also need to develop appropriate attitudes towards road safety. This last process is especially important for adolescents for whom road safety education should primarily be directed to attitudes such as avoidance of risk taking, resistance of peer group pressure, no overestimation of one’s own skills, etc.

4. Implementation and effectiveness of road safety education programmes

4.1. Introduction

In almost every country in the world, road safety education for children is an important part of national traffic safety policy. However, there are also some differences in the organization of road safety education among countries. The first part of this chapter gives an overview of road safety education practice in some European countries, as well as in Australia and New Zealand.

The second part of this chapter goes into the effectiveness of analysed road safety education programmes. In the assessment of the effectiveness of road safety education programmes, Wolf's framework was the reminder and help in reviewing the programmes in a structured manner. The main information about the analysed 'traffic club' programmes is presented in *Table 4.8* and the rest of the road safety education programmes in *Table 4.9*. More detailed descriptions of the programmes are given in the *Appendix.*

4.2. Formal organization of road safety education

Even if there is no general agreement about what should be the content or the form of road safety education, there is a general agreement about the importance of education for road safety. In almost every country in the world (if not in all of them) road safety education has its place within the formal education system. There are also numerous other road safety education programmes, initiatives and products that exist outside the formal educational organization. However, below follows a brief overview of the practice and the general organization of road safety education in schools in some of the European countries and in Australia and New Zealand (Catchpole & DiPietro, 2003).

4.2.1. *The Netherlands*

On a national level, the Ministry of Transport is responsible for the implementation of road safety education in the Netherlands, with twelve Dutch provinces having responsibility for carrying out initiatives. For the age groups 4-12 and 12-18, the ministry of Education and Science also plays an important role by deciding if the road safety education should be part of the school curriculum.

Of all the obligatory training objectives for primary schools, there are two objectives which deal with road safety:

- Children should know the rules of the road and the meaning of traffic signs. They should be able to apply this knowledge in traffic situations they encounter;
- Children should be able to participate safely in traffic as pedestrians, cyclists and as independent users of public transport.

However, it is not compulsory for schools to test if these training objectives are met and they are free in their choice of method and how many hours they spend on implementing road safety education. In most of the primary schools, there is a voluntary theoretical and practical (cycling) exam in the 7th or 8th grade, but certainly not all primary school offer these tests (Rose 25 Country report, the Netherlands).

Road safety education is not obligatory in the secondary schools and there is only an obligatory training aim partly concerning road safety defined in general terms like being able to function safely in ones own environment, including traffic. Again there is no formal testing and the time spent on road safety education in secondary schools is very limited (an average of approximately two hours a year).

4.2.2. *Great Britain*

Road safety education is not part of the National Curriculum in Great Britain, although the materials and resources concerning road safety education developed for schools can be integrated into lessons in subjects that are part of the National Curriculum. Typically, road safety education occurs within Personal, Social and Health Education (PSHE). In secondary schools it is not common for road safety education to be taught outside PSHE, but in primary schools, road safety education can take place also within units of study or topic work, as well as in specific subject area. Road safety education is the responsibility of local authorities and road safety officers are responsible for education, training and publicity in their local area. Good practice guidelines, for both primary and secondary school, provide guidance on road safety education (Department of Transport, 1995a; 1995 b). The survey done by the British Institute of Traffic Education and Research (BITER) and TRL (www.dft.gov.uk) showed that generally, road safety officers follow current advice on good practice. The focus of road safety education is on pedestrians and cyclists. About 50% of the respondent road safety officers were involved in practical pedestrian training, mostly aimed at children aged 5 to 7. In comparison to a similar survey done in 1985. this was a new activity for all but one road safety officers, which illustrates an increase in the use of practical pedestrian training methods in the last years. Almost all road safety units surveyed in the above research , support cyclist training, most commonly for children in the ages from 8 to 11. 73% of the road safety officers support pre-driver training, mainly for students aged 16 to 18. The support for motorcyclist training fell from 65% in 1985 to 45% in 1996. Beside road safety officers, the principal agencies supporting road safety education in the United Kingdom are the police and health promotion officers, with 71% of the police forces and 80% of the health promotion officers undertaking some kind of road safety activities. For pre-school children, road safety education exists in the form of Traffic Clubs (see S*ection 4.3.2*). A recent survey in the United Kingdom (Harland et al. 2003.) indicated, unfortunately, that only 20% of the primary schools in England, Wales and Northern Ireland which responded to the survey, had undertaken road safety work to prepare pupils for the transfer from primary to secondary school and that teaching of road safety education tends to become less with the increasing age of pupils.

4.2.3. *France*

Road safety education is officially part of the curriculum in primary and secondary schools. In secondary school, at the age of 12, all students are required to study for a road safety certificate (ASSR), which covers pedestrians and two wheeled vehicles in traffic, and at the age of 16 students must get another ASSR, which covers wider road safety.

4.2.4. *Spain*

Since 1991, road safety education has been compulsory in primary and secondary schools. Rather than being taught separately, road safety education is incorporated in the school curriculum by a subject teacher.

4.2.5. *Scandinavian countries*

Road safety education in Scandinavian countries is based on guidelines issued by the authorities, but in practice, it is the local authorities that decide on its extent. The same applies to road safety education in schools. Road safety education is part of the official school curriculum, but each school decides on its extent. For pre-school children, voluntary road safety clubs are arranged in co-operation with parents.

4.2.6. *Some eastern European countries*

Some characteristics of organization of road safety education in some of central and eastern European countries are presented in *Table 4.1* (OECD, 1995).

	Croatia	Estonia	Latvia	Lithuania	Belarussia	Czech Republic
What age group is covered by primary school?	7-15	7-11	7-15	6-10	6-10	
Is traffic education compulsory in primary schools?	Yes	Yes	No	Yes	Yes	
If yes, how is traffic education structured (special lessons or integrated)?	Integrated	Integrated		Integrated	Special lessons	Integrated
How many lessons a week?	2 hours	None		15 hours	1-8	
Do special teachers-trainers exist?	No	No	No	No	No	Yes
Are manuals for teachers available?	Yes	No	No	Yes	No	Yes
Are manuals for parents available?	No	No	No	No	No	
Are programmes and manuals based on results of (scientific) research?	Yes	No	No	No	No	
Are special budgets allocated for traffic education?	Yes	No	No	No	No	
Could you give a short description of the programmes and manuals?	Theoretical education for participating in traffic (integrated in some subjects)	Rules of the road		RSE is integrated practically in all subjects; Many schools have special, equipped rooms and grounds for teaching.		

Table 4.1 *The overview of the organization of road safety education in some central and eastern European countries*

4.2.7. *Australia & New Zealand*

Road safety education in Australia and New Zealand faces the same problems as in other countries. Although there are many of different education programmes in primary and secondary schools, there is very little evaluation data. Nevertheless, Australia remains committed to school-based

road safety education programmes, which is often thematic, intensive and supported by visitors.

In New Zealand, road safety education is scheduled at particular times of the year, usually in the form of a two or four week intensive slot which involves roadside practical application with the assistance of Police Education Officers.

Both countries suggest an integrated and cross curricula approach because road safety education has no special and distinct place in the national curriculum. Although they admit that a cross curriculum approach is better than not having road safety education at all, they argue that this approach can have numerous negative implications, like no distinct goals for the programme, no planned sequentiality, learning outcomes or associated assessment tasks, and no allocation in the school budget for professional development and acquisition of resources and materials (Catchpole & DiPietro, 2003).

In order to overcome the lack of relevant evaluation data mentioned above and because there are significant investment in road safety education programmes, Austroads, the association of Australian and New Zealand road transport and traffic authorities, prepared a checklist of seven principles for sound road safety practice in schools:

1. Road safety education should not result in increased exposure for high-risk categories.
2. Road safety education should promote injury reduction measures that are known to be effective.
3. Road safety education should provide children of every age with the skills and knowledge required to perform safely the road-related activities in which they are likely to be engaged.
4. Scarce road safety education resources should not be devoted to programmes that are known to be ineffective in reducing crashes and casualties.
5. Road safety education should not lead to students becoming overconfident about their ability to cope safely with hazardous driving situations.
6. Road safety education should provide students not only with the knowledge and skills required to behave safely, but also with the motivation to do so.
7. Road safety education should provide students with the knowledge that will help them to be safer road users throughout their lives.

4.2.8. *Conclusions on the implementation of road safety education*

In almost every country, children's road safety education and training is considered to be an important part of the national traffic safety policy. Also, for children in primary schools, i.e. children in the ages between 6-9 years old, road safety education even is compulsory in most of the countries. However, organization of road safety education (i.e. responsible authorities, content of education, methods, intensity, mediators, etc.) vary from country to country.

About the best practice related to education in OECD countries, the OECD report 'Keeping children safe in traffic' (OECD, 2004) concludes that road safety education is part of the national education curriculum at all levels from pre-school onward, with regular high-quality input to develop children's skills, risk awareness, attitudes and knowledge. However, further improvements are possible:

- The status of road safety education needs to be improved by integration with other disciplines and better evaluation measures;
- Parents need to be more effectively involved in how road safety education is given, both informally and formally. In particular, parents must be well informed about the need to teach safe behaviour by example;
- The focus of responsibility for child road safety needs to be shifted more towards drivers. However well children may be educated and trained in road safety skills, they remain less able than adults to use their skills and knowledge consistently.

4.3. Traffic clubs: a form of road safety education

Traffic clubs are discussed separately from the rest of road safety educational programmes, because of the close similarities between these programmes. Despite some minor differences, the main ideas of the implemented 'traffic club' road safety educational programmes are the same.

Traffic clubs represent a form of the road safety education which was established in the 1960s in Norway. The main idea of a traffic club is to involve parents in teaching their children road safety by using activities and exercises found in books on road safety. These books are sent to children (members) on regular basis. In most cases the membership of a traffic club is free of charge. The target group for traffic clubs are children from 3 to approximately 5 to 7 years old.[3]

Over time, traffic clubs were introduced in other Scandinavian countries, in Great Britain, Germany and Luxemburg.

4.3.1. *GAERTC – General Accident and Eastern Region Traffic Club*

The first of three analysed traffic clubs is *GAERTC-General Accident and Eastern Region Traffic Club* (West et al., 1993*).* The aim of West et al. study was to investigate the effects of GAERTC traffic club in Eastern England on the road safety knowledge and behaviour of 3-year-old children, as well as on the parental supervision and control of these children. The data was obtained by means of self-reporting.

The GAERTC Traffic Club would send a child an invitation on its third birthday, together with the first Traffic Club book. Joining the Traffic Club is free and every six months, till the age of five, more books would be sent to children that had joined the club. The books, which are colourful and attractive, contain exercises designed to involve parents in the training of their children and exercises for monitoring child’s progress. The issue of parental supervision and control is also addressed.

[3] The targeted ages differ slightly between different traffic clubs.

