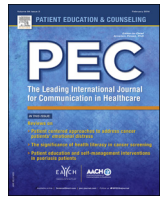




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Road safety education: What works?

J.P. Assailly

IFSTTAR (French National Institute of Transport Research), 11 Av Eglé, 78600 Maisons-Laffitte, France

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ABSTRACT

Objectives: The objectives of the paper are:

- To present the main definitions and issues about road safety education (RSE) such as evaluation, historical evolutions and integration of RSE in Safe Systems Approaches.
- To present examples of good practices in RSE.

Method: Seminal papers, collaborative reports from traffic safety research institutes and books from experts have been used as materials. Very diverse fields of application are presented such as: the importance of emotional experience in interaction with traffic experiences; the efficiency of e-learning; the efficiency of simulators to improve hazard perception skills and calibration of one's driving competencies; the efficiency of social norms marketing at changing behaviors by correcting normative misperceptions; the usefulness of parents-based interventions to improve parental supervision; and finally the importance of multi-components programs due to their synergies.

Conclusions: Scientific evidence collected in this paper shows that RSE may have some positive effects if good practices are adopted, if it is part of a lifelong learning process and if transmits not only knowledge but also "life-skills" (or psycho-social competences).

Implications: for practice From each example, we will see the implications of the results for the implementation of RSE.

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1. Introduction

Road accidents are among the leading causes of mortality of youth worldwide: they account for approximately 35–40% of the injury-related mortality among teenagers and young adults in western countries [1].

Among the various causes of accidents, the human factor is the dominant one in the MVE system (man/vehicle/environment): a human behavioral factor is observed in 90% of crashes, an environment factor in 30% and a vehicle factor in 10%.¹ So, we have definitely to act on the behavioral component, now the question is "how?".

Road safety education (RSE) is one of the main strategies of traffic safety, one of the "four E's": education, enforcement, engineering, emergency systems. Education is certainly not the strategy bringing the quicker benefits: when you transform an "X crossroads" into a roundabout, you observe immediate positive

effects on crashes with the mechanical reduction of speeds and the suppression of lateral collisions, whereas an educational action in kindergartens may produce effects only twenty years later! In the same way, enforcement is generally judged as more efficient than education to reduce drunk driving for example and it is always advocated to accompany media campaigns with enforcement actions. However, we cannot put roundabouts everywhere, we cannot transform a country into a giant safe playground, we cannot have one policeman monitoring every driver, because of limited police resources and because of social acceptability, so, even if not the most efficient, we need education approaches to have a balanced and comprehensive traffic safety policy. Plus, education is what is allowing the social acceptability of the other strategies.

This paper is in two parts: in this first part, we will define what is road safety education, the adaptation of RSE to historical evolutions of traffic safety in Western countries, the integration of RSE in a "Safe system" approach and finally how RSE can be evaluated. In a second part, we will give examples of good practices, focusing on principles and methods having been evaluated positively with teenagers and young adults.

E-mail address: jean-pascal.assailly@ifsttar.fr (J.P. Assailly).

¹ The total exceeds 100% as you may find more than one factor in an accident.

2. Method

Seminal papers, collaborative reports from traffic safety research institutes and books from experts have been used as materials. Very diverse fields of application are presented such as: the importance of emotional experience in interaction with traffic experiences in order to raise concern; the efficiency of e-learning which allows many repetitions of training on the same topic without being confronted with the real traffic risk; the efficiency of simulators to improve hazard perception skills and calibration of one's driving competencies; the efficiency of social norms marketing at changing behaviors by correcting normative misperceptions; the usefulness of parents-based interventions to improve parental supervision; and finally the importance of multi-components programs due to their synergies.

3. Results

3.1. Definitions

What is RSE ?

RSE is built on three pillars [2]. It has three main objectives:

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** toward risk awareness, personal safety and the safety of other road users.

