

Driver Education – A blueprint for success?

A review of the current state of driver education

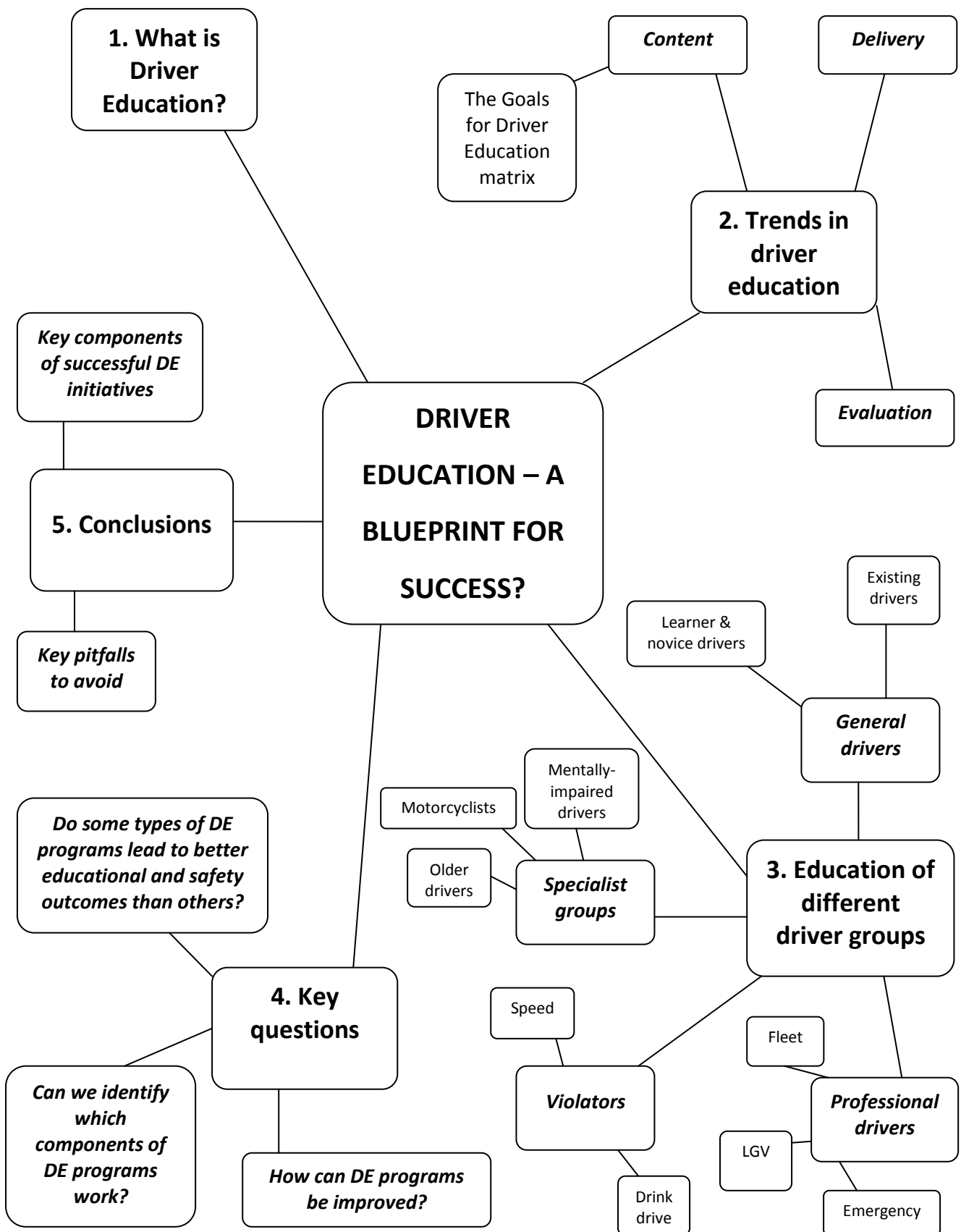
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November 2009

Table of contents

1.	What is driver education?.....	4
2.	Trends in driver education.....	5
	2.1 Content.....	5
	2.1.1 The Goals for Driver Education matrix.....	7
	2.2 Delivery.....	10
	2.3 Evaluation.....	11
3.	Education of different driver groups.....	12
	3.1 General drivers.....	12
	3.1.1 Learner/novice drivers.....	12
	3.1.1.1 Effectiveness of novice driver education.....	12
	3.1.1.2 Graduated Driver Licensing.....	14
	3.1.1.3 Formal and informal driver education.....	14
	3.1.2 Existing licence holders.....	15
	3.2 Professional drivers.....	16
	3.2.1 Company vehicle drivers.....	16
	3.2.2 LGV drivers.....	17
	3.2.3 Emergency vehicle drivers.....	18
	3.3 Violators.....	18
	3.3.1 Speeding.....	19
	3.3.2 Drink-driving.....	20
	3.4 Specialist groups.....	21
	3.4.1 Older drivers.....	21
	3.4.2 Motorcyclists.....	24
	3.4.3 Mentally-impaired drivers.....	25
4.	Key questions.....	26
	4.1 Do some types of driver education programs lead to better educational and safety outcomes than others?.....	26
	4.2 Can we identify which components of driver education programs work?.....	26
	4.3 How can driver education programs be improved?.....	27
5.	Conclusions.....	28
	5.1 Key components of successful driver education initiatives.....	28
	5.2 Key pitfalls to avoid.....	28
6.	References.....	29



1. What is Driver Education?

The term “driver education” can be used to represent different things in different contexts and locations. In the US and Canada, it usually describes programs for learner drivers that consist of in-car practical training and classroom theory. In the UK it tends to be used more in the context of supplementary learning in addition to skills training, and can be applied to learners, new drivers and experienced motorists alike. Mayhew (2007) defined it as “a structured approach to the learning process that can presumably facilitate and accelerate the acquisition of skills”. In the broader context it extends beyond driving skills to attitudinal and behavioural elements and the development of self-evaluation strategies. Generally there are key approaches used in driver education – in car training (on-road or off-road), workshop-based driver education, campaign level education, and e-learning. The target audience, nature of the educational content and the available resources often dictate which approach is most appropriate.

Over the last 15 years, a number of academic reviews of the driver education literature have been published. They have mostly addressed driver education in a broad sense, often integrating other forms of driver training and graduated driver licensing. Conclusions have been mixed, with many evaluations of driver education interventions finding minimal and inconsistent safety benefits (Mayhew and Simpson, 1996; 2002; Clinton and Lonerio, 2006), leading to scepticism among researchers about the effectiveness of driver education (Lonerio, 2008). For example, in a Cochrane Collaboration review of 18 studies published between 1962 and 1999, no evidence was found to indicate that post-licence education was effective in collision prevention (Ker et al., 2005). It has even been suggested that driver improvement interventions have actually increased collision rates (e.g. Janke, 1994; IIHS, 2001). Some studies have provided positive results, indicating that certain driver education strategies have a beneficial effect on learning outcomes and in turn on driver behaviour (Gregersen, 1996; Gregersen and Bjurulf, 1996; Gregersen et al., 2003). However, it remains unclear which methods are consistently effective in driver education (Rismark and Solvberg, 2007).