The effectiveness of GAERTC was assessed by carrying out two surveys, both in the experimental and the control region. The experimental region consisted of seven, and the control region of six neighbouring counties. Both samples, the experimental and the control one, were designed to be representative of the national population. One child and one parent per family were interviewed in each of the surveys (see *Appendix* for the questionnaire design).

	Experimental sample	Control Sample	Overall
First survey in April/May 1990	459	573	1032
Second survey April/May 1991	799	802	1601

Table 4.2. *Sample design and number of participants in each of the groups*

Criteria for the assessment of the effectiveness of GAERTC were:
1. Child's knowledge and reported behaviour;
2. Parent's knowledge and reported behaviour;
3. Attitudes (toward used material, or better said acceptance of the used material).

Table 4.3. gives an overview of behaviours that were affected by the GAERTC traffic club and those that were not.

Behaviour on which GAERTC had no effect (no significant difference between intervention and control group):	Behaviours on which GAERTC had positive effect (significant difference between intervention and control group):
Riding bicycles or other vehicles on the roads	Children running on ahead (when out with parent)- effect (with male children more likely to run into the road the female children)
Children crossing roads by themselves with no adult present	Children stopping on the pavement when told
Children running into the road (when out with parent)	Parental attempts to teach children anything about how to behave in traffic
	Having any books on road safety

Table 4.3. A*ffected and non-affected behaviour by GAERTC*

Regarding children's knowledge of roadside objects, there was no effect of the traffic club on the total number of items recognised. Nevertheless, GAERTC increased children's ability to recognise roads, with male children recognising more of the items.

The traffic club material was favourably received. Those who received the sent material used most of it, and children appeared to like the material (see *Table 4.4*). A total of 80.4% parents in intervention group recalled having received the first Traffic club book.

Proportion of parents who used the book:	Of those who used the book:
32.2 % went all the way through the book	74.5% said children enjoyed the book a lot
20.8% went through most of it	20.6% said children enjoyed it a little
13.6% went through some of it	
12.0% did not use it	
1.55 could not remember if they used it	

Table 4.4*. Acceptance of GAERTC material*

West et al. (1993) found evidence of the effect of socio-economic group and sex differences on road safety knowledge and behaviour.
As mentioned earlier, boys showed better knowledge of roadside objects, but girls showed a tendency to safer behaviour. This supports the standpoint that the relation between safe behaviour in traffic and knowledge or skill, is questionable.

Regarding the influence of the socio-economic group, parents from the manual socio-economic group generally control their children's playing in the street and crossing roads less. At the same time, children from this socio-economic group know less about roadside objects and they are less aware which places are safe or dangerous for playing. The effects of socio-economic group were larger than those attributable to the traffic club. This points out that some factors that were not addressed by the traffic club influence children's and parents' behaviour. The authors of this study suggest that these factors have to do with underlying attitudes and values regarding road safety.

Overall results of this survey indicated that the GAERTC traffic club was favourably received, that it had positive effects on some aspects of children's and parents' behaviour. There was no detectable effect of the traffic club on parental supervision of the children. Nevertheless, the fact that this study relied on interviews (i.e. self-reported behaviours) and not on the direct observation, imposes some limitation on the results of this research

4.3.2. *Swedish Children's Traffic Club*

A study of Gregersen & Nolen (1994) assessed the effects of the Swedish voluntary traffic club organised by the National Society for Road Safety: 'The Children's Traffic Club'.

The general aim of the Swedish children's traffic club is the reduction of crash rates. The more specific aims are increasing parents' knowledge about children's limited abilities in traffic, the implementation of a continuous teaching and training programme to prepare children for different traffic situations, and the creation of correct attitudes among children towards traffic. Similar to GAERTC traffic club, all children aged 3 received an invitation to become a member of the traffic club. In contrast to GAERTC, children pay a small membership fee. Those who join the Children traffic club, receive working material every six months until they are aged 7. Each

of these materials focuses on a special theme, such as how to cross the road, walking in the dark, how to deal with wintry roads, etc.

The Gregersen & Nolen study is one of the rare studies that use the crash rate as the evaluation criterion. The rate was measured as the number of crashes per 100 hours of exposure. The primary aim of the study was to investigate if there are differences between members of the traffic club and non-members in terms of crash rate, traffic behaviour, and the safety concerns of their parents.

The control group (non-members) was randomly drawn from the Swedish population register and the intervention group (members) was drawn from the traffic club member register.

Three questionnaires to be answered by the parents were sent out by mail, in(January, March, and June 1988 respectively. The first two questionnaires were identical and mainly asked about road crashes and exposure in traffic, but there were also some questions about other types of accidents. They attempted to investigate if there are any general differences in accident-proneness which are not influenced by the membership. The third questionnaire included the same questions as the first two, plus additional questions on background factors, children's general habits in traffic, use of safety equipment, strategies in traffic teaching and training, and parent's attitudes and beliefs about children in traffic.
Questionnaires were sent to 2,171 children. The final size of the groups who sent back the questionnaires is reported in *Table 4.5*.

	Questionnaire 1	Questionnaire 2	Questionnaire 3
Members	777	761	732
Non-members	532	518	491
Total	1,309	1,279	1,223

Table 4.5. *Final size of groups in Gregersen and Nolen (1994)*

When compared in background factors, no significant differences were found between the member and the non-member group, which makes a valid comparison between these two groups possible:

		Effect
1.	Exposure:	
	a) Length of time spent outdoors	No
	b) Exposure to traffic environments	Less for the member group
2.	The total traffic crash rate	Higher risk for member group
3.	Time spent in traffic environments without the company of a grown-up	More for non-member group
4.	Number of children receiving theoretical and practical training as pedestrians	More children in member-group
5.	Use of safety equipment	More in member-group

Table 4.6. *Effects of The Children's Traffic Club*

The results such as the use of safety equipment, the number of children receiving teaching and training, the time spent in traffic in the company of a grown-up, and less time generally spent in traffic show that the traffic club achieved positive safety effects. But if we look at the results obtained for the main evaluation criterion, which is crash rate, then the main safety effect of the Swedish traffic club is negative. Comparing the total traffic crash rate, the members of the traffic club had a significantly higher rate than non-members. The member group reported 394 crashes versus 162 for non-member group. Most of these crashes (95-97%) were minor crashes with only vehicle damage or injuries that did not require any hospital treatment.

There are several possible methodological explanations for this negative effect of the traffic club on the crash rate. For example, the member parents' might be more concerned about road safety, which can lead to more sensitive interpretation of what is to be defined as a crash. This may therefore lead to over-reporting crashes. Other explanations could be the effect of the non-response share which was larger in the non-member group, or the overestimation of the skills of the children as road users, etc. After discussing these possibilities, the authors concluded that the study does not give a true answer. The most reasonable conclusion from the study is that the Children's Traffic Club does not have any effect on reducing the crash rate.

4.3.3. *Children's Traffic Club in Scotland*

The third assessed traffic club is the Children's Traffic Club in Scotland. It was launched by the Scottish Road Safety Campaign in November 1995 (Bryan-Brown & Harland, 1999). Similar to two previously described traffic clubs, the membership was offered to three-year-olds in Scotland, and five books were sent (one book sent every six months) . Transport Research Laboratory (TRL), with the assistance of the British Institute of Traffic Education Research (BITER), was commissioned by the Scottish Road Safety Campaign to:

- assess the effects of the traffic club on knowledge, attitudes and reported behaviour of the target group and their parents;
- assess the use made of the materials of the Traffic club;
- indicate the proportion of members who drop out and investigate why some parents do not enrol their child.

Assessment of the effect of the Children's Traffic Club was undertaken in six stages: the baseline survey was carried out on children just under three years old, followed by 5 more surveys, i.e. one survey every six months. Parents and children were interviewed at home. Parents were asked about road safety, road safety education, traffic club membership, and use of the materials. Children were asked about road safety.

During the study, the number of children being interviewed decreased (see *Table 4.7*).

	Experimental group	Control group
Book 1	684	277
…	…	…
…	…	…
Book 5	543	270

Table 4.7 *Decrease in the number of interviewed children in Bryan-Brown and Harland (1999)*

The membership of the Children's Traffic Club has a higher take-up rate (62%) than observed in previous British evaluations, but the take-up varies with socio-economic status. Children coming from high-income families have a higher probability of becoming a member of the traffic club than children from low-income families: 71% of children in higher income families became members of the traffic club compared to 53% of children in lower income families. Over time, the proportion of parents using the Children's traffic club books decreased from 74% for Book 1 to 18 % for Book 5. The authors explain this decrease by the parents' loss of interest.

Although some significant differences were found in favour of the experimental group, it must be noticed that although significant, in most of the cases those differences are not larger than a couple of percents:

1. More parents in the member group have taught their child to hold hands when crossing the road (97% versus 95%);
2. More parents in the member group have shown their child how to cross the road (97% versus 95%);
3. More parents in the member group have taught their child road safety by going through books with them (67% versus 31%);
4. More children in the member group know that they need to think before crossing the road (12% versus 7%);
5. More parents in the member group always get their child out of a car on the pavement side (54% versus 50%);
6. Parents in the member group are more likely to use protected crossings (81% versus 50%);
7. Among children who do go out in the dark, a higher proportion wear conspicuous (53 % versus 42%) and reflective clothing (15% versus 13%).

But it has to be added that the control group showed safer behaviour in other situations:

1. More parents have taught their child to take care at driveways (58% versus 53%);
2. More children in the control group could identify a motorcycle (96% versus 94%);
3. More children in the control group said they should look for cars before crossing a road (76% versus 73%);
4. More parents in the control group said their child always holds hands when walking along a residential street (56% versus 59%).

The report concludes with the remark that because of the methodological limitations, it is difficult to assign the casualty reductions to the introduction of the Scottish club. However, along the same line of reasoning there is nothing in the reported behavioural and knowledge data that suggests that the Scottish club does *not* reduce child casualties.

Since 1995, when the Children's Traffic Club in Scotland was established, the number of children registered as members has been decreasing. In order to compensate for this decrease and to increase the effect of the traffic club activities, the complementary resource 'Pack for use by nursery schools and playgroups' was developed in 2001.

An evaluation study was done by Graham et al. (2003) in which personal and telephone interviews were combined with a postal survey, and nursery and playgroup staff were drawn from over 200 nurseries throughout Scotland. Also interviews were held with local authority Nursery Advisers and Childcare Partnership Coordinators.
About 80% of the nurseries and playgroups contacted were aware of having the Pack. About the half of those who reported having received the Pack, were using it. They regarded the Pack as a useful resource to support and complement the work they already do on road safety. 70% of the nurseries and playgroups using the Pack, find that it has a positive effect in raising awareness of the Children Traffic Club among teachers, children and parents.
However, because of the absence of an evaluation study on its effects, the actual effects of the Pack on members of the children traffic club remain unknown.