To reach good practice, that is evidence-based practice, there are principles to respect that we have learnt from evaluative works [2]:

- Any RSE action must be adapted to the level of development and maturity of the pupil (you do not teach pedestrian safety in the same way to 6- and to 12 years-olds);
- Any RSE action must be based on a sound knowledge of the accidentology of the target (who is more at risk? How crashes happen, what are their mechanisms? Etc.). Without this fitness between education and accident causes, RSE would not be efficient;
- There are interactions between individual (genetic, social) factors and the impact of preventive actions (more generally, we need to match type of person/type of program);
- There is a so-called "Saint Thomas paradox" (difficulty to reach the real "at risk" group, for example, when girls benefit more from the actions than boys);
- There is a necessity to adapt education to cultural and socio-demographic predictors of traffic accidents involvement (for example, fatalism and invulnerability feelings in Africa or Asia).
- The consequence for RSE of the association of risk behaviors in various aspects of youth life (traffic, psycho-active substances, unprotected sex, school problems, etc.) is the need of an integrated approach: because risk behavior is not limited to the road, but also occurs in other domains of life of young people, a more integrated approach may be needed. A more integrated approach might also lead to more effective prevention programs. Peters et al. [8] for instance, evaluated the effects of a curriculum at secondary schools that addressed the psychosocial determinants and behaviors in the domains of smoking and safe sex. The programs not only had an effect on these targeted behaviors, but also had an effect on determinants and behaviors in three domains about which no lessons were taught (consumption of alcohol, fruit and breakfast). For the moment, there are no evaluation studies that considered these potential "transfer effects" on road behavior but a theoretical

model like the GDE matrix, especially the 4th level, leads to this idea of integration of programs (for example, health prevention programs on alcohol and illicit drugs have logical connections and transfer effects on traffic safety of young people).

3.2. The adaptation of RSE to historical evolutions

Concerning mobility and children, the main trend concerning age groups and mode of traffic participation is the historical shift from pedestrian mobility in the last century to car passengers mobility today (with some differences between the E.U. countries, for example, U.K. and Netherlands are still motivating parents and children to go to school walking or cycling, whereas France gives more importance to car passenger mobility).

This reflects on the traffic mortality structure of children (0–14 years-old), for example in France [9]:

- In the 50's, 60's, 70's, 7 children on 10 killed were pedestrians, 3 were car passengers.
- Today, 3 on 10 are killed as pedestrians, 7 as passengers.

So, RSE has obviously to adapt to this shift: RSE now must not be focused entirely on pedestrian mobility as in the past, but must deal mainly with the parents' responsibility. More generally, if we want to impulse the "sharing of the road", RSE has to be as precocious as possible. If we know quite a lot about child pedestrian accidents, the main gaps today are about the influence of parents, the influence of the social environment on accidents and education, the influence of emotions and of affective development on accident involvement, and the use of emotions in RSE.

Concerning strategy orientations, there is an ongoing debate which originated in Sweden many years ago about the content of RSE: education or exposure reduction?

On the one hand, Swedish experts recommend the schools to teach and train their pupils how to make changes in their close surroundings, i.e. by influencing the local authority to reduce the speed limit outside the school for example by collecting and reporting statistics. They advocate the idea that children cannot be taught a safe behavior and that the responsibility of safety cannot be put on the children. This policy orientation comes from previous and pioneering research works by Swedish psychologist Tina Standels [10,11] in a Piagetian² perspective which concluded that pedestrian safety is not possible before adolescence, due to the cognitive and perceptual limitations of children; it would thus be counterproductive to try to educate children, as they could not adapt to traffic before 11 years-old, the only solutions should therefore be risk exposure reduction by traffic regulations and city planning.

On the other hand, some Swedish actors claim that there is a need both for traditional RSE and for actions on exposure. Indeed, to rely only on protection and not at all on education may have perverse effects: as the age of first unaccompanied trips to school is raising due to this orientation toward exposure reduction, pedestrian accidents rates will remain important between 10 and 14 years-old as we have produced inexperienced pedestrian teenagers.

Furthermore, taking the children off the roads and the streets may have also other perverse side effects: lack of physical exercise and health consequences, traffic pollution, time consuming "taxi

² Piaget is one of the most famous child psychology theorists who has studied and explained the cognitive development from birth to adulthood, how "the mind of the child assimilates and adapts to the world".

activity” for parents.

To conciliate the two positions, we may say that a good RSE strategy should be to take into account the level of development of the child, the experience and the exposure.