One of the problems in identifying the effectiveness of driver education strategies is in defining how effectiveness should be measured. Education is generally considered successful if students meet learning objectives and pass assessments, but driver education has a broader purpose as it is expected to produce tangible road safety benefits. However, collision rates can be viewed as an unfair measure to use, as collisions are relatively rare and involve a wide variety of contributory factors, making it difficult to show associations between educational outcomes and crash rates (Engstrom et al., 2003).

In the Local Authority context, education is often a component of the “3 Es” – Engineering, Enforcement and Education. Engineering improves transport infrastructure, enforcement deals with legal action against traffic violators, and education targets the road user and attempts to change attitude and behaviour through effective communication. It has been suggested that in order to achieve maximum effect, the “3 Es” should be used together, but often the resources allocated to the education measures are minimal compared with engineering and enforcement (Forward, 2009). Possible explanations for this include the tangibility of engineering and enforcement measures compared with the more complex and long-term process of educating drivers and bringing about behavioural change, and the fact that a number of attempts at driver education have been unsuccessful (Mayhew and Simpson, 1996) resulting in neglect or total abandonment of the educational element (O’Neill and Mohan, 2002). However, used appropriately within the context of the “3 Es” framework, education can serve as the glue that binds an intervention together and gives it the strength to achieve maximum effectiveness.

2. Trends in Driver Education

2.1 Content

Early driver education schemes often used shock tactics in an attempt to motivate drivers to avoid risky behaviour, despite minimal evidence to support the efficacy of this approach (Lonerio, 2008). Das et al. (2003) studied information processing and attitude change in response to fear-based campaigns, and found they generated favourable cognitive responses and attitude change when participants felt vulnerable to threat. Hence vulnerability mediated the relationship between the campaign and the behavioural change. However, other research has shown negative effects from fear-based programs (Taubman-Ari et al., 2000), including extreme reactions and denial of the message. If the fear created is excessive, the effect reduces because people pay less attention to the message and may even give a hostile or aggressive response (Goldenbeld et al., 2000).

Emotional appeals, on the other hand, are an integral part of mass-media advertising, and in road safety campaigns they have been found to be more effective than neutral information campaigns (Elliott, 1993). Research has shown that elevating levels of worry and emotion can lead to reduced risk behaviour in traffic, especially among certain sub-groups of drivers – those high in sensation seeking, normlessness and indifference to traffic safety, and particularly female drivers – thus indicating that females are more susceptible to emotional campaigns than male drivers (Rundmo and Iversen, 2004). This finding was supported by the evaluation of the Northamptonshire County

Council “2fast2soon” intervention for 14-19 year olds which was based on emotional stimulation – female participants and younger participants (especially those who had not yet begun to learn to drive) were most strongly influenced. Some basic guidelines have been put forward relating to maximising the effect of using emotional material – the emotion-inducing content must be high-quality, relevant to the target audience, and incorporate a clear indication of how to avoid the problem (Goldenbeld et al., 2000).

Recently, positively-framed driving campaigns, showing safe alternative to risky driving behaviours, have been found to be most effective at reducing drivers’ self-enhancement bias (Sibley and Harre, 2009). Self-enhancement bias refers to the extent to which drivers rate themselves as at lower risk of collision compared with other road users, or at reduced risk of negative outcomes in the event of a collision. It is possible that being encouraged to compare their own behaviours to the safe behaviours illustrated in the campaign results in a re-evaluation of the potential risk associated with their driving.

In many cases, driver education interventions have been developed using a common-sense perspective rather than a scientific perspective (Lonerio, 2008), and their content has been evaluated using methods ranging from wholly unscientific to reasonably rigorous with an equally wide range of conclusions. Skills and knowledge-based elements of driver education are often quite well addressed, as these can be defined in terms of DSA skills requirements, Highway Code knowledge, etc. However, these elements do not address attitudinal or behavioural aspects of driver education, or provide a toolkit for continued independent driver development. Over the last 20 years, researchers have put forward suggestions for an appropriate theoretical framework on which to build driver education interventions that could have a lasting effect and significantly impact upon driver behaviour. Early attempts focused on skills, such as the Dreyfus and Dreyfus (1986) 5-stage model. This consisted of 5 levels:

- **novice** – dependent on rules, not contextualised
- **advanced beginner** – acts within rules but within the traffic context
- **competence** – positive emotions associated with successful traffic interactions reinforce behaviour, rule-following is replaced by the ability to discriminate between situations and act accordingly
- **proficiency** – traffic situations are read intuitively but decision to act is still conscious
- **expertise** – performs intuitively and immediately in response to traffic context

The skill model does not address motivational aspects of driving, and thus does not differentiate between collisions caused by skills deficits and those caused by failures of motivation or behavioural intention. Hence there was still a requirement for a framework with a stronger theoretical basis and a logical approach to driver education (Lonerio, 1998), which led to the development of the Goals for Driver Education (GDE) matrix (Hatakka et al., 2002).

2.1.1 The Goals for Driver Education Matrix

The GDE matrix is a framework for driver education which emphasises the requirement for motivational and intentional aspects of driving to be incorporated along with skills-based competence. The GDE matrix is illustrated in Fig.1.

The lowest level, Vehicle Manoeuvring, deals with the concept that in order to operate a vehicle appropriately the basic manoeuvres must be automatised – if they are not, it places extra demand on attentional resources, thereby reducing the capacity available for information processing. This leaves limited amounts of attentional capacity for observation and anticipation in traffic. Improvement of basic vehicle handling skills helps cement the foundations of safe driving, but this level also highlights that it is necessary to maximise driver awareness of typical issues that can lead to loss of vehicle control, e.g. the nature of the vehicle, tyre grip, speed control, etc.

The second level in the hierarchy, Mastery of Traffic Situations, incorporates the traditional focus of driver education, whereby the driver uses their vehicle control skills appropriately and adapts their behaviour to the demands of the traffic environment. This level involves anticipation of other road users' behaviour and requires the driver to make their behavioural intentions clear to other road users. Driver education that focuses on increasing confidence through technical mastery may desensitise drivers to fear and reduce caution in hazardous situations (Job, 1990), and may result in a self-inflicted increase in task difficulty due to increased speed, overtaking and tendency to carry out secondary tasks while driving (Evans, 1991). At this point in the hierarchy it is important to distinguish between the driver's mistakes and violations in traffic – i.e. whether a problem is caused by a skills deficit, a lapse of attention, or an intentional act of violation (Reason et al., 1990).

The third level in the hierarchy refers to Goals and Context of Driving. This level deals with drivers' decisions relating to the purpose of their journey, their destination, any passengers or co-drivers, the nature of any loads being transported, and the time at which the drive takes place. These decisions are related to a number of factors within a person's life and can have a serious impact on driver risk.