4.3.4. *Effectiveness of Traffic Clubs*

When assessing the effects of traffic clubs, it is particularly difficult to take into account the fact that members of traffic clubs are parents who joined on a voluntary basis and probably are very interested in safety of their children. The control group is selected by researchers from non-members. Although it would be advisable to draw the control groups also from those who volunteered to join in order to avoid the selective participation bias (OECD, 1986), this was not the case in any of the investigated studies. Therefore, the found effects of traffic clubs should be treated with caution.

We already mentioned problems associated with the fact that only a proportion of eligible parents actually enrol their children and that the membership is more frequent in the higher socio-economic group. At the same time, crashes are overrepresented among lower socio-economic groups. The association between low socio-economic group and increased risk is reported by many authors and in many countries (Christie, 1995). Differences in pedestrian crash rates were sometimes about five times higher. Therefore, the positive result of traffic clubs must be questioned because of the earlier mentioned selection bias of its members. One cannot ignore the possibility that positive effects are not caused by the traffic club, but that those parents who enrol their children in traffic clubs are already more 'road safety conscious' and responsible.
Furthermore, although parents receive materials and information on what to do with their children, they are not supported or monitored in their activities

during the programme, and therefore any control in that sense does not exist.

These are just some of the issues that make it difficult to draw conclusions about the effectiveness of traffic clubs. Different studies are not unanimous about the effectiveness of traffic clubs. Although some of them are positive about the effects of traffic clubs on road safety, one have to bear in his mind that the data is mostly obtained from self-reporting and by evaluating the acceptance and attractiveness of the resources used. Even when the positive effect of the Traffic club on children's knowledge and behaviour is shown, the question of their relation to the crash rate still exists. Even one of the rare studies that used crash rate as the evaluation criterion (Gregersen & Nolen, 1994), found contra (i.e. negative) effects of the traffic club with traffic club members having higher traffic crash rate than non-members.

Considering all the discrepancies in the reported effects of traffic clubs and the limitations of the applied evaluation strategies, it is not possible at this point of time to reach a conclusion about the effectiveness of the traffic club form of education.

Study	Year	Traffic Club	Target group	Design	Sample size	Evaluation criteria	Effects	Limitations
West, Samons, West	1993	GAERTC (Eastern England)	Children 3 to 5 years old	Experimental and control group; Pre-test with post –test one-year later	1) Experimental group: 459; Control group: 573; Total sample: 1032 2) Experimental group: 799, Control group: 802; Total sample: 1601	1) Knowledge	(0)	– Self-reports (interviews), no direct observations – Effects of socio-economic group regarding knowledge and behaviour were grater than effects of traffic club
						2) Self-reported behaviour	(0) No evidence for affecting road-crossing behaviour (+) Increased attempt of parents to teach children about road safety; decreased running on ahead of children when walking with parents	
						3) Attitudes	(+) Traffic club material was favourably received; 55% registered as members	
Gregersen, Nolen	1994	Children's traffic club (Sweden)	Children 3 to 7 years old	Experimental and control group	Experimental groups: 777, 761, 732 Control groups: 532, 518, 491 Total sample: 1309, 1279, 1223	1) Crash rate	(-) Crash rate higher for members when cycling included (0) No difference when cycling excluded	Data obtained through questionnaires answered by parents (no observations)
						2) Behaviour: exposure to traffic, teaching of road safety, use of safety equipment)	(+) Members spent less time in traffic environments (+) More members received traffic teaching and training from parents (+) Members used safety equipment more often	
Bryan-Brown, Harland	1999	Children's traffic club (Scotland)	Children 3 to 6 years old	Experimental and control group; Pre-test and five post-tests a post-test every six months	Experimental group: 684…. 543 Control group: 277…270	1) Knowledge	(+) More parents have taught children road safety (+) More parents were likely to use protected crossings *(But for some types of safe behaviour, the control group scored better)*	Data obtained through interviews with parents and children (no observation)
						2) Behaviour		
						3) Attitudes		
(0) no effect, (+) positive effect and (-) negative effect								

Table 4.8. *Overview of the main characteristics of the analysed children's traffic clubs.*

4.4. Effectiveness of other reviewed road safety education programmes

Other than studies about traffic clubs, there were seven more studies about road safety education programmes for children. The basic characteristics of the analysed programmes are given in *Table 4.9.*

This report focuses on studies of effectiveness of road safety education programmes carried out after 1995, in which evaluation data was reported. This last criterion was the main limiting factor for the number of studies that were reviewed. It is evident that the number of good evaluation studies of road safety education programmes is more than modest and that further research in this direction is badly needed.

4.4.1 Study and country

The vast majority of analysed studies came from the United Kingdom. Although limiting our search to material written in English influenced this result, the dominance of English studies in this field is evident. Therefore, the results of road safety education programmes evaluations are mostly limited to the problem approaches and conditions which are characteristic for the UK. These results are in line with findings of some previous reviews of safety education (Duperrex et al. 2002) where twelve of the fourteen included studies, were from English speaking countries (seven from the UK). This result is even more significant knowing that Duperrex et al. did not make any language restrictions. All the studies came from highly-developed, high-income countries.

4.4.2 Target group

When searching for studies on children aged 3-11 years of age to be included in this review, it became apparent that studies about the effects of road safety education for other targeted groups are extremely rare. Once again, this is in line with the finding of Duperrex et al. (2002) who, other than fourteen studies with children (aged 3 to 11) as a target group, found only one study that targeted another group i.e. institutionalized adults. Mostly, targeted children are not older than 11 years, which is the age that in most countries marks the end of primary school. As mentioned earlier in the chapter about development, it seems that teenagers (adolescents) are not the primary focus of road safety education.

Study and country	***Target group***	***Sample size***	***Intervention***	***Design***	***Evaluation criteria***	***Effects***	***Long-term effects***
Tolmie et al. 2003 United Kingdom	Children 6, 8 and 10 years old	Total 279 (Experimental group: 172, Control group: 107)	Computer-supported practical training in designated crossing; groups made of 3 children, familiar with each other, worked with the trainer four 30 minutes-long sessions	– Randomly assigned – Experimental and control group – Pre-and blind post-test 10 weeks after the training	1) Conceptual grasp	(+)	
					2) Behaviour (road-side tested)	(+)	
Platt et al. 2003 United Kingdom	Children transferring from primary to secondary schools	Total of 945, but originally pre-test sample was 1,888 (Experimental group: 517, Control group: 428)	"Make choice" programme implemented at school and at home with parental involvement but *no data How, when and how often programme was implemented)*	– Experimental-control group – Pre-and post-test	1) Attitudes	(+) Greater level of personal responsibility	
					2) Knowledge	Not conclusive	
					3) Teachers' responses	(+) On scale 1 to 5, where 1 is excellent and 5 is poor, scored 2	
Clayton et al. 1995 United Kingdom	Children 8-11 years old	At pre-test: 1,222 At post-test 1: 980 At post-test 2: 910	The five-items resource taught at school for 5-6 weeks with teachers having freedom to decide how they would teach the programme	– Experimental and control group – Pre-test- with two post tests	1) Knowledge		After 4 months (post-test2) some effects were retained, but there were also changes observed in the control group (possibly maturation effects)
					2) Attitudes		
					3) Teachers responses		
Zeedyk et al. 2001 United Kingdom	Children 4-5 years old	120	Only one 20 minutes- long session with three types of classroom-based training methods: 1. Play-mat model 2. Board game 3. Discussion with help of illustrated posters and flip-chart materials	– Experimental and control group – Pre-test with two post-tests	Knowledge (about safe and dangerous locations)	(+) All three types of training methods were effective with the type of instruction being not significant; the degree of improvement was small	6 months after post-test 2, the effect was retained

Study and country	*Target group*	*Sample size*	*Intervention*	*Design*	*Evaluation criteria*	*Effects*	*Long-term effects*
Thomson 1997. United Kingdom	Study 1: Children 5 years old	Not reported	Individual training of six training session each 30 minutes long: 1. At the roadside 2. On a table-top model in the classroom	– Experimental and control group – Pre-test with three post-tests	Behaviour (road-side test)	(+) Up to 70% of constructed routes were safe routes	– 2 months after post-test 2 there was a significant deterioration – 8 months after post-test 3 there was small but non-significant deterioration
	Study 2: Children 5 years old	Not reported	Training of children in groups of five: 1) At the roadside 2) On a table-top model	– Experimental and control group – Pre-test with two post-tests	Behaviour (road-side test)	(+) Up to 36% of constructed routes were safe routes	2 months after post-test 2 there was no deterioration in the level of performance

Study and country	*Target group*	*Sample size*	*Intervention*	*Design*	*Evaluation criteria*	*Effects*	*Long-term effects*
Schagen and Rothengater 1997. The Netherlands	Children 7 years old (pupils of the first grade of primary school)	Total of 89	1. Classroom instruction module 2. Behavioural training 3. Combined training	– Experimental and control group – Pre-test and post-test	1) Knowledge (traffic knowledge test)	(+) All three experimental groups had significantly better results than the control group, but no differences between three experimental groups	
					2a) Behaviour – pre-crossing behaviour at the curb	(0) No effect (ceiling effect?)	
					2b) Behaviour- crossing behaviour on the road	(+) All experimental groups differed significantly from the control group, but there were no differences between experimental groups (i.e. teaching method was not significant)	

Study and country	***Target group***	***Sample size***	***Intervention***	***Design***	***Evaluation criteria***	***Effects***	***Long-term effects***
Cross and Stevenson 2000. Australia	Children 6-9 year old	Total of 1,603 (535 high intervention group, 514 moderate-intervention group, 554 comparison group) *Originally the study started with a sample of 2,356 children*	The Child pedestrian Injury prevention Project (CPIPP)- each year (for three years) school- and home-based pedestrian skills training in a real road environment that comprised nine 40-minutes safety lessons and nine home activities, three year in a row	– Experimental and comparison group	1) Knowledge	(+) Significant improvement in knowledge in the first two years	At post-test 2, one year after post-test 1, and two years after the programme, the knowledge had disappeared
					2a) Road-crossing behaviour 2b) Road playing behaviour	(+) Experimental group reported safer road-crossing and road playing behaviour	Although the experimental group reported safer behaviour, risk taking behaviour increased for all groups from the first to the third year of the project

Table 4.9. *Overview of the main characteristics of the analysed road safety education programmes*

4.4.3 Sample size

The reviewed studies vary in sample size (not reported for Thomson, 1997) from 89 to over 1,600. There are several problems regarding sample size. First, very often, large numbers of participants are lost in the follow up. The percentage of lost participants can go up to 50%. In Gregersen and Nolen (1994) 2,171 participants received questionnaires, but the final sample was 1,223. Cross et al. (2000) originally started with 2,356 children, but at the end they finished with 1,603 children. The pre-test sample of Platt et al. (2003) was 1,888 children, but only for 945 children it was possible to match pre-post-test data.