This debate has spread to all E.U. countries and will lead to the concept of Safe systems approach presented below.

3.3. RSE policy and integration of RSE in a “Safe system” approach

3.3.1. What is a Safe System Approach?

Most E.U. countries advocate a Safe System Approach in the prevention of road casualties. Safe System Approaches originate from previous successful approaches in the field of injury control such as the Haddon matrix [12,13]; this matrix in 9 cases defines the risk factors of an injury in 3 categories: the individual, the agent, the environment, and the moment of the action: before, during and after the accident.

The Haddon matrix

| | Before the injury | During | After |
|-------------|-------------------|--------|-------|
| Individual | | | |
| Agent | | | |
| Environment | | | |

All traffic safety factors could be found in the Haddon matrix: personality of the driver (before), agent such as speed (before and during), environment such as bad infrastructures (before) or bad emergency services (after). Safe System Approaches aim to create safe road systems, consisting of road infrastructure, legislation, and vehicles, such that safety is incorporated into the design of the system and not solely dependent on the decisions of individual road users

Safe System Approaches may differ in approach. For instance Vision Zero in Sweden is primarily based on the introduction of safe interaction and shared responsibility, whereas Sustainable Safety in the Netherlands focuses around the application of Reason’s model [14] of Generic Error Modeling Systems (GEMS) to road safety (see Twisk, [15] for a review). Whatever the country, a Safe System Approach stipulates that we cannot rely on an isolated RSE system. A Safe System Approach would primarily focus on hazards arising from the interaction of road users with the road system, and in terms of prevention would aim to eliminate those hazards that exceed their capacities [15].

3.3.2. One example of Safe System Approach applied to RSE

One example of Safe System Approach applied to RSE is the Logic models developed by Bartholomew et al. [16] for health behavior. Just as in the health model, the road safety model consists of two levels: an individual level and a system level. The individual level covers components such as maturation, motivations, abilities, and influences from the social environment. The system level concerns the traffic system that includes the road infrastructure and also regulations such as legal alcohol levels, licensing age and vehicle requirements.

A safe system approach takes also into account the effects of the system-induced exposure: there is a systemic aspect of traffic safety which shows that when a road environment is unsafe, it is unsafe for all road users whatever their age, and when a road environment becomes safer, it become safer for all as well.

The analyses of European statistics show for example that the 15–25 years-old have made the same progress than the rest of the population with an important decrease of crash rates in the last 20 years; efficient traffic safety measures such as speed cameras or preventive alcohol checks by policemen produce the same positive

effects on all age groups. In the same way, geographical differences are systemic as countries with good traffic safety records have good results with their youth as well.

The system-induced exposure is also defined by the question of allowing access to high-risk vehicles at a young age through the legal driver licensing age. However, no support was found for a protective effect of late licensing for young people in a recent Dutch study [17]: compared to young adolescents who are allowed to drive motor vehicles in early-licensing jurisdictions, late licensing does not provide extra protection for youngsters, probably because of the high risk associated with transport modes such as moped riding and bicycling in late-licensing countries. However, another issue about early or late licensing would be to take into account the risks that early licensing might pose to other road users and passengers, as risks to others, i.e., passengers and other road users, are greater from motor vehicles than mopeds or bicycles.

3.4. The evaluation of RSE. How to evaluate RSE?

A common observation is that RSE programs are frequently funded and implemented without evidence of their actual effects [3]. Now the question is which safety outcome measures can show evidence of RSE effects.

The first logical idea which comes to mind would be to see if RSE reduce the prevalence of crashes; however, crashes are rarely if ever taken as an outcome criterion: these are (luckily) very rare events and to show a statistical significant effect of RSE on crashes would need to follow huge populations for very long periods of time, which is nearly always impossible [4].

Thus, we need surrogate measures of the effects of RSE which could be predictive of crashes but easier to obtain.

Two types of data correspond to this objective:

- Safety performance indicators which have been observed by traffic safety research works as predictors of crashes;
- Psychological antecedents of risky behaviors which have been observed as causal mechanisms by social psychology research works.

