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Theoretical background for program development

1. Introduction

An enormous amount of research has in recent years been devoted on the topic of novice driver behaviour and accidents, and a substantial number of research papers and reports can be found on the topic of driver education. However, rather few have concentrated on driving instructors and their training. This is somewhat surprising considering that education as such is by no means a neglected topic in research. This lack of research was also noted in the Merit project (2005).

This report aims to review the theoretical background of DI training as a background for the development of a curriculum for DI education in Turkey. The focus is on current European models and trends which follows from experiences gained through the IFD (2006) project. The main conclusions drawn on the basis of IDF were that adequate driver education by qualified and motivated DI:s is necessary for safe road traffic, that basic training of DI:s in Turkey is insufficient and continuous training is completely lacking, and that there is an urgent need for both improved DI skill training and safety attitude formation.

Road safety is very much in focus within the EU region today, and the European Commission has made road safety a priority in its agenda. The aim of the European Road Safety Action Programme of 2001 (European Commission, 2003) is to halve the number of road accident victims in the European Union by the year 2010. Amongst others, DI:s are identified in the programme as one major target group. To this end, the European Commission initiated a project (Merit, 2005) with the objective to propose ways to improve the training of DI:s, and to set up minimum standards for instructor and examiner qualifications, more of which below.

3. Theoretical background

3.1. What is important in a DI:s work?

The work of a DI naturally involves not only teaching but many other tasks. Often, and depending on the driving school system, the work is also very much business oriented (e.g. Silcock et al. 2000). In this discussion, however, the focus is on the teaching aspect.

There is great consensus in the available literature over what the work of a DI should be about, at least on a general level. Silcock et al. (2000) for example conducted a survey to approved driving instructors (ADI) in Great Britain to answer the question “what makes a good ADI”. Apart from personal abilities such as being patient, tolerant and inspire confidence, an ADI “should be a good driver and know the Traffic Code”. An ADI should also be able to apply a range of teaching/learning and communications methods, and to adapt these methods to the needs of individual clients.

Silcock et al. further emphasise that ADI:s should not only strive to achieve success in the final driving test for the license, but also instil “safe driving habits for life”. They should in their teaching stress that a basic level of car control skills is not sufficient for safe driving. Learners should also understand what they should be doing and why, and what effect it might have on other road users. It is interesting to note, however, that the question of feedback to learners on their performance is not raised, nor is learners’ self-evaluation. Silcock et al. seem to regard feedback as something coming from clients regarding the quality of training, to be used to improve the level of service of the driving school.

Meadows & Stradling (1998) go a step further and raise the need to widen the focus in driver training to cover not only vehicle handling and related traffic skills, but also attitudinal matters. The need to address matters related to lifestyle and motives is raised also by Gregersen & Nyberg (2002). They also emphasise that learners' self-evaluation and feedback from DIs are central elements in learning.

Several other researchers, too, argue that while vehicle handling and traffic management skills are important, they do not alone ensure safety. Hatakka et al. (2002) note that most attempts to improve safety by improving vehicle handling skills only, have actually failed to decrease accidents. Training to master slippery road conditions is a good example: some driver groups benefit from it while the effect is negative for others (Katila et al., 1996; Keskinen et al., 1992). Bailey (2003) notes that driving instruction tends to be characterised by teacher focussed approaches, typically when developing skills for vehicle control. Yet higher-order cognitive skills such as risk awareness, hazard perception, and decision-making are known to have a major influence on driving.

Training which focuses on vehicle handling is often regarded very positively by learners. Rowden et al. (2007), in an analysis on motorcycle rider training in Australia, found that riders reported effective learning and willingly applied the knowledge and skills acquired in rider training once licensed. This, in turn, may be rewarding to the DI and may give him a false sense of success. As Keskinen (2008) points out, the feedback a learner gets from this type of exercises is immediate and promotes a feeling of learning. Indeed, when looking into the accident records of these riders after licensing, Rowden et al. found that in many cases the acquired knowledge and skills did not carry over into practice, i.e. the training did not seem to affect accident involvement. They suggest either a lack of learning transfer, a decay over time of what was learnt, or that other factors not addressed in training (e.g. of an attitudinal or motivational nature) influenced rider behaviour once licensed.

The results of Rowden et al. resemble the results of a study by Peräaho et al. (2000) on the effects on accidents of a training which emphasised "roadcraft", i.e. teaching of skills to avoid accidents. This training was also regarded very positively by students, but it did not have any positive safety effects. Training which strive for producing relaxed and confident drivers, may lead drivers to overestimate their actual driving skills, leading to increased level of task difficulty, e.g. driving faster or overtaking in heavier traffic (Gregersen, 1996; Evans, 1991; Job, 1990; Mayhew & Simpson, 2002). Gregersen (1996) convincingly confirmed in an experiment with a "Skid Car" equipment that training in managing emergency situations produces more false overestimation of actual skills than a training method based on an insight training strategy where drivers were made aware of the fact that his own skill to manage may be limited and unpredictable. Gregersen notes that the actual vehicle handling skill level of the two groups was similar regardless of training strategy.