Second, the problem is not just the decrease in the number of participants during the implementation or evaluation of the program. This is a minor issue as long as the final sample is big enough to allow valid conclusions. The major problem may be the selective nature of the decrease, losing particular subgroups in the sample. In Gregersen & Nolen (1994) the problem was not only general non-response, but also that the non-response share was different for the experimental and the control group. A similar pattern was seen in the Bryan-Brown and Harland study (1999) where the experimental group changed its size from 684 at pre-test to 543 (80%) at the last post-test. At the same time, for the control group the size went from 277 to 270 (97%). Some of the authors report this as a problem and a potential 'result-polluting' factor. Other researchers do not report any data on the loss of subjects during the study, so that it is impossible to take into account the potential relation between the sample-size, the drop-out rate and the effects of the programme.

4.4.4 Intervention

This type of data refers to the programme itself. Again, different authors choose for different ways of obtaining data about implementation of the educational programmes. Cross et al. (2000) collected different measures of classroom as well as parental programme implementation such as teacher's log, assessment of student workbooks, self-reported questionnaires. It seems more than logical that data about the implementation of the programme is crucial for assessment of the effectiveness of the programme (e.g. was the programme implemented as it was intended, and if not, why, how, and to what extent was programme implemented, etc.). However, the absence of information on this subject in evaluation studies indicates that not everyone shares this opinion.
Some of the authors (e.g. Platt et al. 2003, Clayton et al. 1995) did not even attempt to check various aspects of the implementation, as there was no data on how on the programme was actually implemented in comparison to how it was intended to be implemented. So for example, Clayton et al. left it to the teachers to decide how to teach their five-item resource for children 8-11 years old.
Platt et al. did not have any control over parental and children's commitment, and also schools were highly independent in their decision how, when and how often to use educational resources. The results in such cases do not

say much, if anything at all, about the effectiveness of such implemented programmes.

4.4.5 Design of the studies

Our findings for this category are in line with those of Duperrex et al. They found that the studies are not of the highest general methodological quality and we already commented on some of the methodological aspects like sample size, attrition rates, and selective nature of attrition. Although each of the reviewed studies reported use of experimental and control groups, randomization in selection and in the assignment were rarely encountered. In some of the cases, the control group was only post-tested so there was no real pre-post-test match (Zeedyk et al. 2001). Regarding post-testing, only one study (Tolmie et al. 2003) mentions blind post-testing. There are no common time-criteria for post-testing. The time varied from immediately after, to 8 months after the intervention.

4.4.6 Evaluation criteria

The validity of some of the evaluation criteria which were used with respect to their relation with the reduction in the number of crashes (or crash rate) as an ultimate criterion of road safety has already been questioned in the previous chapters. Nevertheless, the reviewed studies do not deviate much from the general tendencies in use of different evaluation criteria. If all criteria are considered, knowledge and (self reported) behaviour are equally present (both approximately in 33% of cases) followed by the attitudes (15%). Only in one study (Gregersen & Nolen, 1994) crash rate is used as an evaluation criterion for the effectiveness of road safety education programmes. Although the rising tendency of using behaviour as an evaluation criterion is apparent, it must be said that in half of the cases it is still the self-reported and not the observed behaviour of the participants.
Tests that are used to measure the evaluation criteria are numerous. There is no common agreement or standard to determine which of the tests should be used for different criteria. It is very common that authors make their own tests for evaluation but in most cases, data about validity and reliability of those tests is not reported.
Some studies (e.g. Platt et al. 2003) rely strongly on views and opinions of those in contact with programmes (teachers, parents, pupils). Although views and opinions of those involved with the programme can be significant for its success, they cannot substitute more direct information and should be regarded as supplemental information about the effectiveness of the programme.
Once more, it has to be emphasized that there is an evident need for further investigation and clarification of relations between different evaluation criteria.

4.4.7 Effects

The final discussion concerns the reported effects of the reviewed road safety education programmes. The effects of the reviewed programmes varied considerably in size and also depended on the evaluation criteria which were used. Comparing the effects of different programmes is difficult because of the across study differences in the types of intervention and the types of criteria that were used. Because the relation between the criteria

used and the reduction in the number of traffic crashes is not always clear, it is not possible to draw a general conclusion about whether road safety education reaches its the ultimate goal.

Elvik & Vaa (2004) also investigated the effects of road safety education by conducting a meta-analysis of a very limited number (seven) of available studies that quantified the effects of pre-school and in-school education on the number of traffic crashes of children. The available Scandinavian studies on the effectiveness of the road safety education of pre-school children (0-6 years) gave conflicting results that could be a consequence of the weaknesses in study methods. On the other hand, it appears that training children aged between 9 and 12 in the right way to cross a road leads to fewer crashes.

Regarding other evaluation criteria, it can be concluded that road safety education programmes changed knowledge, behaviour, and attitudes of the target group. However, as mentioned above, the relation between these changes in knowledge, attitudes and behaviour, and traffic crashes is still poorly understood.
In our opinion, the study of Tolmie et al. (2003) is an example of a programme that performed all steps required in its development and evaluation. As an example of seriously planned, developed, implemented and evaluated road safety education programme, a detailed description of this programme is given below, while the remaining road safety education programmes are discussed in the *Appendix*.

4.4.8 A 'good' road safety education programme

An example of a 'good' road safety education programme is described in Tolmie et al. (2003), *Training children in safe use of designated crossings*. Objectives of this programme were to:

1. Conduct a task analysis of each of three main types of designated pedestrian crossing, pelicans, zebras and signalled junctions with a pedestrian phase, and on this basis to develop detailed specifications of crossing strategies or safe patterns of behaviour for each type.
2. Develop software for computer-supported practical training of primary school age children in safe use of designated pedestrian crossings, taking use of these strategies and an understanding of their purpose as the goal of learning.
3. Establish the baseline performance and conceptual grasp of children aged 6, 8 and 10 years, relative to adults (by means of roadside testing on each of the three crossing types).
4. Evaluate the effectiveness of the computer-supported training in designated crossing by post-testing children to measure changes in performance and conceptual grasp, and comparing these changes with those exhibited over the same period by untrained control samples of the same age and background.

4.4.8.1 Development of crossing strategies

Strategies for each of the three classes of designated crossings were devised on the basis of task analysis of the logical sequence of actions required to execute a crossing in an ideally safe fashion. Given the range

and diverse nature of designated crossings, the authors formulated four considerations which guided the process of strategy development:

- The strategies had to be as internally consistent as possible to prevent those elements in strategies for different crossings conflicting with each other and to enhance a shared common structure;
- Each strategy focused on a clearly specified set of actions together with the order in which these actions should ideally be executed;
- Strategies had to embrace flexibility to some extent and not to consist of rigid rules;
- Strategies had to be taught together with other aspects of traffic decision-making.

Each strategy actually represented a relatively long list of actions (19 elements for pelican crossings, 14 elements for zebra crossings, and 18 elements for junctions with pedestrian-called phase) or 'desired behaviour elements', coupled with appropriate conceptual issues. These conceptual issues focused on children's conceptual understanding of the purpose of actions taught.

4.4.8.2 Software for computer-supported practical training

The software, or rather, the computer-based material for this training programme was developed according to the design principles defined in Tolmie et al. (2003). The software was to be used by small groups of children (ideally three) that work with an adult trainer. The trainer is helped by the guidance on key points. The task structure enables children to take the lead in decision-making and to be involved in child-child discussion. The software consists of four sets of simulated traffic problems, each set to be used in one training session. A set is in the form of a general travel objective that has to be accomplished by an on-screen character. The task of the children is to select the route they think is the most appropriate one and to help the character to navigate the route safely. Each route includes four or five designated crossings and only these kinds of crossings are used; other types of crossings are omitted. At each crossing point, children are required to determine what things the character needs to do and in what sequence. This has to be done both preparatory and during the crossing. The feedback is provided in such a way that it is not possible to proceed further if some crucial actions are not performed. In that case the whole sequence has to be repeated. For some actions, it is the trainer who gives feedback. The trainer encourages children to discuss and agree on the steps the character needs to take. Also, the trainer encourages children to consider any issue they forgot to consider. In this manner, is the children not just learn the actions and their correct sequence, but they also get a generalised conceptual grasp of each type of crossing.

4.4.8.3 Evaluation methodology

Experimental design

Tolmie et al. used a 'Test - Intervention/Control- Re-test' design where children were individually pre-tested and randomly assigned to intervention (training) or control (no-training) group. Post-test took place ten weeks after the training, and the same procedure as for pre-testing was used. Both pre- and post-testing took place at the roadside.

Participants
A total number of 279 children were divided over the two locations. At the first location, West Dunbartonshire, there were 133 children (89 in the intervention group and remaining 44 in the control group) from a deprived area on the outskirts of Glasgow. The children were from three age groups, 5-6, 7-8 and 9-10 years old. At the second location, Gateshead, 146 children from a slightly less deprived area (83 in the intervention group and 63 in the control group) were included in the study. The adult sample consisted of 24 people older than 21.

Training procedure
Children in the intervention group were divided into groups of three. Each group was from the same class so that the children were familiar with each other, which is important for collaborative activity. Children from the given schools always worked with the same trainer. The training sessions lasted between 20 and 30 minutes each, with an approximate frequency of one session per week.

Testing materials and procedures
All the children were roadside tested on the same three types of designated pedestrian crossings (pelicans, zebras and junction traffic lights with pedestrian-called phase) before the training, and again approximately 10 weeks after training had finished. In behavioural testing, the observation sheets were used that presented a step-by-step checklist of the behaviour that would be evident in an ideally safe crossing. The lists were based very closely on the developed strategies and there was a checklist for each type of crossing. Children were tested on one type of crossing at a time and the order of testing on each crossing type was randomized across the sample. Also, children responded to a series of questions addressing central conceptual points about each type of crossing. For each type of crossing, conceptual measurements were taken after behavioural testing.

Pre-test results show how well children performed prior to training. Data obtained by pre-testing can serve as a base to determine which aspects of crossing behaviour need further and more intense training and, also, pre-test results serve as a base line against which the effects of training can be evaluated.

It is important to mention that the authors chose for blind post-testing. The researchers post-tested only those children they had not trained and so they did not know whether the child to be tested was trained or not (i.e. whether child to be tested came from intervention or control group).

Data from adults was gathered in the same way.

4.4.8.4 Evaluation results

The evaluation results will be given for pelican crossings only; the results for the other types of designated crossing are similar. The evaluation method and results obtained in the study by Tolmie et al. are, in our opinion, the illustration of how good evaluation should be performed, what kind of measurements can be taken and how to establish possible relations between different measurements.

Pelican crossings (pre-test results)
There was no difference between intervention and control groups in pre-test results. Significant differences were found between different age groups, on both behavioural and conceptual measurements, with older children performing better than the younger children.
In spite the existence of age trends, even young children performed well on behaviour such as taking up position by the request button (0.91), pressing the button in order to call green man (0.83), and walking at an appropriate speed while crossing (0.75)[4]. But the authors call for cautiousness. Some of these high results could be due to the fact that the children were accompanied while performing and therefore probably showed their best behaviour.
On the other hand, children performed many aspects of crossing behaviour very poorly and in some cases required behaviour was not displayed at all. Even 10 year old children were very poor in perceptual search strategy judging by the following results: keep looking right till all salient traffic stops 0.24, keep looking left till all salient traffic stops 0.23, looking right again to double check 0.06. The results of the six-olds were even poorer: 0.10, 0.09 and 0.04 respectively.