Fig. 1 Goals for Driver Education matrix – adapted from Hatakka et al. (2002)

	Knowledge and skill	Risk increasing aspects	Self-evaluation
Goals for life and skills for living (general)	<p><i>Knowledge about/control over how life goals and personal tendencies affect driving behaviour</i></p> <ul style="list-style-type: none"> • Lifestyle/life situation • Group norms • Motives • Self-control, other characteristics • Personal values 	<p><i>Risky tendencies</i></p> <ul style="list-style-type: none"> • Acceptance of risk • Self-enhancement through driving • High sensation seeking • Susceptible to social pressure • Use of alcohol or drugs • Values, attitudes to society 	<p><i>Self-evaluation and awareness of</i></p> <ul style="list-style-type: none"> • Personal skills for impulse control • Risky tendencies • Safety-negative motives • Personal risky habits
Goals and context of driving (trip related)	<p><i>Knowledge and skills concerning</i></p> <ul style="list-style-type: none"> • Effect of trip goals • Route planning • Evaluation of requested driving time • Effects of social pressure in car • Evaluation of necessity of trip 	<p><i>Risks connected with</i></p> <ul style="list-style-type: none"> • Driver's condition – mood, alcohol level, etc. • Purpose of driving • Driving environment (rural/urban) • Social context & company • Extra motives (i.e. competing with others) 	<p><i>Self-evaluation and awareness of</i></p> <ul style="list-style-type: none"> • Personal planning skills • Typical goals of driving • Typical risky driving motives
Mastery of traffic situations	<p><i>Knowledge and skills concerning</i></p> <ul style="list-style-type: none"> • Traffic rules • Observation • Signals • Anticipation • Speed adjustment • Safety margins 	<p><i>Risks caused by</i></p> <ul style="list-style-type: none"> • Wrong expectations • Risk-increasing style (i.e. aggressive) • Poor speed adjustment • Vulnerable road users • Disobeying rules • Unpredictable behaviour • Information overload • Difficult conditions (i.e. darkness) • Poor automatisisation of driving skills 	<p><i>Self-evaluation and awareness of</i></p> <ul style="list-style-type: none"> • Strong and weak points of traffic skills • Personal driving style • Personal safety margins • Strong and weak points in hazardous situations • Realistic self-evaluation
Vehicle manoeuvring	<p><i>Knowledge and skills concerning</i></p> <ul style="list-style-type: none"> • Control of direction and position • Tyre grip and friction • Vehicle properties • Physical phenomena 	<p><i>Risks connected with</i></p> <ul style="list-style-type: none"> • Insufficient skills or automatisisation • Poor speed adjustment • Difficult conditions (low friction, etc.) 	<p><i>Awareness of</i></p> <ul style="list-style-type: none"> • Strong and weak points of basic manoeuvring skill • Strong and weak points in relation to hazards • Realistic self-evaluation

Anticipation of risk at this level depends on awareness of the problems associated with insufficient planning, inappropriate goals of the trip, and the context of the drive. Awareness of their own personal goals relating to the journey and of their habits when encountering difficult situations helps the driver prepare to deal with them. Trip-specific goals and the context of the drive are affected by higher-level goals and lifestyle factors, i.e. middle-aged drivers tend to drive for work or family reasons, while young drivers tend to do more leisure driving with friends in the vehicle (Laapotti et al., 1996).

The top level of the hierarchy, Goals for Life and Skills for Living, emphasises the importance of lifestyle factors and values in determining driver risk (Gregersen, 1996). For example, a highly car-oriented lifestyle appears to be especially risky (Hatakka, 2002). When driving is used as a means of self-enhancement, risk may be increased as acting-out the role to which the driver aspires may involve unsafe behaviours. The anticipation of risk at this level is dependent on knowledge about the relationship between lifestyle, risky motives and driving – drivers should be aware of their own characteristics at this level and the potential effect they have on their risk. Self-awareness and self-evaluation is fundamental to controlling risk at this level. The educational methods utilised in the “driver improvement” context are often focused on self-reflective and self-evaluative approaches (Hatakka and Keskinen, 1999) but these are not commonly used in normal driver education (GADGET, 1999).

Within a hierarchical framework, success or failure at the higher levels affect performance at lower levels. Psychomotor skills are fundamental requirements at the lowest levels, and are applied under the regulation of the higher levels relating to goals and motives. Consequently driver training should address not only basic skills but also higher level issues within the hierarchy, taking into consideration goals relating to driving and methods of dealing with lifestyle pressures that manifest themselves in the driving context.

The three columns within the matrix relate to the three key elements at each level. Firstly there is Basic Knowledge and Skills – familiar from traditional driver training, but taking a different approach at the higher levels of the hierarchy where they refer to knowledge of personal goals and situational factors that may impact on driver risk. The second column, Risk Increasing Aspects, consists of issues that can impact directly on driver risk, from a situational and a behavioural perspective. The third column, Self-Evaluation, has been suggested to be the most important element for driver education and the development of driving skill after training (Hatakka et al., 2002). Research on

expertise development indicates that reflective thinking is an essential characteristic of an expert (Kolb, 1984), therefore it is important to promote self-evaluation skills in driver education as they do not develop spontaneously.

Compared to the skill model, the GDE model has a broader perspective, indicating that changes in motivational and intentional factors can explain risk reduction with increased experience, which strengthens safety attitudes through increased appreciation of appropriate attitudes and behaviour (Tronsmoen, in press).

Driver education in general, especially learner driver education, still focuses largely around the boxes in the lower left hand corner of the GDR, while the upper right hand corner is neglected, although these areas are incorporated into driver improvement programs and used for experimental purposes (Hatakka et al., 2002). Self-assessment skills relating to driver attitudes and individual motives are part of the highest levels of the GDE matrix, and have been acknowledged as the most promising area for improvement in driver education (Lynam and Twisk, 1995). The GDE matrix also provides a framework on which to evaluate driver education methods. Educational approaches to improve self-evaluation skills include feedback during training, self-assessment tools, and discussions about personal experience. It is clear that pedagogical methods could benefit from re-evaluation and active learning methods and self-reflection should be promoted in driver education.

2.2 Delivery

Trends in delivery methods also vary to some extent over time. Technology has impacted upon the ways in which driver education is administered at both an individual level and a campaign level.

Traditionally, all individually-oriented driver education involved face-to-face interaction between teacher and learner, often supported by video resources which were not necessarily directly related to the educational content, whereas more recently approaches have shifted towards self-instruction, computer-based learning including online education, and interactive simulation (Lonero, 2008). Some recent studies have indicated positive effects of computer-based instruction and simulation in driver education, compared with conventional classroom presentation (Masten and Chapman, 2004).

At campaign level, technology has also affected delivery methods, with online campaigns becoming more frequent and the internet providing a wealth of information relating to the educational element of road safety initiatives.