The feeling of mastering the basic skills involved in driving is also regarded by many researchers (e.g. Harre, 2000; Hatakka 1998) as a crucial component in the risky driving behavior of many young drivers. Rosenbloom (2003) attribute this to a feeling that things are under complete control.

The evidence above exemplify that skill training is not enough. Consequently, the current approach in Europe is therefore to move away from the tradition to regard knowledge of matters such as vehicle handling, traffic rules and hazard perception, as synonymous with safe driving. Training should instead be extended to cover also matters related to lifestyle and

motives. The methods used in teaching must also be adjusted accordingly. This, in turn, affects DI training as well, and DI training and testing curricula must correspond to the demands of road safety (Merit, 2005). The European Commission has therefore requested that planning of DI standards should be done with the GDE-matrix (Goals for Driver Education) as a starting point.

The matrix is a conceptual construct aimed at providing a holistic understanding of the competencies needed to drive safely (Merit, 2005). It has on the European level been accepted as the starting point for the development of driver education. From this follows that DI:s should also be familiar with the matrix and should be able to implement it in their work. As Gregersen & Nyberg (2002) puts it, DI:s should naturally themselves be familiar with the things they teach. Below is a short description of the matrix. A more thorough description, and a discussion on how it may be implemented in driver education, may be found in Peräaho et al. (2003).

3.2. The GDE-matrix

The framework was introduced in its present form within the EU-funded research project GADGET (Hatakka, Keskinen, Gregersen & Glad, 1999) and published internationally for the first time by Hatakka, Keskinen, Gregersen, Glad & Hernetkoski (2002). Stemming from the project, the framework is sometimes referred to as the "Gadget-matrix".

1.1. Background: The hierarchy of driving behaviour

Although knowledge of how to use the controls of a car and how to manoeuvre it forms the basis of driving, modern research in traffic psychology has demonstrated that it is not sufficient for good and safe driving. Of importance is not only **what the driver can do** (know-how), but also **what the driver is willing to do** (e.g. Rothengatter, 1997). Willingness has to do with motivation and attitudes. Theoretically, a driver's tasks and associated skills may be presented as a hierarchy (Keskinen 1996, figure 1).

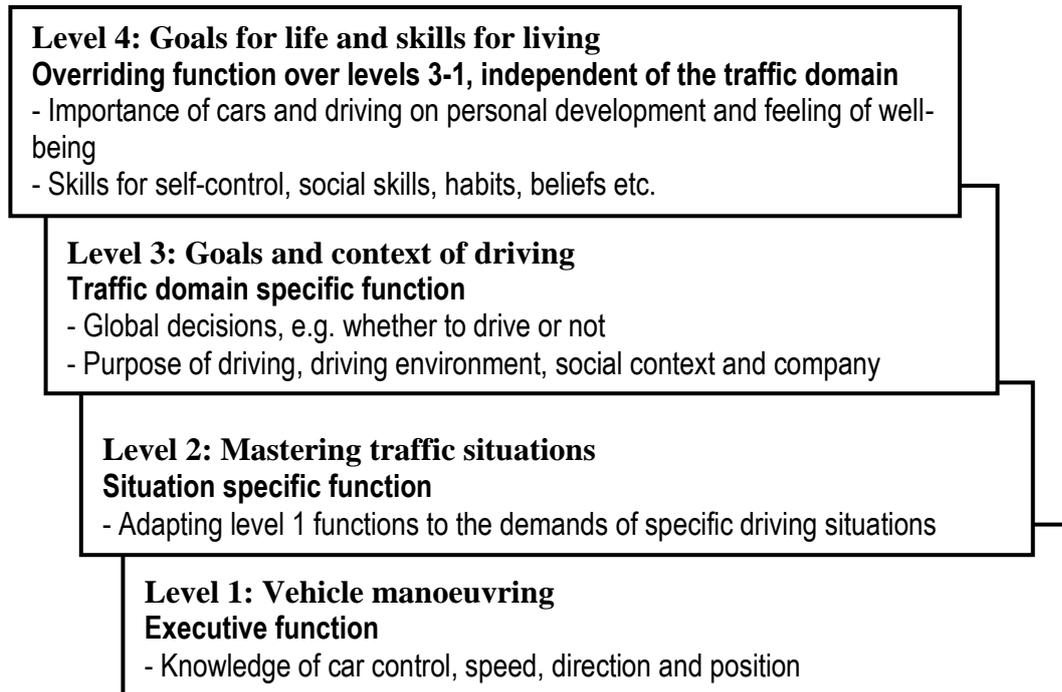


Fig.1. The hierarchical levels of driver behaviour (adapted from Keskinen, 1996).

The hierarchical view of driver tasks, as presented in Figure 1, owes to cognitive psychology, which is today the dominant approach in psychology. The cognitive approach to psychology looks upon individuals as active and goal-directed participants in and observers of their environment, e.g. traffic. The internal mental processes of an individual are emphasised as being the driving force behind all behaviour, and the observable behaviour is then just the end result of a long cognitive process. For example, before the actual decision to drive, a driver makes many part-decisions: why to drive, when, with what, with whom, in what conditions, in what physical state etc. These decisions are mostly not made consciously but they affect the actual driving performance: how well it is carried out, suitability, obedience to rules etc.