In general, when individual behavioural elements were divided into three phases: 1) an approach/set-up phase, 2) a looking phase, and 3) a crossing phase, the looking phase scores are the weakest scores in the pre-test phase for all age-groups, especially for looking in the correct order. All three age groups have a mean of zero on this measure.

- When *comparing behavioural performance pre- and post-test results*, the post-test performance of trained children was significantly better in all three age groups. They improved significantly more than children in the control group, which shows that training was effective. It has to be said that children in the control group also improved their performance and that this effect was inversely proportional to age (younger children improved their performance the most) while in the intervention group all three age groups improved to about the same extent. Improvements of looking behaviour, which had the lowest pre-test results, were the largest: trained children were about twice as likely to perform any element of looking behaviour as in the pre-test.

- When *comparing pre- and post-test conceptual measurements,* all three age groups of trained children achieved significantly higher scores than children in the control group, and again the average improvement was the same for all three groups. Children in the control group improved slightly on post-test conceptual measures, but this improvement did not correspond to the improvement on behavioural measures. Control group children improved their behaviour, but 'the understanding of the importance of this behaviour' did not improve.

- It is interesting that Tolmie et al. investigated *the correlation between results on pre- and post-test between behavioural and conceptual performance.* The underlying assumption is that a good training programme will improve the relation between behaviour and the understanding of this behaviour. This will lead to a higher statistical correlation at the post-test and therefore it was expected that children

[4] Scores represent the mean proportion of children exhibiting the target behaviour

who performed well on behavioural measurements would perform equally well on conceptual measurements. In line with these expectations, results of Tolmie at al. show that correlations were relatively low at the pre-test (trained group 0.30, control group 0.45). At the post-test, the correlations increased in the trained group (from 0.30 to 0.55) but in the control group, which had an initial advantage at pre-test correlation (0.45 compared to 0.30), it even decreased slightly (0.44 at post-test compared to 0.45 at pre-test).

	Pre-test	Post-test
Control group	0.45	0.44
Trained group	0.30	0.55

Table 4.10 *Correlations between behavioural and conceptual measurements at pre- and post-test for control and trained group found by Tolmie et al. (2003)*

These results indicate that the training programme improved the link between behaviour and understanding of the importance (significance and purpose) of this behaviour.

- *Comparing the performance of children to the performance of adults* gives the information on the improved performance of children compared to that of adults, and indicates where further improvements can be expected. Post-test performance of children drew much closer to the adult level of performance, in behavioural and even in performance measurements. However, 'conceptual understanding' is an area where there is a real difference between adults and children. At the same time, this is the area where further improvements can and must take place. Just looking at the adult level of performance, it is interesting to see that the trend observed in children, also applies to adults. When comparing the performance of adults during the three phases of the crossing task, once more it is the looking phase that scored lowest.

When the results for all three types of crossing are taken together, some general conclusions about the effects of this training programme can be given:

- The poor performance of children on the pre-test makes it clear that training in the use of designated crossings is necessary. The difference in pre-test performance existed between different types of designated crossings with best results on zebra crossings, then pelican crossings and finally junctions.
- The training programme of Tolmie et al. worked. All three age groups of children improved in both behavioural and conceptual performance and behaved more safely and strategically after the training. This is a significant result, bearing in mind that the training programme consisted of only four 30 minutes sessions on a computer.
- Nevertheless, one should bear in mind that Tolmie et al. used only one post-test, ten weeks after the training. Therefore, as long as the kind of long term post-testing (e.g. one year after the training) is not carried out, the long terms effect of this training programme are unknown.

- Improvements on all three types of crossings were approximately the same. However, bearing in mind the different levels of performance which depended on the type of crossing as a starting point, the post-test level of performance on the three types of crossings mirrored the pre-test results. Both pre-test and post-test had the same order of scores: zebras, pelicans and finally junctions.
- Performance of children in the control group also improved between pre- and post-testing. The authors explained this finding as a consequence of the fact that children had to make 24 crossings just for pre- and post-testing, which represented a kind of practice for these children. Additionally, it seems that designated crossings make it relatively easy to deduct the best way of crossing.
- Tolmie at al. conclude that additional attention during training is necessary for the following points:
  1. Additional training is useful for *junction crossings* with the lowest pre- as well as post-test results, compared to other two types of crossings;
  2. *Perceptual search behaviour* demands an increased emphasis during training as well as conceptual elements that are coupled with it;
  3. *Conceptual understanding* as a whole, asks for more attention because it remains continuously behind behavioural performance.

4.5 Conclusions

Often, road safety education programmes are not followed by thorough, or even any kind of, evaluation. Although the inclusion criterion for the road safety education programmes selected here was that they had to provide at least some kind of evaluation data, the approaches, techniques and evaluation methods that were used varied significantly between the programmes. Although each of the programmes included a control group in the research design, there was often no randomization.

The assessed educational programmes originated from high-income countries, mostly from the UK, with children as a target group. Sample sizes ranged from 89 to 1600 children with sometimes high and even potentially selective attrition. Information about the way that the programmes were implemented was often limited. Changes in knowledge and self-reported behaviour were equally often used (33%) as outcome measures. The only criterion related to traffic crashes was the crash rate and it was used in only one of the assessed educational programmes.

The diversity of programmes and, above all, the diversity and weaknesses of evaluation procedures, did not allow drawing a general conclusion about the effectiveness of the programmes assessed here. However, in consideration of the evaluation criteria used, analysed programmes brought changes in knowledge, behaviour and attitudes of their target groups. The robustness and durability of these changes as well as a general increase in road safety of those children still remains to be seen.

5. Education in other prevention fields

5.1. Introduction

The problems of evaluation and effectiveness are not exclusive to the field of road safety education. Similar problems, difficulties and 'flaws' in the evaluation process can also be found in health education fields like drug and alcohol use prevention, AIDS-risk reducing programmes, mental health promotion, et cetera. Nevertheless, we consider experience in other educational fields helpful for learning about the good practice evaluation and the probable ingredients for effective educational programmes.

Because the educational programmes in the fields of health education were not the primary concern in this study, several review articles have been used in this chapter.

5.2. Some characteristics of evaluation of programmes in other educational fields

5.2.1. *Alcohol and drugs*

Elmquist (1995) reviewed 22 instructor-led parent-oriented programmes whose objective was to prepare parents for preventing their children's use of alcohol and other drug. 120 criteria, grouped in five main topics were chosen to conduct this review. The results for the criteria in the 'Evaluation' category are presented in *Table 5.1.*

The results of the Elmquist review are striking. Almost half of the reviewed programmes were not evaluated at all, and none of the evaluated programmes was long-term evaluated or evaluated in terms of implementation. Here implementation refers to evaluating the extent and thoroughness of programme delivery and the extent to which all participants received the full programme.

Breslin et al. (1997) reviewed 61 alcohol *treatment* (not prevention) outcome studies published between 1989-1993 .The status of the recent alcohol treatment outcome methodology has been compared with previous surveys of studies published between 1980-1984 and between 1976-1980. This review is very useful for getting the general picture of the methodological issues and problems which are frequently encountered. The general conclusion of Breslin et al. is that because of the large variability in the amount and quality of pre-treatment data and the types of outcome measures reported, meaningful comparisons among studies are nearly impossible. Among alcohol treatment studies there is no consensus about the use of instruments for assessment of the pre-treatment drinking and the severity of dependence, nor is there consensus about the battery of non-drinking measures. The lack of comprehensive pre-treatment data remains a serious problem and self-reports are the most common source of data (used in 91.8% of studies). As in the previous surveys, the general finding of the review of alcohol treatment research literature is the lack of methodological robustness.

	Percentage of programmes that assessed certain criteria
I Evaluation	
A. No evaluation	45.5
B. Participants evaluate (user satisfaction)	22.7
C. Short-term evaluation	
1. Pre-test and/or post-test	4.5
2. Regular assessment	0
3. Outcomes evaluated	36.4
Participant awareness	18.2
Knowledge gains	18.2
Attitude changes	13.6
Behavioural intentions	13.6
Behavioural changes	9.1
D. Long-term evaluation	0
E. Implementation- fidelity of delivery	0
II Methods of Evaluation (Assessment)	
A. No methods of evaluation are specified	45.5
B. Self-Report (retrospective)	27.3
C. Criterion referenced assessment	18.2
D. Rating scales (participants evaluate session)	18.2
E. Rating scales/checklists (retrospective)	9.1
F. Normative referenced assessment	0
G. Self-recording as behaviour occurs	0
H. Direct observation and recording	0
III Research/Field Tests	
A. No research or field tests reported	45.5
B. User testimonials	27.3
C. Pilot/Field Tested	22.7
One group field test (pre-post)	9.1
Controlled study (outcome of expand control. Groups is evaluated)	4.5
Controlled study (exp and control groups are evaluated according to specific objectives)	0
Data included with the program	0
D. Celebrity testimonials	18.2
E. Marketing research	13.6
F. Expert appraisal	13.6
G. Publisher testimonials	0
Categories are not mutually exclusive	

Table 5.1 *Percentage of programmes that assessed criteria in the category Evaluation (Elmquist, 1995)*

A similar review, but this time on drug treatment outcome studies published from 1993 to 1997, was performed by Ellingstad et al. (2002). A comparison with Breslin's et al.'s (1997) most recent methodological review of alcohol treatment outcome studies has also been carried out. The authors conclude that the drug treatment outcome studies are methodologically weak. Of the 117 articles that met the fist inclusion criteria for reviewing, 76.1% were excluded because they presented little or no follow-up data to support their declaration about treatment effectiveness. 71.4% of the reviewed drug studies do not report on post-treatment drug use and it is difficult to understand how effectiveness of the treatment can be evaluated in this case. As in the case of alcohol studies, there is no accepted standard set of variables that should be used in substance abuse treatment outcome studies, which makes it difficult to compare the effectiveness of different studies. Furthermore, the drug studies report the follow-up attrition rates significantly less often. Only 7.1% of the drug studies present follow-up data for 18 months intervals (3.6% for 24 months interval). This non-existence of long-term outcome studies makes drawing conclusions about variability and stability of treatment outcomes impossible.

5.2.2. *Mental health*

Studies in which changes in the mental health of children who took part in a programme were compared with changes in children, who did not, were reviewed in Wells et al. (2003).
Similar to other intervention fields, there is a large difference between the number of studies that was found in a first search and the number of studies that was included after review. In this review, eight inclusion criteria were used:

1. an unambiguous description of the aims of the intervention;
2. the reporting of the numbers of groups or subjects;
3. the allocation methods and the comparability of groups;
4. details about the intervention and outcome measures;
5. recording and accounting of loss to follow-up;
6. description of outcome measures including data about their validity and reliability;
7. clarity and precision of analysis and results;
8. adjustment for design effect.