It is not possible to specify which methods of delivery are most appropriate, as this depends entirely on the nature of the intervention, target audience and context.

2.3 Evaluation

Most education is evaluated using learning outcomes and pass rates but the success of driver education (beyond passing the DSA test) is harder to quantify. Traditionally, evaluations of driver education have been limited in scope, power and rigour (Clinton and Lonerio, 2006), but the importance of evaluation, and feeding findings back into the development of driver education, is acknowledged within the research fraternity – Keskinen et al. (1998) stated that “the development of driver education will take place in short steps, with constant evaluations of the results and trying to avoid solutions which are thought to be final”. Beyond asking if driver education works, the trend is heading towards answering a broader range of evaluation questions, such as:

- Do some types of driver education programs lead to better educational and safety outcomes than others?
- Can we identify which components of driver education programs work?
- How can driver education programs be improved?

Many individual evaluations have not addressed these questions. This review aims to extract some answers from the broad driver education literature.

The majority of driver education programs have not been formally evaluated, but a substantial literature of published evaluations exists. Studies evaluating effects of programs report mixed results – some show a modest contribution to a reduction in collision risk (e.g. Ker et al., 2005; Zhao et al., 2006), while others show no effect or even a negative effect (e.g. Elvik and Vaa, 2004). One of the biggest, most rigorous and most influential driver education evaluation projects was the DeKalb study conducted in the US in the late 1960s (Stock et al., 1983). Unfortunately the findings increased the controversy surrounding driver education rather than clarifying the situation, and the data has been repeatedly re-analysed and debated ever since. Despite re-analysis and reinterpretation, the findings have been consistent – the improved driver education program implemented in the study showed some short-term benefits but there was no significant or reliable crash reduction (see Mayhew and Simpson, 1996, for a review). Evaluation of driver education is vulnerable to methodological deficiency, analytical variation, individual interpretation and differences in schemes

that prevent direct comparison of evaluation studies. Hence the need exists for “short steps” and “constant evaluations”, as specified by Keskinen et al. (1998). The evaluation of the success of driver education is also influenced by the changing requirements of the end users and the changing demands of the traffic environment. Both the traffic environment and the driver’s educational requirements are dynamic, changing in accordance with a number of factors such as technological developments, legislation, economic climate, demographics, etc. As mentioned previously, the GDE could provide a static framework from which to evaluate driver education within a dynamic context, thus allowing evaluations to be compared more easily and facilitating extraction of elements of a “blueprint” for driver education.

3. Education of different driver groups

Given the breadth of the subject of driver education, it was deemed appropriate to focus on four key groups of drivers and the kinds of driver education they experience. The first group, general drivers, incorporates learner and novice drivers, and looks at educational interventions for the existing general motoring public. The second group, professional drivers, focuses on fleet drivers and emergency vehicle drivers. The third group, violators, focuses on educational measures aimed at rehabilitating drivers caught breaking traffic laws. The final group, specialist groups, looks at education for older drivers, motorcyclists and drivers with mental impairments.

3.1 General Drivers

3.1.1 Learner/novice drivers

3.1.1.1 Effectiveness of novice driver education

Within Europe, learning to drive typically addresses only the two lower levels of the GDE, focusing on manoeuvring skills and mastery of traffic situations. Fuller (2005) points out that “it has to be recognised that universally in Europe driver training courses have developed on a piecemeal basis and are not based on evaluative research. Neither have they been traditionally designed though the application of established principles of learning or skill acquisition”. This has been attributed to a mobility bias whereby more emphasis is placed on getting people onto the road than on maximising training and safety benefits – Dussault (1994) notes that “the demand for safety turns out to be a by-product of the demand for mobility”, concluding that “mobility has won out and will always win out

over safety". Hirsch (2003) attributes the apparent failure of novice driver education to show significant impact on collision rates in Canada to two factors related to mobility bias – firstly the under-development of research-based driver education curricula designed to reduce risk taking in young drivers, and secondly the practice trading driver education for time off graduated licensing restrictions. Driver education is meant to mitigate novice driver risk, and it is increasingly recognised that it is necessary to change the choices and habits influencing actual driving behaviour, but the individual, social and cultural factors underlying those choices are not yet well addressed (Lonero, 2008). Some studies have found a small effect from novice driver education interventions (e.g. Robazza and Bortoli, 2005; Masten and Peck, 2004) while others have found a stronger effect but only for the initial period of licensure (e.g. Shope et al., 2001).

Many driver education programs have been created in an attempt to re-train high-risk young drivers through improvements to driver knowledge and safety awareness, and the use of strategies to bring about attitudinal change (OECD, 2006). These have also displayed varying effectiveness, for example the Loewenstein Hospital Rehabilitation Centre study involving a 4-5 hour workshop on the possible effects of involvement in a serious collision, which included a simulation of life without a limb or in a wheelchair. Results showed that a particular group of licence-holders were most susceptible to this intervention – those with low academic achievement (Kolb, 1984). Many other studies do not specify the educational background of participants thus reducing comparability of intervention evaluations. The literature indicates that variance among young drivers exists based on educational factors, developmental factors, and socioeconomic status (Ulleberg, 2001). Falk and Montgomery (2009) point out that "it is no easy matter to change the attitudes and behaviour of young men in a safer direction, even through a theoretically and empirically founded intervention".

In Norway a multi-faceted campaign was carried out targeting adolescent drivers, focusing on speeding. It incorporated two multimedia productions, a training program about traffic safety for implementation by schools, police surveillance, posters, commercials and competitions on driver safety knowledge. Campaign teams visited schools to talk to the adolescents individually. A questionnaire survey indicated that the campaign changed risk perception related to speeding and other driving hazards to a significant extent, and respondents reported carrying out less risky behaviour in traffic. The number of speed-related accidents was reduced by 13%. Control groups in other areas did not display a change on any of these variables, and there were no significant differences between groups for sex, age, licence status, experience or collisions, thus the authors concluded that the campaign caused the changes in the experimental group. It is, however, unclear

which elements contributed most to the success of the intervention or whether it was the actual combination of approaches that caused the effect.

3.1.1.2 Graduated Driver Licensing (GDL)

There has been an increasing trend towards graduated driver licensing (GDL) schemes, and the UK has embarked on some degree of graduated licensing in the form of the New Drivers' Act. The advent of GDL has strengthened the relationship between driver education and licensing, but the introduction of more safety-oriented driver education, after a new driver becomes licensed and accumulates a certain level of experience, has been suggested (McKnight, 1985). The rationale for this relates to the cognitive resources of learner drivers – they do not initially benefit fully from driver education due to the excessive demands of basic vehicle control skills until automatisations has taken place, then they are able to move up the levels of the GDE. It has been commonplace for attendance at driver education schemes to lead to early release from GDL restrictions, but this is contrary to the principles underlying GDL, which are based on maximising learners' time in the driver education system. In the Ontario and New Zealand GDL systems, the time discount was justified on the basis that learners who take driver education will assimilate knowledge, skills and abilities more quickly due to the intervention, thus suggesting that driver education is in some way equivalent to on-road driving experience, and indeed suggesting that driver education attendees are safer drivers. Evaluation studies from Ontario, Nova Scotia and British Columbia suggest that time discounts have in fact compromised the overall safety impact of GDL (Boase and Tasca, 1998; Mayhew et al., 2003; Mayhew et al., 2002), cancelling out any potential safety benefits. Driver education in this context was bringing licensing of pre-drivers forward, thus increasing risk. In the New Zealand system, the learner-phase time discount was removed in 1999 when improvements were made to the program (Begg and Stephenson, 2003) and the discount was due for removal in British Columbia in 2007.