Although the levels (the word “level” is synonymous with the things it represents) are qualitatively different from each other and separated in the model, no single level is independent from the other levels. They are all present in a driving situation, and together they encompass the different components make up a driving task. A change at one level brings about a change at other levels too, and performance is constantly evaluated and adjusted through feedback, upward as well as downward.

But interdependence and feedback does not imply equality. A basic assumption in the model is that a higher level controls and guides behaviour on a lower level. The cognitive structures that we call the "highest level" (level 4 in the model) provide the basis for a person's way of life, in general as well as in the specific traffic context. They are therefore more stable and fundamental compared to the other three levels, which in turn have more to do with actual driving situations and subordinate to the goals motives on the highest level. The factors and inner models that are located on the highest level are therefore the ones that are most important from a safety point of view. No matter what amount of vehicle handling skills,

safety knowledge, or knowledge of rules a driver may have, the effect of this knowledge is ultimately dependent upon if and how the driver uses it or is willing to do.

Level 4: Goals for life and skills for living

The personal motives, behavioural style and abilities, and the social relations of a driver in a broader sense are the main ingredients at the highest level in the hierarchy. These include personality factors such as self-control, but also life-style, social background, attitudes, gender, age, group affiliation, importance of cars and driving as parts of one's self-image, and other preconditions that research has shown to have influence on choices and behaviour as a driver, and consequently on accidents. Important sources for the formation of internal models on this level are social groups, family, friends, or role models such as racing car drivers. It is important to notice the effect of feedback for the formation of these models, especially if the feedback comes from someone who is regarded important by the individual. For example, in the case of young drivers, positive remarks from friends easily strengthen the behaviour in question.

This level also includes factors such as a driver's physical and mental abilities (e.g. handicap and cognitive level of functioning). They are factors that the individual driver, or driver education for that matter, can do very little about other than taking them into consideration as something which limits the choices available. However, awareness of such personal limitations serves to lessen their negative effect.

Later extensions of the hierarchy (Keskinen & Hatakka, 2005) have included a societal or cultural component on top of this level, emphasising the influence of the outside world and a person's living conditions on behaviour. For example, the effect of culture on driving is amply demonstrated by Özkan (2006), with focus on Turkey. In particular, Özkan demonstrates the importance culture plays in what is regarded important when it comes to driving and what is not. If the findings hold true for driver license holders on the whole, it is reasonable to assume they hold equally true for learner drivers and DI:s as well. Evidence of the effect of cultural factors on accident risk is reported also from Sweden, where e.g. immigrants from the Middle East and North Africa have been found to have a four time higher crash risk than drivers born in Sweden (Merit, 2005).

The recommendations put forward by the EU include training for DI:s especially on the higher levels of the GDE-matrix, and on teaching methods in accordance therewith (Merit, 2005).

Level 3: Goals and context of driving

The second highest level in the hierarchy concerns the context and goals of a particular trip, for example why is the driver driving, where to, when, and with what. This includes strategic choices such as route planning and time of day, as well as driving fitness. These decisions and choices are determined by the preconditions on the highest level (level 4).

The vehicle becomes in a way the tool for reaching whatever higher level goals the driver might have. Although the physical environment in which the driver operates is as such beyond the influence of the driver, he or she can normally choose whether to drive or not. He can, for

example, mostly choose whether to drive himself or take a taxi. And if he decides to drive, he can choose whether to drive in daylight or at night, or sober or while drunk. These decisions have a direct influence on behaviour, failure or success, on the lower levels. For example, if the person decides to take a taxi home after a party, he frees himself from the task of having to master traffic situations (level 2), as well as the task of manoeuvring the car (level 1). The effect of his driving fitness is thus minimized as far as safety is concerned – he can very get to sleep in the back seat of the taxi cab.

Level 2: Mastering traffic situations

Focus on the second level in the theory is on competence that has to do with knowledge of how to drive in a certain traffic situation. A driver must be able to anticipate and adjust his/her driving in accordance with the constant changes in traffic (e.g. choose an appropriate speed). Knowledge of traffic rules, hazard perception, and interaction with other road users are typical contents on this level.

Choices that are made on this second level follow from third level choices and fourth level preconditions. For example, a driver who decided (on level 3) to drive despite bad weather conditions might be in for serious trouble if the weather turns even worse and if he did not reserve enough time for the trip, or if careful driving is not among his priorities (level 4) in the first place.

Skills for mastering traffic situations are essential for success in traffic. It is necessary, that licensing systems should guarantee that these skills are on a good level. However, as driving is essentially a self-paced task, the driver can choose the demands that are put on his or her skills (Hatakka et al., 2002).