The result of the first search was 8 000 publications of possible interest, 425 were used for further review, and only 17 studies met all of the inclusion criteria. The discrepancy between these numbers shows how small a proportion of research meets basic criteria needed to enable proper evaluation. In the field of mental health interventions, the problem of defining the most suitable outcome measurements (i.e. evaluation criteria) is also frequently encountered.

5.2.3. *AIDS prevention*

Another significant large group of educational programmes is in the area of AIDS risk-reduction interventions. What is the current state of the programmes in this group? It seems not very different from other discussed groups of programmes. In Kim et al. (1997). 40 AIDS intervention studies from the period 1983-1995 targeting adolescents were reviewed in order to determine whether these efforts had been effective. The outcome measures assessed were, as in other cases, again:

1. *Knowledge*: factual knowledge regarding AIDS transmission, risk behaviours, et cetera;
2. *Attitudes*: impact on attitudes, both increasing positive attitudes toward personal protective behaviour and negative attitudes about risk behaviour;
3. *Intention*: intention of the respondent to use a condom and/or remain abstinent;
4. *AIDS-risk Behaviour*: condom use behaviour, last time or general; sexual abstinence; number of sexual partners.

Once again, it is the outcome measure 'changes in knowledge' that is most frequently used to assess the effectiveness of the programme and again, the positive impact of interventions is most frequently found on this outcome measure.

5.3. Summary of the findings about the evaluation of educational programmes in other fields than road safety

Based on the results of various reviews on the evaluation of different educational interventions in the fields of drug and alcohol use prevention, AIDS-risk reduction, promotion of mental health et cetera, some general conclusions can be drawn:

1. Although there are large numbers of studies about various educational programmes, all reviews found a limited number of studies that could meet inclusion criteria regarding rather basic evaluation data. It seems that well performed evaluation, or even evaluation performed at all, is rather the exception than the rule.

2. Even when some evaluation data is found, it is seldom exhaustive. Most of the studies are methodologically weak (sample size, attrition rates, assignment to the groups, et cetera) and very often no information about the used method is reported.

3. Common criteria for the evaluation of educational programmes do not exist and there are many differences between studies. This makes comparison between studies and drawing valid conclusions about the effectiveness of different programmes difficult.

4. As in road safety education programmes, different programmes in the same educational field use different outcome measures. Relations between measures and educational aims of the programmes are not always established. Nevertheless outcome measures such as knowledge, or rather changes in knowledge, and attitudes still remain the most frequently used outcome measures. Moreover, data about changes in outcome measures is mostly obtained by self-reporting and it is that the self-reported data is very rarely validated by any other data source (even when this data exists and is not difficult to find).

The common message found in almost every document regarding the assessment of effectiveness of educational programmes in various other fields is not different from the message in the field of road safety education. There is a strong need for a better evaluation process and better evaluation data if one wants to draw valid conclusions about the effectiveness of different educational programmes.

5.4. What is effective in other educational fields?

Because of the varying quality of the evaluations which were carried out, establishing the effectiveness of various educational programmes is a challenging task. Nevertheless, some characteristics of possibly effective educational programmes have been identified.

5.4.1. *Education on sex related risks*

The already mentioned review of Kim et al. (1997) concluded that interventions which demonstrated an increase in condom-use and a decrease in the number of sexual partners were significantly more likely to be theory based and that they were longer in duration than the interventions that did not have this outcome.

Yamada et al. (1999) named the following five features of effective primary prevention programmes for preventing sexually transmitted disease in adolescents: theory-based design, communication of facts about sexually transmitted disease, skill-building exercises, use of trained facilitators, and a duration of at least 8 hours.

Similar are the findings of Kirby et al. (1994) regarding the effective programme characteristics of school-based programmes for reducing sexual risk behaviour. Kirby et al. found the following effective programme characteristics:

- Narrow focus on reducing sexual risk-taking behaviours;
- Use of social learning theories as a foundation for programme development;
- Going beyond the cognitive level by focusing on recognizing social influences;
- Changing individual values;
- Changing group norms and building social skills;
- Providing basic and accurate information about the risks;
- Reinforcing clear and appropriate values to strengthen individual values and group norms;
- Providing modelling and practice in communication and negotiation skills.

Although the authors identified these common characteristics of effective programmes, there is very little evidence regarding which factors, or combination of factors, had a positive impact on the *sexual behaviours* measured. At The British Medical Association and Sex Education Forum seminar in 1996 (http://www.scre.ac.uk/resreport/pdf/080.pdf), the following characteristics of programmes have been found to be effective in terms of behavioural and health outcomes:

- Focusing on specific behavioural objectives (e.g. delaying intercourse or using condoms);
- Having a theoretical grounding in terms of how action is affected by understanding and beliefs;
- Having a minimum of 14 hours tuition or teaching in small groups;
- Using active learning methods which involve pupils and helping them to personalize information;
- Giving accurate information about risks;
- Addressing social pressure on young people;

- Adopting clear values and messages appropriate to the pupils' age and experience;
- Using activities to practise relevant communication and negotiation skills;
- Adopting effective training for teachers/educators who provide the programme.

Nevertheless, one of the conclusions of this seminar was that only few effective programmes have been replicated or re-evaluated at a later date. Therefore, caution is requested in applying a programme in another, new context or applying it more widely.

5.4.2. *General health promotion*

After assessing the effectiveness of nutrition education, Contento et al. (1995) found that in general, interventions using educational methods directed at behavioural change were more effective than programmes which focused on providing information, and assumed that attitude and behavioural changes would result from it. More effective educational strategies take into account the motivations of particular population groups; they involve self-assessment and feedback and require active participation, as they are based on appropriate theory and prior research.
Fletcher et al. (1997) studied reviews of the effectiveness of school based health promotion where prevention programmes for alcohol abuse, substance abuse, tobacco control, sexual health, and crash prevention programmes were included. Conclusions of this systematic review are that traditional pedagogical health education programmes are effective in increasing children's knowledge of health topics, but do not produce lasting behavioural change. More innovative health programmes are those that can bring significant changes in health behaviour. Innovative health promotion interventions include, in various combinations, training of social skills and resistance skills, the exploration of influences and pressures children feel, activities aimed at building awareness of social norms and establishing group norms and activities involving the use of peer leaders. According to Fletcher et al. the most promising strategy for school based health promotion programmes is likely to be a generic or holistic approach with a core mental health promotion or emotional well-being programme, delivered through the school years, combined with knowledge-based modules on special subject (e.g. smoking, alcohol, drugs, sex, et cetera).

Conclusions of the World Health Organisation (WHO) about the effective components of school based oral health promotion programmes (WHO, 2003) are that school-based interventions are effective when there is long-term sustainable support and commitment from the family, school, professionals and government. Effectiveness is related to the amount of classroom or circular time devoted to the programme, the extent to which the programme is supported, and the commitment of teachers and students. Therefore, according to the WHO, in order to fully integrate oral health promotion activities in the school curriculum, training and professional development for teachers are imperative.

5.5. **Conclusions**

The evaluation practice in other educational fields appears not to be very different from the evaluation practice in road safety education. Experience

with programmes for the prevention of AIDS, drug and alcohol use, mental health, et cetera shows that numerous programmes are not evaluated at all. Long-term evaluation is even more rare. Most of the performed evaluations do not meet one or more basic methodological criteria. A great variability in the amount and quality of pre-treatment data (even if this data exists at all), types of used outcome measures and evaluation instruments exist. Even when it is possible to use outcome measures that are more directly related to behaviour (e.g. the number of people infected with AIDS, the number of people who started or quit smoking, the number of cigarettes smoked per a day, the amount used of the drug, the frequency of use, etc.), changes in knowledge still are the most frequently used outcome measure.

Because of the diversity and difficulties in following the methodological requirements of a good evaluation, it is difficult to formulate a firm conclusion on the effectiveness of various programmes and propose best practice guidelines.

After summarizing the experience with effective programmes in various educational fields, it seems that most of these programmes:

1. are theory-based;
2. are longer in duration;
3. provide basic and accurate information;
4. go beyond the cognitive level by addressing issues of social pressure, communication and negotiation skills, establishing clear values and group norms, etc.;
5. involve some modelling and practice;
6. involve some kind of training for the educators.

6. Conclusions

This review addresses the following questions: how effective is road safety education? Which are the features of a 'good' programme. What is the evaluation practice in road safety education and are there lessons to be learned from current practice? Is road safety education comparable to education in other prevention fields and could the experience from other prevention fields help to improve the effectiveness of road safety education?

6.1. Importance of Road Safety Education

Every country finds road safety education important, and in many countries road safety education is compulsory. It seems that there is a general belief that road safety education works. However, although widely accepted as an unavoidable part of the holistic approach to road safety, the question of the specific effectiveness of road safety education is frequently raised. The most important issues in hindering the progress towards effective road safety education, is the lack of evaluation of road safety education programmes.

6.2. Effectiveness of Road Safety Education

It is impossible to arrive at a general conclusion about the effectiveness of road safety education programmes. There are numerous programmes and there are numerous differences between them regarding various important educational aspects.

6.2.1. *Evaluation practice in Road Safety Education*

In general, the high-quality evaluation data about road safety education programmes, and also about educational programmes in other fields, are not easy to find. Even if there are some well-performed evaluations, the problem of generalizing the results of educational evaluations still remains. Changes in programme, or in the circumstances under which the programme is realised, ask for a new evaluation study to enable estimating the effects of those changes.

When considering all the limitations and obstacles of current evaluations of effectiveness of road safety education programmes, one can even question whether road safety education has the capacity or potential to be effective. It is evident there are still a lot of omissions in evaluations carried out on road safety education programmes that make it impossible to reach firm, reliable, applicable-to-every-case conclusions about the effectiveness of road safety education.

Road safety education programmes are a far from simple matter. They demand a systematic, well-planned approach. There are still many minor questions: not minor by their significance, but minor by the limited scope of the problem. These are questions about the effectiveness of special instructional methods, type of mediators, which tests are the most suitable for measuring effectiveness of programmes on certain evaluation criteria, et cetera.

6.2.2. *Road Safety Education in relation to education in other prevention fields*

Educational programmes in other fields are struggling with similar problems. The problem of performing a good evaluation is not exclusive to the field of road safety education. The limitations of evaluation practice in other prevention fields also prevent straightforward conclusions about the effectiveness of these educational programmes.

6.2.3. *Road Safety Education Programmes – State of the art*

After reviewing the road safety education programmes included in this report, we reach the following conclusions:

- Although there is a great number of road safety education programmes, the number of programmes that is followed by a thorough evaluation which is performed 'by the book' , is rather limited. It is not clear whether this is caused by a lack of knowledge among the researchers, or that it is just going along with the 'common practice' in which evaluation was far from being a compulsory part of educational programmes. Most likely it is a combination of the two, as well as the complexity of the evaluation process itself that makes meeting the requirements so difficult. A good evaluation process requires money, time, good organization, et cetera, to perform such a high-quality evaluation. However, as in almost every study on the effectiveness of educational programmes, we also draw conclusions and recommend further research and improved evaluation designs so that more reliable evidence can be obtained (See *Section 4.2 Evaluations of education programmes*).