3.1.1.3 Formal and informal driver education

In Norway a driver education curriculum based on learning objectives developed in accordance with the GDE was evaluated, and the formal driver training was found to be positively associated with safety attitudes. The more formal driver education respondents received, the less frequently they reported violations. However, the study indicated that high levels of lay-instructor training and additional driving experience were associated with non-ideal attitudes and risky driving (Tronsmoen, in press), but other studies have indicated that lay instruction and additional experience contribute

to lower levels of driver risk among new drivers (Gregersen et al., 2000; Sagberg, 2000; Mayhew et al., 2003). Interestingly, parents of learners who had participated in driver education schemes had confidence in the safety benefits of the schemes and did not feel further supervision or training was required, therefore it is possible that lowering parental confidence in driver education could increase supervision and display safety benefits for young novice drivers (Plato and Rasp, 1983).

The conflicting findings relating to the effectiveness of driver education are representative of the research evidence in this field. Hirsch (2003) proposes three key reasons why driver education had not appeared to reduce adolescent driver risk in many evaluations:

- Driver education curricula are typically not based on valid scientific research of driver risk
- Driver risk taking has multiple, potentially co-varying sources that are not treated easily by a single intervention
- Policymakers have not been fully informed of the potential risks of driver education providing time discounts in GDL

The GDE matrix provides a framework that can address the first two points, as it is based upon a background of established driver risk research (see Hatakka et al., 2002 for further details), and it assists in the formation of an appropriate intervention that addresses issues at the skills level and at the behavioural level. The AAA Novice Driver Education Curriculum Outline is based on the hierarchical approach to addressing driver characteristics, traits, mental states, skills, motives, values and self-evaluation skills (Lonerio, 2008). The importance of self-evaluation is borne out by the results of a change in driver education in Denmark, whereby self-assessed defensive driving skills were promoted resulting in a reduction in multiple-vehicle collisions – a finding which was attributed to the relationship between self-assessment and educational benefits (Carstensen, 2002).

3.1.2 Existing licence holders

On an individual level, the education experienced by existing UK licence holders tends to be minimal, unless they participate in an intervention due to a driving conviction or as part of a fleet safety initiative. Drivers who volunteer to participate in advanced driving courses such as those offered by the IAM or RoSPA are often considered to be validating an already superior level of competence and self-awareness, and merely augmenting it with additional skills, rather than displaying a genuine need for education to compensate for elevated risk. There is strong evidence supporting the approaches in these kinds of driver education schemes incorporating an education curriculum with

on-road training, indicating that it improves driving knowledge and performance (Korner-Bitensky et al., 2009). Unfortunately no studies were available linking this to crash involvement. This bi-modal style of intervention appears to be more successful than a uni-modal education approach exclusively relying on classroom education. Violators, occupational drivers and specialist groups are covered in forthcoming sections so these will not be covered here.

At campaign level, both national and local campaigns are regularly aimed at the general driving population. National campaigns, such as THINK!, tend to send a clear and narrow message to a broad audience at relevant times and in relevant contexts, i.e. Christmas drink-drive campaigns on TV, summer motorcyclist awareness promoted on A-roads, etc. Local campaigns are not always as clearly targeted in terms of matching the audience with the nature of the message and the medium on which it is conveyed.

3.2 Professional Drivers

3.2.1 Company car drivers

The UK Government is keen to promote education for at-work drivers as part of their road safety strategy (DETR, 2000), and there appears to have been an increase in formal assessment and education of fleet drivers in response to the introduction of Corporate Manslaughter charges. However, the quality of the interventions and the performance outcomes are not always straightforward, as they can have a negative effect on driver risk due to overconfidence (Glad, 1988) – a phenomenon well-documented in relation to the effects of skid training (Katila et al., 1996; 2004; Christensen and Glad, 1996).

A Swedish study compared the effectiveness of an individually-oriented driver education intervention, a fleet safety campaign, a group discussion, and financial incentives within a large organisation (Gregersen et al., 1996). Collision risk and cost were analysed for the following two years, and the authors concluded that the individual driver education and the group discussions were associated with the largest reduction in crash rates. This supports the effectiveness of fleet driver education and also the benefits of the self-evaluative processes that can be brought about by group discussions, in accordance with the GDE. Another study investigated the effects of a newsletter-based information campaign and an insurance-premium related incentive program on fleet managers' motivation to promote safe driving behaviour (Newnam et al., 2006). They found no

benefit from the incentive scheme, consistent with previous research in this area (Janssen, 1994; Watson et al., 1996). In terms of the newsletters, fleet managers had a more positive reaction if they perceived that the newsletter had intrinsic relevance and was concise, simple to read and easily comprehensible.

Safety culture can play a bit part in the safety motivation of fleet drivers, and it has been suggested that organisations make more effort to promote safety culture and promote driver education, journey planning, alternative transport methods, alternative working methods (e.g. teleconferencing, home working) and trip co-ordination accordingly (Darby et al., 2009). In some cases it is impossible to alter people's driving exposure, but attitudinal and behavioural assessment and corresponding education can mitigate fleet driver risk. There are many online assessments available for fleet drivers, which identify training needs and create a "paper trail" for the organisation to show that a risk mitigation strategy has been implemented. In some cases the assessment outcomes are being linked to relevant e-learning modules to form an individualised driver education curriculum (i.e. DriverMetrics FDRI in conjunction with a2om e-learning suite).

Selection of appropriate fleet driver assessments and education interventions is a difficult task for fleet managers, and they may not be equipped with a broad understanding of behavioural risk and pedagogical rigour on which to base evaluation of different options. Hence it is important for fleets to implement rigorous process and outcome evaluations in order to justify investment in education initiatives and to understand which educational processes are effective for their drivers (Newnam et al., 2006).

3.2.2 LGV drivers

The focus of driver education for UK LGV drivers has changed somewhat with the recent introduction of the Certificate of Professional Competence, which has made it compulsory to undertake some form of driver education every 5 years. It is of concern that the CPC could effectively bring about a reduction in the age limit for UK truck driver licensing and thereby create an increase in crashes – as suggested by the research on Graduated Driver Licensing for novice car drivers discussed earlier in this review.