Level 1: Vehicle manoeuvring

Any motivation to show off through driving (level 4), or knowledge of traffic rules (level 2) make no sense if a person does not know how to start a car engine in the first place. The role of this first, or lowest, level in the hierarchy is in the theory considered to be **executive** in respect to choices made on levels 2, 3 and 4. Especially the connection to the previous level (level 2) is obvious, but the focus is different. Focus on this level is on the vehicle and its properties, and on the interaction between the driver and the car. Emphasis is on skills that have to do with vehicle control and handling. This includes not only basic skills such as knowledge of controls, driving off, braking, gear changing etc., but also more complex knowledge such as keeping the car under control, evasive manoeuvring, understanding the concept of traction, the impact of seat-belts, use of rear-view mirrors, etc. For example, if the driver in the example above who is driving in bad weather is driving too fast, he might drive straight in a bend as the demands on manoeuvring skills become too great on the slippery road. On the other hand, an appropriate choice e.g. regarding speed makes driving manageable in slippery conditions despite weaker manoeuvring skills.

More crucial than the actual skill level is how these skills are used, and for what purpose. Thus it can be concluded that if we want effective driver training, we should carefully consider which skills should be emphasised and how these skills should be practised for the particular target group (Katila et al., 2004).

Connecting the levels to driver training: The GDE-matrix

The four-level hierarchy is expanded in the GDE-matrix with a second dimension incorporating **knowledge and skills**, **risk increasing factors**, and **self-evaluation (self-assessment) skills** (table 1). It is thereby possible to create a structure for defining what driver education and teaching should focus on.

Table 1. GDE-matrix (from: Peräaho et al., 2003).

Hierarchical level of behaviour (extent of generalisation):	Central content of driver education:		
	Knowledge and skills the driver has to master	Risk increasing factors the driver must be aware of	Self-evaluation
Goals for life and skills for living (global)	Knowledge about / control over how general life goals and values, behavioural style, group norms etc. affect driving.	Knowledge about / control over risks connected with life goals and values, behavioural style, social pressure, substance abuse etc.	Awareness of personal tendencies re. impulse control, motives, lifestyle, values, etc. Developing self-evaluation skills.
Goals and context of driving (specific trip)	Knowledge and skills re. trip-related considerations (effect of goals, environment choice, effects of social pressure, evaluation of necessity, etc.).	Knowledge and skills re. risks connected with trip goals, driving state, social pressure, purpose of driving, etc.).	Awareness of personal planning skills, typical driving goals, driving motives, etc. Developing self-evaluation skills.
Mastery of traffic situations (specific situation)	General knowledge and skills re. rules, speed adjustment, safety margins, signalling, etc.	Knowledge and skills re. inappropriate speed, narrow safety margins, neglect of rules, difficult driving conditions, vulnerable road-users, etc.	Awareness of personal skills, driving style, hazard perception, etc. from the viewpoint of strengths and weaknesses. Developing self-evaluation skills.
Vehicle manoeuvring (specific task)	Basic knowledge and skills re. car control, vehicle properties, friction, etc.	Knowledge and skills re. risks connected with car control, vehicle properties, friction, etc.	Awareness of personal strengths and weaknesses re. basic driving skills and car control (especially in hazardous situations), etc. Developing self-evaluation skills.

Column 1: Knowledge and skills

The first column in the framework (Table 1) describes what a good driver needs to know at each level in order to drive a vehicle and cope in normal traffic circumstances. This includes e.g. how to manoeuvre the car, how to drive in traffic, what rules must be followed (skills belonging to the two lowest levels), how trips should be planned (third level skill) and how personal preconditions influence behaviour and safety (skill belonging to the highest level). The term "knowledge and skills" encompasses both practical and theoretical knowledge and skills.

Especially the lower half of this column is familiar to the traditional notion of driver training, where basic knowledge of e.g. traffic rules, manoeuvring and driving in different traffic situations are typical contents.

Column 2: Risk increasing factors

The second column in the framework is closely related to the first column but it emphasises particular knowledge and skills related to factors that increase or decrease risk. The content in the second column stands in its own right because of the importance of these factors for safety. They must in practical driving school education be integrated into teaching of general skills and knowledge (first column). Not only do the risks referred to here connect **directly** to a certain driving situation (e.g. the effects of ice and snow, or worn-out tyres) but also **indirectly** (e.g. social pressure or life-style). The risks are thus different on different levels of the hierarchy.

There are potential hazards at all levels of the hierarchy the driver needs to be able to recognise, such as risks related to type of the trip or personal motives or behavioural tendencies. In driver education in practice, traffic-related risks can hardly be treated separately from the skills that are being taught: every particular risk has to be tied to some body of experience. **Skills and risks can therefore not be separated in driver education.** The reason why risks have been emphasised in the framework has simply to do with their importance.

Column 3: Self-evaluation

Modern pedagogical thinking regards self-evaluation as a central and essential element of learning. Self-evaluation might be defined as a process whereby an individual tries to get feedback on his or her personal actions from within the self. In the context of driving it is a matter of becoming, or wanting to become, aware of **personal preconditions and tendencies as well as skills and abilities regarding manoeuvring, coping in traffic, planning of driving, and life in general.** In short, being able to perceive realistically different factors that have an influence on driving, and the importance of one's own actions and motives in the process.