- The vast majority of road safety programmes have children as their target group. Road safety programmes for other groups like elderly people, the handicapped, or ethnic minorities, are not so often found. However, data about road accident involvement of, for example, children from ethnic minority groups indicates that they might represent a particularly endangered group. Therefore, it is necessary to recognise the special needs of these groups when developing road safety education programmes that have to be effective in multi-cultural society.

- Most of the road safety programmes focus on children who are not yet in their teens. Road safety education programmes for teenage children, adolescents, do not seem to be not so numerous. A similar trend is also noticeable in the field of developmental theory. However, the accident rates for this age group indicates that they require more attention concerning road safety education.

- Road safety programmes for children are mostly focused on the pedestrian task.

- Most evaluated and published road safety programmes originate from high-income, western countries. The conclusions and recommendations based on these programmes should be taken with certain caution when applied to other parts of the world where different conditions prevail.

6.3. What is effective in Road Safety Education?

Regarding potentially 'effective components' of road safety programmes, the studies and developmental studies reviewed in this report point out that:

- Road safety education should start as early as age of 4-5 and should be continued through primary and secondary school; taking into the account the developmental trends and constraints (see *Chapter 3*).

- Practical training is the most effective, and training should prospect from action to concept. Both the practise and developmental theories support this statement.

- If the classroom instruction is enriched enough with good demonstrations of model behaviour, for instance by means of video, table-top models, et. cetera, and the demonstration makes clear what the model behaviour is, such classroom instruction could draw near the effectiveness of a behavioural training (Schagen & Rothengater, 1997).

- Modern educational methods, in the form of computer-supported practical training for small groups of children interacting with each other, are effective ways of training children. Road-side training could be, at least for a part, exchanged for this type of training (see Tolmie et al. 2003; Foot et al. 1999; Dunbar et al. 1999.).

- No differences were found in the effectiveness of different training methods, such as play-mat models, board game and illustrated posters, in influencing children's road safety knowledge (Zeedyk et al. 2001).

- Individual training, irrespective of whether it is done with roadside training or a table-top model, is superior in its effectiveness as compared to group training. When there are limitations in terms of time and/or instructors, reasonably good results can also be achieved by group training which includes interaction between children (Thomson, 1997).

- Adult-led learning and peer collaboration are particularly useful in road safety education, and the interactivity of learning must not be underestimated.

6.4. Limitations of road safety education

Just like every road safety measure, road safety education also has its limitations. Although human errors are 'responsible' for the vast majority of road crashes, road safety education is only an effective measure if humans make these errors because of the lack of knowledge, insight or skills that could be acquired by education. In other cases, like when errors are made because of the high complexity of the task, education cannot offer the solution.

Even if educated, some people continue to make more errors than others and they seem to be less suitable for some tasks. In these cases, the role of education can be to point out these limitations to such persons and to stimulate them to avoid the dangerous situations that they could not successfully cope with.

Even if people have both knowledge and capability, it does not mean they will automatically behave safely. They also need to be motivated to behave in that way. It is also difficult to change behaviour that has become automatic and these kinds of changes ask a large effort from the person himself (Twisk, 2004).

6.5. Implications for the EVEO evaluation

The current review has provided input for the design of the EVEO evaluation study, with respect to criteria for the selection of potentially strong evaluation programmes, the choice of the evaluation criterion, and the design of the evaluation study. The EVEO study will incorporate well implemented programmes, with clear educational objectives and target groups. Effects are measured using a valid intermediate variable. 'Valid' means that there is a known or logical relationship between behaviour and crashes.
As most projects in EVEO are relatively small, the chosen evaluation design is a pre-test – post-test design with control group. Random assignment to treatment conditions will not be possible and effective. The alternative is to use the pre-test to control statistically for a possible self-selection bias.

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Appendix Analyzed road safety education programmes

Road safety education for children transferring from primary to secondary school (Platt et al., 2003)

The purpose of this research was to develop and evaluate a road safety training/awareness resource/programme to ensure that children have developed the skills required to match the independence they are given when they move to secondary school.
A draft educational programme entitled *'Making Choice'* was developed that consisted of five resources: leaflet and booklet for parents, safer journey planner for children, and activities for primary, and secondary schools.

The newly developed programme 'Make Choice' was evaluated by:
1. A nine questions survey of children's travel patterns 'Out and about';
2. A 16 item attitude scale 'Moving On';
3. 18 questions about personal safety, parked cars, cycling, traffic directions, using buses, injury risk, green issues, peer group and social pressures, divided into 7 groups;
4. Responses of teachers that used resources;
5. Children's recall of the resources and their recall of help from parents and schools.

The design used in this research was a pre-test post-test design with a control group and an experimental group. Although originally the pre-test sample consisted of 1,888 children and the post-test sample of 1,788 children, it was only possible to match the data on the pre- and post-test for 945 children (428 in the control and 517 in the experimental group). The timetable of the programme is presented in the following table.

Pre-tes t (In primary schools)	Jan-Feb 1999	1,888 pupils
Post-test (In secondary schools)	Oct-Dec 1999	1,788 pupils

The authors explain this high data loss of about 50% by the transfer of children to secondary schools that were not participating in the research, pupils from control schools transferring to the experimental schools and vice versa, and by the absence of children on the day of the post-test.

The results obtained on the 16 item attitude scale were used to compare pre- and post-test results, but this was done separately for the experimental and the control group. On eight statements, both groups showed significant differences. Only on four statements, three of which were concerned with independence, did the experimental group show a significant difference between pre- and post-test scores.

An 18 questions test about 'knowledge of road safety' consisted of seven categories of questions. Although there were some significant differences in some of the answers between experimental and control group, we find it rather difficult to draw a conclusion about general differences between the experimental and the control group. The first difference concerns choosing a different route. The authors do not state that this is also a safer route for

crossing between parked cars. However, interestingly enough, there was no difference between groups in giving the correct sequence of actions when crossing between parked cars.
A second difference was in the percentage of children in the control group that chose the option to ride a bicycle on the pavement. There was no difference between groups in the number of children choosing to ride on the road.
However, it had to be added that most of the questions were multiple-choice questions and that some of the significant differences were reported only on some of the choices within one question. Therefore, it is difficult to establish the actual difference between the experimental and the control group. The authors give no difference in any of the general scores between two groups.

The programme stated the importance of parental involvement in road safety education, but practically in this particular program, parental engagement (understood as use of the resource by parents) was totally dependent on personal interest and commitment of parents. The same applies for children and their use of their resources. Primary and secondary schools were also very independent in their decisions about how, when and how often to use resources, so the use of suggested activities actually depended on teachers. In the vast majority of schools the programme was integrated within Geography or PSHE. The conclusion from this type of organization is that researchers did not have control over the degree and quality of the intervention.

Although the exact proportion of the teachers giving their response in relation to the total number of teachers involved in teaching the resource is not clear, the response of the teachers that used the resource (is given in the form of frequencies of the answers on a 5-grade scale regarding presentation and format, ease of use, relevance to the age group, and timing of the materials to schools. The majority of the ratings, approximately 50%, rated the 'Make Choice' by the score 2 (scale from score 1= excellent to score 5 = poor).

The discussed evaluation criteria, attitude and knowledge questionnaire, were used to evaluate the effect of the use of the resources upon children's awareness of road safety issues and their decision making responses. The authors conclude that the attitude scale indicated that the experimental group showed a greater level of personal responsibility, and that the *Making Choice* test suggested that the greatest effect of the intervention upon the experimental group was in increasing their awareness of personal safety issues. As the authors conclude: they were better informed about how to make a reverse charge call, and they were more likely to offer general awareness messages about keeping safe when out. In the overall conclusion about outcome of the evaluation of the programme, the authors conclude that the programme successfully met the original objectives and they strongly recommend the programme to be published and promoted nationally for schools and road safety professionals.

With the discussed limitations of the evaluation process in this study in mind, it seems that this would be the optimistic conclusion.

A child based approach to road safety education for 8-11 years old (Clayton et al., 2005)

Although the project of Clayton et al. consisted of four stages: 1. Listening to the children, 2. Developing the educational resource, 3. Piloting the resource, and 4. Evaluation of the resource, we were interested mainly in the last phase where the effect of teaching the resource upon children's attitudes towards road safety and knowledge and understanding of road safety were evaluated.

The resource, previously piloted and modified on the basis of teachers' comments on it, consisted of five elements: the big book, linked stimulus sheets, interactive poster, street sounds cassette tape, and notes for teachers. They were focused on:

- the relative risks of the road environment and how to minimize them;
- ways of taking personal responsibility for keeping safe as a pedestrian, cyclist, and vehicle occupant;
- the traffic environment in the future.

Clayton et al. used a pre-test two post-test design with control group. The experimental group was exposed to the educational programme for a duration of five to six weeks, so the time interval between pre-test and post-test 1 also was five to six weeks. Post-test 2 was undertaken after a period of four months. These four months also included summer holidays and post-test 2 aimed at evaluating the longer term effect. Pre-test was conducted in 9 experimental and 7 control schools in Britain with 1222 children of 8-11 years old, post-test 1 with 980 and post-test 2 with 910 children. The project took place in the period May to December 1994.

For the evaluation of the effects, Clayton et al. used:

1. An 11 question survey of children's use of the roads as a pedestrian and as a cyclist, dealing with 'Using the roads';
2. A 14 item questionnaire, to be answered with 'yes', 'no' or 'not sure' on different statements, with the theme ' Thinking about roads';
3. A multiple choice test of road safety knowledge, the 'Roads quiz';
4. A series of question based upon six photographs of typical road situations, the ' Looking at photographs' item.

At the same time, in a parallel process, evaluation was made of the organization, the presentation of the resource material, and its acceptability for use in school by teachers.

The results showed that the experimental group obtained significantly higher scores than the control group.

It is interesting to mention that the authors of this study explicitly stated that they did not attempt to demonstrate any reduction in the crash rate. However, in common with the majority of similar studies, they attempted to assess whether the teaching of the resource resulted in an increased level of knowledge and a change in attitudes. Evaluation was largely in terms of the children's ability to determine safer strategies in a variety of situations. However, the authors did not discuss the relation between this criterion and crash reduction, as they did not discuss, or control, other factors that might

have influenced the outcomes of the evaluation, e.g. the effect of the teacher, the style of teaching, or the amount of time spent on teaching.

Children and road safety: Increasing knowledge does not improve behaviour (Zeedyk et al., 2001)

Zeedyk et al. reported two studies, of which only the first one is about the evaluation of educational effects. We also presented the most important findings of the second study, because they are significant for further investigation of the relation between knowledge of road safety and traffic behaviour .