Previously, the majority of post-licensing LGV driver education focused around the effects of fatigue, as this is a key problem broadly identified within the research (e.g. Bunn et al., 2005; Hanowski, 2007; Gander et al., 2006). The prevalence of Obstructive Sleep Apnoea in LGV drivers and the role

it plays in exacerbating fatigue has also been a recent focus of attention (e.g. Alonderis et al., 2008; Pizza et al., 2008), leading to increases in health-related education for the LGV driving population.

3.2.3 Emergency vehicle drivers

Typically, UK emergency vehicle drivers receive a comprehensive driver education package prior to commencement of independent emergency driving, in order to prepare them for the high-risk situations they are likely to face when driving operationally. A combination of in-car and classroom education is traditionally provided, addressing core driving skills and moving up the GDE to look at motives and their potential influence on attitudes and behaviour, particularly in the form of “red mist”.

Recently some emergency service fleets have made increasing effort to utilise the GDE to inform a new approach to driver education, incorporating a broader range of educational methods. In particular, South Wales Police have implemented a program with a full pedagogical framework based on the GDE, addressing all levels starting with the lower left-hand corner and working up to the upper right-hand corner. The scheme incorporates in-car education, classroom-sessions, comprehensive attitudinal training, use of simulator technology for assessment and training of tactical decision making (in accordance with driver goals and motives as specified in the GDE), and encouragement of self-evaluative processes to promote ongoing self-development. This scheme is currently under evaluation but preliminary analyses relating to early stages of implementation suggest a safety benefit measured in terms of crash rates.

3.3 Violators

Key aims of driver education for violators are to increase their awareness of the potential danger of breaking traffic laws (McKenna, 2005), to modify their attitudes in favour of observing laws, and to bring about a behavioural change in favour of keeping to driving rules (Delhomme et al., 2008). These interventions are often described as “rehabilitation” courses, which creates an image of a fundamental change in the individual as a result of the intervention (Taxman and Piquero, 1998). It isn’t often so dramatic, but many educational programs incorporate traditional rehabilitation approaches used in other contexts (Nichols, 1990).

The majority of violator penalties involve licence suspension, warning letters, financial penalties etc., which have been shown reduce subsequent offending rates in a 6 to 24 month period following participation (Masten and Peck, 2004). The size of the effect tends to increase with the scale and obtrusiveness of the penalty.

In terms of educational improvement schemes, some research indicates that the most significant effect is seen in interventions involving direct in-person contact with a driver improvement agent (Struckman-Johnson et al., 1989). The majority of driver improvement and speed awareness interventions involve direct facilitator contact, but it should be noted that these findings relate to research dating back 20 years – remote interventions have progressed a long way with the advent of the internet and the increasing refinement of computer graphics and interactive systems. It is likely that modern distance-learning materials are far more engaging and facilitate learning more effectively, and therefore may have an effect closer to that traditionally found in a direct-contact situation.

3.3.1 Speeding

Excess speed is not uncommon and many drivers do not perceive it as a serious offence (DfT, 2004). Publicity campaigns aimed at attitudes to speed are common in many countries, but these countermeasures appear to have had limited impact on driver behaviour and speeding is still prevalent (Corbett and Simon, 1992; DfT, 2004). However, this may be due to ineffective campaign content and delivery strategy – Parker (2002) state that “it is often the case that the content of such campaigns owes more to the imagination and inspiration of the advertising agency than the theoretical principles of psychology” (p. 140).

In the case of speeding, it is now commonplace for a Traffic Violator School (TVS) approach to be used, diverting offenders onto a Speed Awareness course rather than imposing a licence endorsement. Research in the US indicates that positive effects of TVS programs may be cancelled out by the dismissal of the violation, which in turn leads to an overall increase in crash risk (Peck and Gebers, 1991; Gebers et al., 1993). A meta-analysis conducted by Masten and Peck (2004) brought the appropriateness of the use of TVS approaches and home-study courses (online or paper-based) into question, on the basis of the potential effects of violation dismissal upon completion. In the UK, driver diversion into Speed Awareness and the National Driver Improvement Scheme is popular for a number of reasons:

- Viewed as a proportionate response to an initial motoring offence
- Violators prefer to receive education than licence endorsements
- Allows the Government to avoid the allegation of revenue generation from motoring convictions as revenue funds courses
- Attractive to police forces as it is a self-funding road safety intervention and is popular with the general public

Some forces are extending their driver diversion schemes beyond general speeding and careless driving courses – for example Thames Valley Police have launched a broader scheme for young drivers, linked to the a2om e-learning modules.

3.3.2 Drink driving

Penalties for drink driving tend to be more punitive than those implemented in response to speeding or careless driving incidents. The aim of the punishment approach is to deter road users from drink driving through fear of sanctions, but research indicates that an alcohol education sentence augments the punishment of licence revocation, producing a greater positive effect in terms of fewer subsequent drink-driving convictions (Popkin et al., 1988; Sadler and Perrine, 1984). However, the education must be tailored to the needs of the target group – some programs treat drink-drive offenders as a homogeneous group (Argerio et al., 1985) which has provoked debate about the homogeneity of the drink-drive offender population (Gottfredson and Hirschi, 1990). It is unlikely that all drivers convicted of drink-driving share the same characteristics, motives, goals and reasons for carrying out the behaviour, therefore individual consideration is required. If a GDE-based approach is used, their motives and goals can be identified at the higher levels of the hierarchy, and explicit links between inappropriate goals and risk outcomes established, leading to ongoing self-evaluation and ultimately self-regulation. Many studies support the continued role of education for drink-drive offenders as opposed to a strictly punitive approach (i.e. Taxman and Piquero, 1998), but generally a combined approach appears to be the most effective in reducing recidivism. It is generally recommended that a dual approach is taken to all violator interventions, in order to achieve maximum effectiveness.

The small effect sizes of the majority of violator education interventions in terms of crash risk benefits have led researchers to question whether driver improvement is justified in terms of

resource costs and infrastructure requirements (Masten and Peck, 2004). Issuing warning letters to offenders is a very cheap intervention and can address large numbers without difficulty, and produces a similar small crash reduction - so does the increased cost-effectiveness for the same per-person effect mean that driver education schemes for violators should be replaced with automatic issuing of warning letters? Despite short-term savings, it would appear not, as driver education interventions are very much in an ongoing state of development. It has long been advocated that driver education should be more closely tailored to the problems and characteristics of narrow target groups (i.e. Donelson and Mayhew, 1987), and the development of sound psychologically-based educational frameworks such as the GDE has been relatively recent, therefore many interventions have not yet had the chance to implement the full range of tools at their disposal to maximise effectiveness. If efforts were abandoned prior to this opportunity, it is likely that significant future safety benefits would be missed.