Conclusion

When we move upward and to the right in the matrix, we notice that there is qualitative change regarding the what the driver has to learn and become aware of: from what is basically concrete and easily defined operations to more abstract constructions that are hard to define. As for teaching, a combination of methods have to be used. The contents of the highest level, and much of the third level, is something that cannot be reached through traditional teaching methods, as becomes obvious from the descriptions above. The goals are mostly hidden even to the driver himself, although they can be, to some extent at least, revealed through feedback and self-evaluation. It is possible to cover all levels of the hierarchy only through use of a combination of different teaching methods such as driving in traffic, demonstrating, practising

singularly or in groups, discussions, and feedback. This implies that a DI should be able to master a wide range of methods and techniques.

The message of the GDE-matrix is that good or bad (from a safety point of view) decisions and choices on higher levels, especially on the highest level, affects the demands on lower level skills. If a driver is, for example, motivated to show off his skills (highest level), it might put too high demand on his vehicle handling skills (lower level skills). However, the driver can, through feedback and self-evaluation, become aware of this motivational tendency and adjust it to a level that suits his actual skill level.

All levels are equally important and present in every driving situation. From this follows that they should all be familiar to DIs and included in driver training and taken into consideration even in training situations that focus on matters that theoretically belong to only one level, e.g. manoeuvring. It is emphasised in the GDE-matrix that the effects on behaviour of higher level goals and motives should be included in driver training in order to make drivers aware of not only strengths and weaknesses in vehicle handling, but also of the influence and demands put on these skills by higher level goals and motives. The lower levels are familiar to driver training as we know it today. The higher level factors, on the other hand, are more difficult to grasp, as they cannot be observed and measured directly. They are to some degree accessible through the second highest level especially when using self-evaluation as a tool. Continuous self-evaluation is therefore included in the GDE-matrix as an essential element of training. The task of the DI is therefore to encourage learners to reflect upon their behaviour and skill level, especially from a safety point of view.

This is not an easy task as safety may not be number one among the motives of youngsters (Mayhew & Simpson, 2003). The methods used should therefore appeal to the target group. The issue of age and experience has relevance in this respect: age affects more than experience how and for what purpose one is driving. Experience, on the other hand, has more effect on how well a driving task is carried out. In the GDE-matrix, the two top levels are more age specific than the two lower levels, as all drivers must possess the skills specified in the matrix irrespective of age. From this follows that driver training, targeted as it is on younger age groups, should focus on making learners aware of the influence of their own motives and tendencies on driving and safety rather than on trying to make them into even more skilled drivers technically (Berg, 2006).

3.4. Teaching based on the GDE-matrix versus traditional teaching

The relevance of the GDE-matrix for DIs is that it gives them a possibility to understand why certain types of educational strategies do not produce the desired results (Merit, 2005). The understanding that despite the same amount of knowledge, individual motives influence the way this knowledge is used, makes it possible to adapt the training strategy to the individual. The role of teaching in accordance with the GDE-matrix is outlined below. The text is based on a presentation by Keskinen (2008) but extended with additional comments.

Traditionally, teaching in driver education concentrates on the two lowest levels of the GDE-matrix: *manoeuvring skills* and *mastery of traffic situations*. Focus is also put on knowledge and skills, and partly also on the risks involved on these two lowest levels. Not so much emphasis has been put on the higher levels: *goals and context of driving* and *goals for life and*

skills for living. Even less energy has been invested in teaching about risks and self evaluation skills on these two highest levels.

If we, however, consider the concept of feedback and its role in learning, we may notice that teaching in one or another form is especially important in the area where it does not nowadays exist and less important in the area where it is used with maximal effort.

It is easier to learn manoeuvring than to develop skills for living

We know from experience, that the easiness of learning differs on different levels of the matrix but also in different columns (Table 2). On the lowest level, manoeuvring, where the learning task is a simple perceptual-motor task, the learning takes place easily and it is also very rewarding. The learner recognises easily the development of his own skills on this level. Learning of risks is also easy, as is learning to evaluate one's own skills.

Table 2. GDE-matrix: easiness of learning (Modified from Hatakka, Keskinen, Glad, Gregersen, Hernetkoski, 2002)

	Knowledge and skills	Risk-increasing factors	Self-evaluation
Goals for life, skills for living (general)	**	**	*
Goals and context of driving (trip related)	***	***	**
Mastery of traffic situations	****	****	***
Vehicle manoeuvring	*****	*****	*****

* = DIFFICULT, ***** = EASY

But the learning gets more difficult already on the next level: mastery of traffic situations. It takes more time to master different traffic situations than to learn the basics of car manoeuvring. Learning to evaluate how developed one's own skills are for mastering traffic situations is even more difficult.

How the goals and context of driving, or the goals for life and skills for living affect a driver's safety on the road is a difficult learning task. Of course it is not so difficult to learn these things as a piece of knowledge or "in theory", but it is more difficult to behave in accordance with this knowledge.

It is even more difficult to evaluate how skilled a driver is on these levels, and what his own special risks are.