The purpose of the first study was to assess children's knowledge about safe and dangerous places at which to cross the road, and to compare the effectiveness of three different classroom based training methods.

120 children, all pupils of the first group in primary schools, in the age group 4-5 years old, participated in the study.

Three testing sessions were performed: pre-test, post-test 1 a few days after intervention, and post-test 2 six months after the intervention in order to assess the long-term effect. Results were compared to those of the control group, although with regard to the control group, this study had some limitation in its design. Children in the control group were tested only once, at the time of post–test 2 for the experimental group, six months after the intervention. This means that the data for the control group that would match those in pre-test and post-test 1 did not exist.

Three different training methods were administered in only one session of approximately 20 minutes:

- *Playmat model* (27 children) which is a mat with roads and toy models of vehicles, pedestrians, buildings, trees, and other items relevant to traffic. A child was presented with a scenario in which they had to go to school from home. Throughout the activity, a child interacted with an experimenter in an informal manner.
- *Board game* (29 children) was a road safety board game sold in toy stores. Children played the game in groups of four, with an experimenter providing support and advice throughout the game.
- *Talk using illustrated posters and flip-chart materials* (29 children) that represented a simplified version of the Green Cross Code[5]. Children were divided into groups of eight to ten and they were encouraged to take an active role in the event.

The knowledge of children was assessed by using 11 photographs, 5 representing safe and 6 representing dangerous situations. The children were expected to decide whether the scene represented a safe place to cross the road, with a score range from 0 to 11. Besides this, children also had to justify their choice of location as being safe for crossing, with a score range from 0 to 11.

[5] Green Cross Code is a guide in the form of a short step-by-step procedure designed to enable pedestrians to cross roads safely.

The first aim of this study was to assess the level of knowledge of children aged 4 to 5 years. The study showed that children already possess a fairly good knowledge about safe and dangerous locations at which to cross the road. The residential areas in which children lived made no difference in their initial level of knowledge.

The results concerning the effectiveness of three methods of instruction are as follows:

- All three types of intervention were effective and the knowledge of children increased;
- The degree of improvement was small (1 point on average) but this can be considered as a significant improvement, keeping in mind that it was just one, 20 minute long session;
- The effect was retained six months later;
- And surprisingly, type of instruction was not significant. All three interventions were effective and no differences between interventions were found. All three types of instruction were equally effective.

Although in the second study reported by Zeedyk et al. no educational programme or intervention was evaluated, the results of this study are highly relevant for the discussion of the relation between knowledge and behaviour.

The purpose of the second study was to test if there is transfer of knowledge to children's behaviour in real-life traffic. Participants in this study were 47 children; all of whom had participated in the first study. They were now 5 to 6 years old. 23 of them were children who had received some kind of intervention during the first study and 24 of them were the children from the control group of the first study. This means that children who had received some kind of intervention were compared to those who did not.

Behaviour of the children in real-life traffic was inconspicuously videotaped and assessed. There were three types of road-crossing situations:

1. Crossing at an obscured junction;
2. Crossing with moving traffic;
3. Crossing between parked cars.

Children's knowledge about all three situations had been already assessed in the first study.

In general, this study gives indications of how children behave in a realistic traffic environment. Most of the children carried out their crossings alone, i.e. not accompanied by adult, and at a dangerous location. The on-road performance of children was generally poor.

The second study's main question about the possible transfer of knowledge to children's behaviour was answered negatively. No differences were indicated for the control or the intervention group. The greater knowledge of children from the intervention group did not result in safe choices for any of the situations assessed. Although children's knowledge increased with training, investigation of the behaviour did not reveal any differences between trained and untrained children. The children's knowledge did not influence their behaviour.

Developing Safe Route Planning strategies in young child pedestrians (Thomson J.A., 1997)

Thomson assessed effectiveness of individual and group training of children's judgments concerning safe crossing locations and routes, both at the roadside and on the table-top traffic model.

Study 1
Children were individually trained in one of two ways:
1. At the roadside in streets near their schools;
2. On a table-top traffic model set up in their classroom.

Children were pre-tested on three separate occasions in order to establish baseline measures of skill, at the roadside. There were three post-tests: Post-test 1 immediately after the training period, Post-test 2 approximately two months later, and Post-test 3 after approximately 8 months.

Control data was obtained from age-matched children who received no training at all.

Children received six training sessions, each lasting approximately 30 minutes, at the frequency of one or two sessions per week. The aim of training was to teach the children to recognize dangers of obstructions limiting their view of the road, of intersections with complex traffic, and of meandering across the road.

Baseline measurements (pre-test) showed that children were able to construct very few safe routes.

After the training (post-test 1), the results of the children improved significantly with up to 70% of constructed routes belonging to the category of safe routes. It is interesting that trained 5-year old children performed at the level of 11-year old untrained children. There were no differences between the two training methods.

The results at post-test 2 showed significant deterioration in level of children's performance, followed by further small but non-significant deterioration in the next six months (post-test 3). It must be emphasized, that after eight months and with the deterioration in their performance, 5-year old trained children continued to perform close to the level of 9-year old untrained children.

Study 2
This time, not individual but group training was assessed, both at the roadside and on a table-top model. Children were trained in groups of five and they were expected to be as active as possible.

Pre-test and post-test measurements were obtained, but in the case of group training, only post-test results immediately after the training (post-test 1) and two months after the training (post-test 2) were gathered. No evaluation of the long-term effect of the group training was done.

Although it was evident that the children benefited significantly from the training, improvement was not at the level of that for the individual training

(36% more safe routes in group training comparing to 70% in individual training). On the other hand, although improvement was not as large as in the case of individual training, it seems that the effect of group training was more robust. Group training showed no deterioration after two months period, as was the case with individual training. Thomson did not have an explanation for the more stable performance obtained by group training.

Classroom instruction versus roadside training in road safety education (Van Schagen & Rothengater, 1997)

The purpose of the study done by Van Schagen and Rothengater was to compare effectiveness of:

1. A classroom instruction module which consisted of 5 hierarchically structured sessions of 30 minutes each. A work book, a 10 minutes long video that demonstrated the required road crossing behaviour, and table-top models for practising road-crossing with a model pedestrian were made available to be used as a material for the classroom instruction module.
2. A behavioural training which also consisted of five sessions of 15 minutes each. Children practised individually under adult supervision in normal traffic conditions.
3. A combination of training and instruction model which comprised three classroom sessions first and, next, training sessions. This meant that the children received less practise than in the behavioural module, and that the instructor made explicit references to explanations.

89 children, with a mean age of 7 years and 4 months, all pupils in the first year of primary school, participated in this study.
Three experimental groups received one of three types of instruction during five consecutive schooldays, while the control group received no safety education.

Pre-test and post-test measurements were taken in the form of knowledge tests and roadside behaviour tests.

At the knowledge test, all three experimental groups differed significantly from the control group while there were no differences between experimental groups.

The roadside behavioural test had a two-factor structure:
1. The pre-crossing behaviour at the curb: results on this factor were not significantly improved and authors found a possible explanation in a 'ceiling effect' Most children performed adequately on this factor even before educational intervention.
2. The crossing behaviour on the road: all experimental groups differed from the control group, but there were no differences between the experimental groups.

All three evaluated types of educational modules had a significant effect on the children's knowledge and on the observed behaviour, whereas no improvements were found for the control group. Differences between the three types of interventions were not found. Contradictory to some of the

previous findings, cognitive instruction not only had an effect on knowledge, but also on road crossing behaviour. At the same time, behavioural instruction did not only improve behaviour, but also children's knowledge. Possible explanations for these findings might be that cognitive, classroom based instruction, also included demonstration and modelling of required behaviour. Also, the content of the instruction was based on concrete crossing strategy, without use of abstract concepts.

Child Pedestrian Injury prevention Project: Student results. (Cross & Stevenson, 2000),

Methods
This study describes the results of a 3-year semi-experimental trial.
Goals of the project were:

- To improve children's pedestrian safety knowledge;
- To improve children's road-related behaviour of crossing and playing;
- To reduce children's risk in and exposure to traffic;
- The long-term goal was to reduce pedestrian injury in 6 to 9 year old children, but this was not assessed.

The programme was implemented in two metropolitan communities and a third community was used as a comparison.

Community 1 was subjected to *'High'* intervention: a school and home based pedestrian safety education programme as well as a community education and environment intervention.
Community 2 received *'Moderate'* intervention: school and home based pedestrian education programme, with no community or environment intervention.
The comparison community received a nutrition education programme and the standard health education programme which contains several road safety related activities.

In each of the 3 years of the project the pedestrian safety education programme consisted of nine 40-minute pedestrian safety lessons (at school) and nine home activities. The key focus was on pedestrian skills training in a real road environment using school access and traffic roads. The parents were expected to be actively involved.
A half day training for teachers was conducted at the beginning of each of the 3 study years (to maximize teacher implementation).

Sample
The sample consisted of 1,603 children (535, 514, 554), but initially the study began with 2,356 children. This is an example of how the number of children participating decreased over time. One of the recommendations when evaluating programmes, especially on long-term effects, is that the size of the sample needs to be bigger than statistics demands, because over time the number decreases significantly.

Instrumentation
1. For the assessment of knowledge and self reported behaviour a self-report questionnaire was used. The questionnaire contained 23 questions: 10 were related to knowledge, 3 to playing behaviour on or

near the road, 3 to road crossing behaviour, 2 to exposure to the road environment, and 5 to parental instruction. The questionnaire was assessed regarding test-retest reliability, and the face and content validity of this instrument were assessed. This was done as a recommendation for constructing and using different questionnaires as a tool for measuring outcomes of different programmes.

2. Unobtrusive observation of road crossing behaviour for the validation of the behavioural road-crossing findings in questionnaires. The sub sample consisted of 80 students who were randomly selected. The correlation was 0.50, when correlated to classroom interviews correlation was 0.80.

Variables that were assessed and by which programme was evaluated were:
- Knowledge of pedestrian safety;
- Road crossing behaviour;
- Road playing behaviour.

Additionally, three measures of classroom programme implementation were used: a teacher log, a post-implementation teacher self-report questionnaire, and assessment of student workbooks. Teachers delivered 84%, 75% and 59% of the programme in the three years respectively.
The was also a parent self-report questionnaire; parents reported completing 55%, 56% and 44% of the total number of home activities during the three years.

Results:
1. Pedestrian safety knowledge: in the first two years (post-test 1 and 2) a significant difference in pedestrian knowledge was observed between the intervention and comparison group, but in the final year (post-test 3) this difference had diminished.
2. Road crossing behaviour: significant differences were observed over the 3-year period; in both, the intervention and the comparison group decline in adult accompaniment was observed, but the decline was significantly lower in the intervention group.
3. Road playing behaviour: the intervention group reported safer playing behaviour than the comparison group, but in time the proportion of children who reported undertaking activities which placed them at greater risk of injury increased in all three groups.

General conclusion: in all groups, student risk taking increased from the first year to the third year of study; children typically increase their risk taking behaviour as they grow older.