Safety performance indicators may be in an *empirically tested* relationship (the increase in crash risk is known) or as a *logical* relationship (the increase in crash risk is supposed) [5]. Rates of drunk driving, speeding, risky street crossing, etc. are safety performance indicators which can be usefully measured to predict crash involvement. Risky behaviors can be measured by observation in real traffic situations or by self-reports with questionnaires, both methods have predictive validity (see Elliott et al. for a review) [6].

Psychological antecedents of risky behaviors are attitudes, behavioral intentions, beliefs, etc; many social psychology studies originating from theoretical models such as the health belief model, the theory of reasoned action or the theory of planned behavior have shown how they predict safe or dangerous behaviors (see Glanz et al. for a review) [7].

3.5. What do we know from RSE evaluations? What are the good practices ?

3.5.1. Good practices in general principles

A first common observation in E.U. countries is that RSE is much more developed in the primary schools as there is only one teacher per classroom to reach and convince, then less developed in secondary schools (many teachers, heavier programs, etc.) and quasi absent in high schools and colleges. This is paradoxical as traffic fatalities rates are the highest between 15 and 25 years-old.

One recommendation would be clearly to develop RSE for these age groups.

Apart from this age problem, our review of literature on RSE allows us to identify good practices:

- The most effective teaching methods are those that encourage active student participation (role playing, simulations, etc.) and interaction with adults (discussion).
- The best results are achieved by interventions that improve the psycho-social skills of students such as self-esteem, assertiveness and resistance to peer pressure.
- It is necessary to adapt the program to the level of maturity and experience of the students.
- Interventions on “at risk groups” are usually more efficient, but school contexts are not well suited to this type of approach for reasons of ethics and confidentiality.
- “Multifocal” interventions that combine multiple targets seem to be more effective (youth, interventions with parents, teachers, action on the environment of the school, etc...), especially those which actively involve parents throughout the program.
- The consistency of messages is a key success factor, consistency in the speech of stakeholders, consistency between rhetoric and action.
- The quality of the implementation of the program is as important as the program itself (involvement of teachers).
- The training and supervision of stakeholders is essential for the success of the action, such as training teachers to group dynamics in order to ensure their relationships with students.
- The quality of the school environment plays a role beyond teacher training on the program: provision of new school activities, tutoring for students, development of the relationship between parents and teachers, involving health services, representation of parents.
- The main causes of failure are related to interventions in crisis situations or moralistic approaches based on fear, or programs too dependent on the outside (that is, not having enough involved the school staff and parents), or did not, or insufficiently developed teacher training.

3.5.2. Good practices in the characteristics of the education strategy (methods chosen)

- Importance of emotional experience to touch young people, in interaction with their traffic experiences.

One example: for the past few years, the Loewenstein Hospital Rehabilitation Center in Israel has hosted workshops for 17 and 18 years-old students from vocational and academic high schools [18]. Some of those who attended the workshop already had a driver's license and some not. The rationale of the intervention is to expose the young drivers (or the future drivers) to a meaningful experience that would imprint important messages of safety in their behavior, or at the least, in their attitudes.

The program was effective for vocational school students and for those participants who already held a driving license while attending the workshop, but not for academic high school students. Students at vocational high schools who attended the workshop showed markedly safer attitudes toward driving than their classmates who did not attend; no such difference was found among students at academic high schools. In the same way, the intervention is more beneficial for young drivers who have driver's licenses, have some driving experience as well as have participated in the workshop. They might be more aware of the dangers on the road and thus, the issues are more relevant for them. The driving experience of young adults who do not yet have a driver's license is limited to episodes of driving with the driving instructor. In this

situation, perhaps the young student does not feel the responsibility of coping with traffic conflicts but rather relies on the instructor.

- Efficiency of e-learning which allows many repetitions of training on the same topic without been confronted with the real traffic risk.

One example: the a2om e-learning package for young offending drivers, used in the Young Driver Scheme (YDS) and other educational schemes in Britain [19,20].

The YDS was launched in 2008 in the Thames Valley Police district (UK), where drivers below 25 years of age who had committed a non-serious driving offence could chose to take part in the e-learning course instead of paying a fine, and possibly have penalty points added to their license. The majority of the YDS drivers had committed speed offences. The purpose was to see if this e-learning package could have an impact on the offending rate of young drivers.