The feedback makes the difference

When considering these differences regarding the easiness of learning, it is possible to recognise many differences regarding the learning task. Learning on the lowest level concerns perceptual-motor skills, whereas on the highest level it becomes an intellectual and analytic learning task. There are also other differences, but one of the differences that have major effect on learning is that the required feedback is qualitatively different on each level.

All learning of skills is based on feedback. When the learner is practising, he is acting in a way he believes is right. Then he waits to see what happens, i.e. he waits for the feedback. After that he adjusts his behaviour according to this feedback and tries again. Trial after trial he learns more and more and his behaviour will be more and more skilful. The starting point for the feedback is the difference between the present situation and the perceived goal. A comparison between the present situation and the goal gives information to the learner so that he can change his behaviour accordingly.

The origin of feedback

The origin of feedback can, according Annett (1961), be intrinsic or extrinsic. *Intrinsic feedback* is based on the knowledge a learner can get from the normal sequence of actions when practising a task. No special arrangements or devices are needed to get feedback during or after the performance. What Annett calls *extrinsic feedback* is when the learner gets feedback from another source than the normal sequence of actions. The feedback is provided to the learner through devices or other persons during or after the performance. In learning of many skills this "special arrangement" is called a teacher. Apart from giving information concerning goals and the accomplishment of the skill itself, one of the major tasks of the teacher is to offer feedback to the learner.

Another useful way of classifying feedback is to divide it into internal and external feedback. *Internal feedback* (proprioception) is what the learner gets inside his body from his own inner senses, for example kinaesthesia. *External feedback* (exteroception) is feedback collected from outside the body through the senses, for example sight, hearing and touch. The source for the feedback can be either natural, or it can be arranged (Table 3). The intrinsic feedback is partly internal, especially when it comes to learning motor performance, and partly external. The higher in the hierarchy the learning task is situated, the smaller is the proportion of internal feedback. On the highest level, there is no possibility to use internal feedback in learning. External feedback becomes then important.

Intrinsic or natural feedback is always important but as we can see later, it is not enough.

Table 3. How the learner gets feedback: natural or arranged feedback

	<i>Intrinsic (natural)</i>	<i>Extrinsic (arranged)</i>
<i>Internal</i>	- feeling how hands move on steering wheel - acceleration/deceleration	- device gives feedback straight to driver's "inner senses": rumble strip on road

External	- seeing how the car moves	- hearing teacher's explanations
	- seeing other drivers' behaviour	- seeing ones own driving on video
	- hearing horn honking	

The role of goals and feedback

Clear goals are important for effective learning, because they make feedback possible. Without goals there is no possibility to get feedback, as feedback for controlling behaviour is in a psychological sense always the difference between the present situation and the goal. This is why an explicit description of goals is so important for the learner, and of course also for the teacher. They both have to know "where they are and where they should be heading".

The most important aim in creating the GDE-matrix was to give a full description of the contents of the skills of a safe driver.

Differences in the quality of feedback

Intrinsic or natural feedback plays an important role when we take a look at the quality of feedback in learning to drive. Four different aspects of feedback have been chosen to describe the differences in feedback between lower and higher levels of the matrix.

The different aspects of feedback, which are important in learning are: 1) time delay after action, 2) specificity of feedback concerning the performance, 3) the availability of feedback during the performance and 4) need for the reconstruction of feedback.

Considering driving, we can notice that the qualitative aspects of feedback on each hierarchical level differ from each other and this puts demands on the teaching as well.

1. Time delay after action

On the two lowest levels, manoeuvring and mastering traffic situations, the time delay from action to feedback is very short. The delay could almost be described immediate. This is of course always the case when the task is based on psychomotor processes. The delay after turning the steering wheel until the car starts to turn is very short.

However, when the driver's task is to learn how to plan and execute complete trips (length, environment, driver's physical and mental condition, company in the car etc.), then the time delay is much longer. Only later may the driver understand, that it was not a good idea to start driving after heavy physical exercises late in the evening and reserve a short driving time for a long trip. It also takes a long time to get feedback from one's own actions when learning how matters on the highest level, goals for life and skills for living, affect one's personal driving safety. A driver may have a habit of driving long distance trips at night, especially when he is angry or upset. The feedback regarding the safety effects of this kind of behaviour, may take months or even years. The same may apply for drinking habits.

2) Specificity of feedback concerning the performance

The feedback on the lowest levels of the hierarchy is specific and differentiated. There is exactly one piece, or at least only a small number, of specific feedback after each action. For example, when turning the steering wheel on a dry surface (when the car is moving), the response of the car is always the same. However, there will be some variation when the road surface is slippery, and it usually takes a long time for a new driver to learn this difference. Also in traffic situations, the responses of other drivers are fast and the experience of managing the situation is also immediate.

The feedback a driver gets on the trip level and on the life skill level are not at all as specific as on the lower levels. They are more general and undifferentiated by their nature on these highest levels. These responses are often only positive or negative, but not specific, and they do not provide any feedback differentiated enough to change behaviour. When a task is to learn to combine drinking and driving habits, the feedback may be quite general. The driver may know that driving and drinking do not fit together. But how should he change his behaviour, and what options does he have?