3.4 Specialist Groups

The selection of specialist groups for consideration was guided by current research trends. The older driver population is the fastest-growing segment of the motoring public, and is therefore the subject of research interest. Currently motorcycle safety is a key area of interest as motorcycling is experiencing an increase in popularity – it offers riders an opportunity to deal with traffic congestion, provides a cheaper and greener form of transport, and (in many cases) constitutes a hobby. The other group that were chosen for consideration, mentally-impaired drivers, were selected due to an increased emphasis on independence and the need to offer equal opportunities to all potential road users where possible.

3.4.1 Older drivers

The key risk factor for older drivers is functional impairment, which is often the product of medical conditions and other age-related declines (Retchin, 2003; Owsley, 2004). This constitutes a very different risk pattern from that found in younger drivers, where risk-taking behaviour is the key contributor. It may not be possible to counter functional impairments directly through driver education, but it is possible to educate older drivers about how their impairments may affect their driving performance, and to facilitate the acquisition of compensatory strategies (Owsley et al.,

2004). Research has suggested that older drivers use 3 strategies to deal with the challenges of ageing – Selection, Optimisation and Compensation (SOC Model – Baltes and Baltes, 1990).

- Selection refers to the adjustment of goals to meet the most important needs of the individual – this is used by those experiencing some loss of resources
- Optimisation refers to enhancement and refinement of means to maximise resources – this is used by those who have not yet experienced loss of resources
- Compensation refers to the use of new and alternative means to reach or maintain their goals – this is used by those experiencing more considerable loss of resources

Driver education tends to fit in with the Optimisation section, as it provides the enhancement and refinement of means to maximise resources as specified, but as an individual's resources decline further it becomes ineffective so Selection and Compensation strategies must be implemented. These may include a reduction in driving exposure, especially under certain conditions, and using alternative means of transport (Lang et al., 2002). It is difficult for older drivers to shift from an optimisation approach to a selection/compensation approach as driving is a fundamental part of older people's primary goals (Rudman et al., 2006), so many may seek optimisation as a compensatory mechanism for declining resources. This means that older driver assessment is an essential prerequisite to enrolment on an education program, as inappropriate use of education strategies can lead to false confidence, thus affecting key elements at the higher levels of the GDE and increasing risk.

It already appears that some older drivers continue to believe that other road users are responsible for difficulties they encounter whilst driving, and they are unwilling or unable to change their beliefs about their own driving or to alter their driving habits – therefore programs including elements that challenge their values in the driving context may be have more impact (Nasvadi and Vavrik, 2007). However, it is difficult to encourage this subset of older drivers onto an educational program, as they do not recognise their own increasing limitations. Self-selection bias is a key problem in older driver education, but the Suffolk Grand Driver project reported that a number of voluntary participants were found to have serious age-related performance decrements and were provided with educational interventions to improve their driving, in combination with broader education relating to self-regulation and driving cessation. Whilst it is encouraging to know that voluntary schemes are highlighting some drivers with educational requirements, it is likely that these drivers were either already concerned about their own performance or were encouraged to attend by concerned third parties. It is possible that a large proportion of older drivers, who believe that their driving is unchanged but in reality are experiencing serious age-related declines, are not being detected. Also,

attendance at older-driver programs seems to be associated with licence revocation, so it is important to frame an intervention appropriately by highlighting the educational nature and reassuring potential candidates that the objective is not to stop them driving. In reality, very few older drivers appear to be removed from the road by force. Research has shown that doctors' knowledge relating to the relationship between specific medical conditions and fitness to drive is generally weak, indicating a requirement for increased medical education on assessment of driving fitness (Nouri, 1988; King et al., 1992; Marshall and Gilbert, 1999).

The most effective older driver education schemes have been tailored to the requirements of older drivers in terms of pace, participation and practical elements, e.g. 55 Alive, Driving Decisions Workbook self-study program (Eby et al., 2000), Wiser Driver (Strain, 2003), Knowledge Enhances Your Safety (KEYS). Educational programs for older drivers addressing age-related functional changes display a positive impact in terms of knowledge gains and safety orientation (AAA, 1998; AARP, 1997) but in many cases the extent to which attitudes and self-perceptions are altered is unclear (McKnight et al., 1982; Janke, 1994). Changes in attitude and self-perception play a critical role in generating intention of behavioural change and are therefore prerequisites to changing actual behaviour (Ajzen and Madden, 1986; Strain, 1991). However, Owsley et al. (2003) reported that self-reported perception of visual status changed over the course of their intervention, with a consequent increase in awareness of implications for driving performance. They also found that participants reported more self-regulatory practices and avoidance of hazardous driving situations compared with a control group.

Within the framework of the GDE, evidence-based recommendations for elements to include in an older driver education program include (Korner-Bitensky et al., 2009):

- Physical training aimed at flexibility, co-ordination and speed of movement
- Educational material to increase general driving knowledge
- On-road component to address driving-specific skills

Programs should include education on the roles of goals and motives in driving, and encourage the use of ongoing self-evaluative strategies in order to address the areas at the top of the GDE.

Interestingly, a fully multi-faceted approach incorporating motor, sensory, cognitive and behavioural aspects has not yet been evaluated, but a pilot study is being carried out by Korner-Bitensky et al. called Stay SHARP (See, Hear, Attend, Respond, Perform) but results have not yet been formally published.

Other approaches to improving older driver safety are also being investigated, for example the RAC Foundation recently looked into the impact of infrastructure elements on older driver risk, in order to identify areas that could be targeted. However, early findings suggest that whilst there are infrastructure changes that may benefit older drivers (and, indeed, all drivers), education is likely to be a more appropriate and effective way of reducing risk. It is hypothesised that increasing older drivers' awareness of their own driving performance through self-evaluative strategies will lead to increased self-monitoring and recognition of changing needs over time, which in turn should lead to the employment of adaptive coping strategies and a reduction in crash risk.

3.4.2 Motorcyclists

Whilst motorcycling is often separated out from driving due to fundamental differences in vehicle type and nature of road use, there are communalities in road user behaviour, and education is vital to safety in motorcycling. Motorcycle training has recently been reviewed and amended to include the new off-road element of the riding test. However, no changes have been made to some of the key educational elements of rider licensing.

The Compulsory Basic Training (CBT) course that allows provisional licence holders to ride a low-powered motorbike or scooter with L-plates is a one-day course incorporating off-road training, rider safety education and a two-hour road ride. Considering that many CBT participants have no experience of road use, it could be considered to be extraordinary that they are released with a permit to drive after approximately one hour of theory-based rider education, and another short segment on safety equipment education. On that basis, the Bedfordshire and Luton Casualty Reduction Partnership launched the Motorcycle Training Matters project, incorporating the "1st Ride" course – a pre-CBT course enabling prospective riders to try riding in a secure off-road environment prior to the CBT course, and giving trainers the opportunity to provide more comprehensive education relating to equipment, highway code knowledge, safety skills, attitude and behaviour. The scheme has also developed a post-CBT element, incorporating further skills training with more advanced attitudinal and behavioural assessment and education, and the encouragement of ongoing self-evaluative processes to facilitate self-monitoring and self-development, in accordance with ascending levels of the GDE. Evaluation of 1st Ride is not yet complete but results will be available in 2010, and the post-CBT course has not yet been administered.