The YDS course consisted of an initial workshop with a face-to-face interaction with a driver trainer, who discussed various ways crashes can come about, attitudes, behaviors, distractions

and other factors. After completing this session, drivers could log onto a website, where the educational material was presented. There were five e-learning modules. After completing each module, the participant was locked out for 4 days before a new one could be attempted. All five modules were to be passed within 28 days. Every module except the first ended with a 25 multiple-choice question test on the module content, based loosely on the UK's Driving Standards Agency theory test items.

The material is largely visual and interactive, with the general set-up for the first module being an animated scenario in which you are driving a car that ends in a road traffic accident. This is replayed several times from different angles, with risk factors pointed out. The participant can also go back and study any part of the module again at anytime. In most of the modules, questions are asked about what the participant thinks about the risks involved when the scenario has been presented.

Data on driving offences for samples of drivers from the YDS was compared to another driver improvement scheme (Speed Awareness Scheme, SAS), and a group of fined drivers; self-reported collisions and mileage were also registered. The results indicate that the on-line YDS education has resulted in a behavior change (reduction of offences and collisions), which is not present for the other driver improvement scheme (Speed Awareness Scheme, SAS), and for the group of fined drivers.

The drivers reported higher levels of aggression, stress, sensation seeking, drunk driving, and driving violations, six months after the course than before. However, these levels were lower than those of controls, indicating that the initially low levels for the education group were due to socially desirable responding, as measured by a lie scale, an effect that waned after the course. These results can be interpreted as a positive effect of the education, although this conclusion is tentative and not in agreement with all effects in the data. The results are in disagreement with previous evaluation studies using the same or similar instruments, and show the need to include controls for social desirability in self-report studies.

- Efficiency of simulators to improve hazard perception skills and calibration of one's competencies.

One example: simulators and computer-based learning in Germany [21]. Two groups of student drivers were presented with different types of learning material, computer-based versus paper-based on the subject “Anticipatory Recognition of Hazardous Traffic Situations”.

Learning success was tested by analyzing the students' gaze behavior while accomplishing a driving simulator task. To measure the adequacy of each participant's self-efficacy expectations, the participants were asked to predict their ability to anticipate hazardous situations immediately prior to the two test drives. The results confirmed that the didactically sound implementation of computers efficiently supports the acquisition of driving-task-related cognitive skills in general and hazard perception skills in particular. In the light of better hazard perception skills and defensive self-efficacy expectations as a result of using computers, the implementation of computers in driver education is more likely to support safe behavioral patterns in traffic than conventional materials.

- *Social norms media marketing can be effective at changing behaviors by correcting normative misperceptions.*

One example: social norms marketing in Montana [22]. Social-norms marketing is an intervention strategy that originated on college campuses. It consists of disseminating accurate information about the real statistics of students' alcohol use, usually in the form of newspaper ads, flyers, posters, electronic media, etc., as there is a dysfunction of risk perception by students called the "false consensus" (young people think that much more of their peers are binge drinking and drunk driving than in reality). Works have shown that corrections in these misperceptions can reduce drinking: a study [22] has evaluated the efficacy of a high-intensity social norms media marketing campaign aimed at correcting normative misperceptions and reducing the prevalence of drinking and driving among 21-to-34-year-olds in Montana.

The social norms media campaign was successful at exposing the targeted population to social norms messages in the counties within the intervention region. Moreover, the campaign has reduced normative misperceptions, increased use of designated drivers, and decreased drinking and driving among those young adults in counties within the intervention region.

- *Parents-based interventions can be very useful to improve parental supervision for example, education is a key dimension for increasing parent knowledge and use of safety seats; even when their children are young adults, parental supervision of the weekend nights and of the selection of peers is still a very important protective factor.*

One example: the Checkpoints Program designed to increase parental limits on teenage driving has been evaluated [23]

Based on protection motivation theory, the Checkpoints Program includes a videotape entitled Who Wants to Be a Driver?, newsletters, and the Checkpoints Parent-Teen Driving Agreement. The video and newsletters were designed to be persuasive; they highlighted teenage driving risks, recommended parent actions, and included testimonials from satisfied families.