3) Availability of feedback during performance

When performing psychomotor tasks, feedback is always present. The acting person gets feedback e.g. by seeing how the car moves or how the traffic situation develops. One of the reasons why there is always feedback on the lowest levels is of course that the feedback on these levels is also immediate. In other words, it is easy to get feedback from the driving performance itself. For example, if the car engine stalls due to improper operation of the clutch, the driver can immediately see what happened. Feedback from the DI may be needed initially to point out the connection, but the learner may thereafter through trial and error find the correct operation for himself. All trials, however successful, provide immediate feedback and produce either positive or negative reinforcement.

But when we consider feedback from the behaviour on the highest levels, it becomes evident that immediate feedback is only seldom available. Someone else has to provide it, and that is usually the responsibility of the DI. Responses, and therefore also feedback, from the environment may be accidental: there is not always police surveillance on the road, and accidents are rare events.

4. Need for construction of feedback to get meaning out of it

On the lowest levels of the hierarchy, the feedback could be said to be “self-explaining”. There is no special need for reconstructing the feedback to understand its meaning and to take corrective actions on the basis of it. This self evident nature of the feedback on the lowest levels is partly based on its three qualitative aspects: short time delay, specificity and availability.

On the third level, the trip level, there is also a possibility to get partly self-explaining feedback, for example when a person has difficulties in driving because he is tired. The problem may be that the driver still has difficulties to understand the reasons for this tiredness during driving, and especially, what he could do about it.

The phenomena on the third and fourth level may be easy to understand, but the preventive methods are not always that easy. Driving to a restaurant for a drink and then driving back while intoxicated seems for some persons to be a difficult equation to solve. Here the learner

driver needs extrinsic feedback because intrinsic feedback only may not be enough. One of the reasons for this is that high level information processing is needed when collecting high level feedback.

Differences in the quality of feedback: summary

On the lowest levels there is a good possibility to get useful, intrinsic feedback for learning even without the help of other persons as long as the learning situation is arranged so that it is safe. Extrinsic feedback is not necessary if the environment is such that it makes it possible for the learner to practise.

On the highest levels, the possibilities to get useful intrinsic feedback for learning are very limited without the help of others. Extrinsic feedback is necessary.

The differences between the levels are even larger when we move from the column knowledge and skills to self-evaluation skills.

This is the real challenge for teachers and the methods used in teaching. On all the levels, the teacher should give the learner enough possibilities to practise without controlling his behaviour too much.

On the lowest levels, where the learning task is more like a perceptual–motor task, the possibility of getting enough and good quality feedback is excellent. Feedback follows immediately after action and it is very specific. The feedback on the lowest level tells the learner exactly what the effect of his behaviour is. Also on the next level, mastery of traffic situations, the feedback is pretty self-evident, but not as much as on the lowest level. Already the interaction between road users demands more knowledge and more interpretation than the feedback on the lowest level. We could therefore say that, on the two lowest levels, the learner could manage the learning task by himself as long as he can practise in an isolated area with minimum risk of a serious collision. A teacher is needed when practising in traffic in order to guarantee reasonable safety.

On the lowest level it is also possible for the learner to learn to evaluate his own skills, as long as he knows the target level of his skills. But already on the next level this is not any more so self evident as the interaction between other drivers and vulnerable road users is so complicated.

As Lund (2006) points out, training aimed solely at the two lower levels without raising self-knowledge related to learning and skills can easily become pure proficiency training. This may lead to excessive confidence in one's own skills and to the fact that the skills a rider believes he/she should possess are used to achieve goals entailing risky driving. An understanding of the effect of factors at the highest level together with self-knowledge regarding one's own weaknesses and strengths can be important in counteracting such tendencies. The GDE matrix aims at developing training that makes riders reflect before choosing a driving style or driving behavior.

The feedback on the two highest levels is qualitatively different. The feedback is less rapid because, as opposed to the lowest levels, it is by its nature more probabilistic than deterministic. A certain act on the first level always produces a certain effect. There is a firm connection between cause and effect. But on the higher levels, one may have to wait a long

time for the effects, and even then they are not so simple. A driver may, for example, go on drinking and driving successfully for many years even though the risk level is rising all the time. Or the driver may think that his way of living and driving is not risky even if it may contain many risky elements. Especially for self-evaluation on the highest level, there is not so much good quality feedback to be derived from what you do in traffic directly. All feedback on these highest levels needs a great deal of interpretation in order to be useful.

This means that on the highest levels, a learner would need more extrinsic feedback from the teacher who could give a meaning to what the driver has noticed in traffic. On the lowest levels, on the other hand, the need for teaching is not so great, because the skills on these levels may be learnt even without a teacher, through feedback from the learner's own actions.

Conclusions

In order to meet the demand of learning on the higher levels of the hierarchy we need, besides structural changes in driver education, changes especially in the methods that are used in teaching. The methods have to provide effective learning also when dealing with topics that are difficult to learn. This means that more effort, and more resources, should be pointed towards the higher levels instead of the lower ones.