It is not just novice riders who require education – existing riders often develop bad habits, and many people are returning to riding after a number of years without a motorbike. Bike technology

has moved on a long way in recent years, and the demands of traffic conditions may also be quite different, so there is a strong need to provide education for those who do not have up-to-date motorcycling experience. The Motorcycle Training Matters project provides police-assessed rides for existing riders, and advice on routes to additional training, thereby establishing a “training continuum” ranging from pre-CBT through to advanced motorcycling. Bikers are encouraged to participate in the project forum in an attempt to promote self-evaluation and a culture of bike safety within the MTM community. A psychometric assessment of rider risk is also under development to assist with the identification of training needs, and to assist with guided self-reflection. Attitudes to training within the biking fraternity are extremely varied, and further research is required to identify the most appropriate strategies to target different sub-groups with appropriate educational interventions.

3.4.3 Mentally-impaired drivers

It is important that efforts are made to enable people to learn to drive, regardless of any disability, including mental impairment. The mobility of people with disabilities is essential for the individual and for society, as mobility is associated with improved health status, autonomy and reduced need for social support – which are desirable from an ethical and an economic viewpoint (Hakamies-Blomqvist et al., 1999). The majority of research on drivers with mental impairment focuses on those with Cerebral Palsy (CP). A UK study found that an increasing number of young people with CP are learning to drive, but in some cases they have not been able to gain a licence (Simms and O’Toole, 1993). The same trend has emerged in Sweden – many people with CP have started driver education but been forced to give up prior to completion, and those who have obtained a licence have typically required much more education than learners without CP (Falkmer, 1998). Even those who did not gain a licence took a large number of lessons prior to cessation, thus indicating a problem distinguishing those who have a suitable skill base to facilitate successful driving from those who do not. A third of unsuccessful learners stopped early in training, suggesting that many key problems could be identified quite quickly – research suggests that spatial perception problems and lack of ability to perform dual tasks may be key factors (Falkmer et al., 2000). This is consistent with previous findings that drivers with CP and/or brain damage with perceptual and cognitive impairments performed badly in driving tasks (Sivak et al., 1981). In order to maximise success it would be necessary to implement an appropriate selection system based on spatial perception and multiple-task processing capability, then identify the most appropriate educational methods to

minimise the duration and maximise the effectiveness of driver education for learners with CP, as it is clear that existing methods are not appropriate.

4. Key questions

Having looked at the research evidence relating to a range of areas within driver education, it is necessary to return to the evaluation questions set out in the early part of the review:

- Do some types of driver education programs lead to better educational and safety outcomes than others?
- Can we identify which components of driver education programs work?
- How can driver education programs be improved?

Answers to these questions are put forward based on consideration of the research findings above.

4.1 Do some types of driver education programs lead to better educational and safety outcomes than others?

Yes, varied levels of success have been reported between different types of driver education programs, however, a lack of evaluative standardisation and rigour makes it hard to compare effectiveness in many cases. It is often rather like comparing a dog, a cat and a hamster, and asking “which one is the best?” – they are all fluffy animals and they all serve as good pets, but the decision as to which is the best is highly dependent on what you want from it. Recently, evaluations are more focused on tangible effectiveness measures which are directly related to the intervention, rather than associations between interventions and measures such as collision involvement which are heavily influenced by confounding variables. This should provide more valid data relating to the comparable effectiveness of driver education programs.

4.2 Can we identify which components of driver education programs work?

Identifying effectiveness of components of driver education schemes is not an easy task, as they can be heavily influenced by the effects of surrounding culture and environment, e.g. previous local engineering, enforcement and education systems, related social and behavioural traditions, or

regional cultural norms. Hence it is necessary to acknowledge the possibility that evaluation outcomes for each intervention may be influenced by additional factors.

Within individual driver education schemes, it is often possible to identify which elements were most successful within a scheme. This information can be used to inform similar schemes, but it is important to ensure that findings are used carefully, as differences in the broad context of different schemes may have a substantial impact on the effectiveness of component elements, therefore it is recommended that successful scheme components are only transferred between interventions matched for type, target audience and approach.

There is too much variation in “driver education” as a whole to be able to identify specific one-size-fits-all components from which successful driver education interventions can be constructed.

4.3 How can driver education programs be improved?

The research indicates that ensuring education interventions are built upon an established driver education framework – notably the GDE – could lead to improved quality of driver education. It would also be beneficial to assess participants prior to allocation of educational interventions, in order to facilitate targeting of appropriate educational material and utilisation of optimal educational methods. It is also important to tailor the content and delivery style of the educational material to the target audience as closely as possible, to maximise their identification with the message and in turn their acceptance and potential behavioural change. Utilisation of the most appropriate range of delivery methods available may assist in educational effectiveness – in many cases a combination of in-vehicle education and workshop/e-learning education, with a driver-coaching element where feasible. This allows the education to address basic skills, technical mastery, and trip and personal goals in accordance with the GDE, and gives facilitators the opportunity to promote self-evaluative strategies.

Appropriate and continuous evaluation of any educational program will increase its effectiveness if the results are fed back in throughout the project, as it provides information about which elements are working most effectively (and which are not). These results are important as variation in driver education schemes can have an unexpected impact on different elements of the intervention, therefore careful monitoring allows any unexpected effects to be investigated and provides the tools for continuous adjustment and improvement of the education program.

5. Conclusions

This review of the research has shown that there are few “universal truths” in driver education, due to variation in target groups, educational requirements and context. However, it is possible to identify a number of guidelines to assist in the development of successful driver education interventions, and some pitfalls to avoid.

5.1 Key components of successful driver education initiatives

- Identification of the target audience and creation of educational content tailored specifically to their requirements
- Using educational frameworks, particularly the GDE, to inform content ensures that the intervention addresses educational requirements at all levels
- Ensuring that the educational content and the method of delivery are well-suited provides a well-balanced intervention
- Continuously evaluating the intervention and feeding the results back into programme development facilitates identification and rectification of inappropriate elements, thereby improving effectiveness

5.2 Key pitfalls to avoid

- Attempting to target too many groups with a single intervention – it is more effective to meet the specific needs of a narrow group than to fail to meet the needs of a wide group
- Designing an intervention to fit with existing activities, policy and resources at the expense of educational rigour and tailoring to the audience
- Allowing participation in driver education to provide a get-out clause for violation penalties or graduated licensing time restrictions

It is therefore concluded that whilst we are currently unable to outline a comprehensive “blueprint for success” in driver education, and indeed it is debatable whether this is possible due to the varied requirements of different driver education schemes, there are key elements that should be taken into account when planning and implementing driver education. The GDE offers a valuable framework on which to build and evaluate interventions, so whilst it doesn’t constitute a “blueprint”, it does provide a useful tool to assist in progressing the effectiveness of driver education interventions a stage further.

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