The Checkpoints Program has been demonstrated to increase parental limit setting in each of the three randomized controlled trials conducted either while the teenager was driving on a learner's permit or at licensure.

- *Comprehensiveness and synergy between various techniques are needed, theory and practice, knowledge and skills are complementary.*

One example: the You Hold the Key (YHTK) Teen Driving Countermeasure developed by the Hamilton County General Health District in Cincinnati, Ohio [24].

The objective of this program was to increase safe driving and passenger behaviors among teens 15–19 years of age in Hamilton County, Ohio. All of the activities and presentations provided by

YHTK are focused on increasing safe driving knowledge, attitudes, and behaviors among young drivers. YHTK is a 10 week comprehensive school-based program consisting of safety promotion education, cooperative learning, student-oriented discussion, interactive lessons, student-led role-plays, prevention videos, and presentations from safety experts.

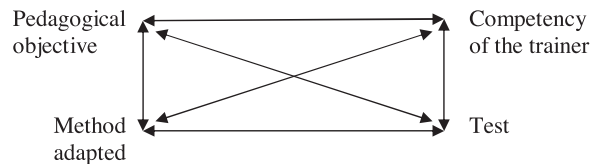
A total of 1365 high school students from three Southwestern Ohio high schools receiving the YHTK program served as the participants of this study. The program produced significant increases in student likelihood to wear seatbelts, to require passengers to wear seatbelts, to avoid drinking and driving, to refuse to ride with a friend who had been drinking and to reduce distractions while driving.

These improvements were observed immediately after the program and after a six-month follow-up. Compared to pretest scores, females showed significantly greater improvement than males in limiting the number of passengers to the number of seatbelts in the vehicle at immediate posttest, in feeling that they could avoid situations where their friends were drinking alcohol and driving at immediate posttest, and in knowing strategies to decrease distractions while driving or riding in a vehicle at six-month follow-up. Unfortunately and as usual, it is not the most at risk group which has been reached!

4. Conclusions

Scientific evidence collected in this paper shows that RSE may have some positive effects if good practices are adopted.

A "four corners" model may synthesize the organization of RSE on a particular topic:



The two ways arrows means that each time you change something in a one corner, it will suppose changes in the three others: for example, if you introduce a new pedagogical objective, you will need to have a competent trainer, be it the parent, in order to reach this objective; this trainer will have to use methods adapted to the objective (for example, the improvement of self-evaluation supposes active methods like group discussion or coaching); and finally, things have to be tested, otherwise people do not do it!

RSE should be part of a *lifelong learning process*. Therefore it should not be considered a mere subject at school, although currently in most countries this notion prevails; it mainly takes place in schools and kindergartens. As early as kindergarten, it should be developed as a continuous learning process. The requirements of different age groups should be clearly defined taking into account the different mobility patterns of age groups, and this up to older drivers. For each age group and/or user group, tangible goals should form the basis to develop tailored strategies and interventions. The effect of the interventions should be subject to regular evaluation and quality control in order to reveal major gaps in delivery mechanisms and to adjust the chosen approaches.

Finally, new approaches have been developed, aiming at the person and not only at the driver, called "life-skills" (or psychosocial competences) training; these deal with, for example, the reinforcement of self-esteem, perceived self-efficacy, assertiveness, resistance to peer pressure, self-control, self-regulation, etc. We may also think to "meta-cognitive" skills as self-evaluation. These "life-skills" approaches are so holistic and address globally

the health and well-being of young people, because they suggest that psychological distress is often the cause of risk behaviors and addictions [25,26]. Their difficulty lies in the time, investment and commitment they suppose, which limits for the moment their numbers. However, evaluations in the US or in Australia have shown positive effects of these programs.

5. Implications for practice

The main implications for practice is that any RSE action must be based on a sound knowledge of the accidentology of the target, that we need to match type of person/type of program, that we should pursue the efforts to reach the real “at risk” groups, that there is a necessity to adapt education to cultural and socio-demographic predictors of traffic accidents involvement and that we need to encourage active student participation (role playing, simulations, etc.) and interaction with adults.

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