This implies that focus should be directed on the competences of DI:s. For example in Norway, in the new rider training system, DI:s are also required to possess insight and training in how to help learners to acquire self-knowledge (Lund, 2006). This demand is approached by providing compulsory training courses to DI:s in addition to their basic training, on how to approach learners when it comes to higher order cognitive skills. As Lund (2006) points out, DI:s must simply raise their competency levels.

4. HOW SHOULD DI TRAINING BE CONSTRUCTED?

From the studies above and the results of the MERIT project, it is obvious that in order to cover the various aspects of the GDE-matrix, a combination of teaching methods have to be employed. Although there will still be place for "traditional" educational methods such as lecturing or demonstrating, the aspects that relate to higher order cognitive skills will have to be addressed through other methods (Keskinen, 2008).

One basic question which has to be asked when giving driving instruction is what purpose it serves: helping learners to pass the driving test, or to prepare them for solo driving after driving school and to foster ongoing learning after the driving test (Hermes, 2007). This question is perhaps not apparent to learners when they enter driving school as the reason for coming is naturally to get a driving license, but it should be clear to DI:s from the start. In the end it is also a question of DI:s being responsible for training safe drivers.

As mentioned at the beginning of this report, the Merit-project (2005) was initiated with the objective to propose ways to improve the training of DI:s, and to set up minimum standards for instructor and examiner qualifications. The standard of education of DI:s within the EU region today is generally poor and there is a huge variation in both quantity and quality between the countries studied (Merit, 2005). Furthermore, DI training does not adequately cover all aspects of driving, especially those aspects that are related to a driver's higher order cognitive skills (Merit, 2005). These skills cannot be taught through lecturing or

demonstrating or similar teacher-focused approaches that DI:s appear to rely on (Merit, 2005). From the nature of the higher order skills on the higher levels (motivation, attitudes, values) follows that they are not directly observable, and that DI:s must be able to address these issues during training, while driving as well as in class. This is not an easy task, and the issue is currently in focus of an EU project (Hermes, 2007) aiming to develop a training package for DI:s on communication skills.

4.1. Minimum standards

The conclusion of the Merit project (2005) was that both the basic and further education of DI:s need to be improved, and that there are significant differences between countries in Europe, reflecting cultural, philosophical, economical and historical differences. These differences concerned quantity but also quality. Short-, medium- and long-term visions were therefore set up to harmonise DI standards in Europe, specifying minimum standards for DI training. These standards focus on DI requirements for category B licenses, and may have to be modified somewhat for other categories. A full description may be found in the Merit report (2005), but the main issues may be divided into six categories:

General competencies

Apart from a comprehensive knowledge of the GDE-matrix, a DI should have...

- a) Comprehensive knowledge of the Goals for Driver Education, in the form of the GDE-matrix
- b) Familiarity with a wide range of communication, teaching and motivational skills, with a particular emphasis on targeting self -evaluation skills amongst learner drivers (right column of GDE matrix)
- c) Ability to assess the skills of the learner driver and to identify and address shortcomings
- d) Ability to drive in a consistently high social, defensive and environmentally-friendly manner
- e) Knowledge of the official training curriculum and/or driving test requirements for applicants for a driving licence

Conditions for entering the profession

The current requirements for access to the profession varied significantly between the countries studied in Merit, especially regarding length of education prior to entering DI education, minimum age, and previous driving experience. It was recommended that DI:s should...

- a) have sufficient schooling to meet the demands of training and working in the profession
- b) possess the driving licence of the category he/she intends to teach in
- c) have a minimum of 3 years driving experience with the relevant category of vehicle
- d) complete a screening process, in order to gain access to training and the test to become an instructor
- e) undergo a medical test - including an eyesight test - commensurate to the safe execution of the profession
- f) undergo a background check with regard to prior criminal offences and/or traffic offences, to ensure that the applicant is a fit and proper person.

Initial qualification

Obligatory training is today required in all the studied countries except Belgium, Cyprus, Great Britain, Ireland, Italy, The Netherlands and Northern Ireland. Voluntary training is, however, the norm in these countries as there is an obligatory test. No fixed standards or curricula have been set for this voluntary training. All the included countries except the Republic of Ireland have obligatory tests for applicant DI:s.

The recommendations qualification (training and testing) were as follows:

1) Training

Applicants shall be required to undergo obligatory initial professional training prior to the test. Such training shall be carried out in accredited driving instructor training centres which are subject to oversight by a recognised and appointed body. The programme shall at least include training on the teaching methods and skills required to teach all levels of the GDE-matrix.

Experience with teaching real learner drivers is required prior to the trainee instructor gaining full qualification. This experience must be subject to supervision by a qualified supervisor, during both practical and theoretical driving lessons.

Detailed content requirements for training and testing are listed in article 5. Persons responsible for training applicant instructors must possess sufficient knowledge and skills to train in the specific area in question.

2) Testing

Applicants shall undergo testing, according to the competencies laid down in article 1 and the specific goals specified in article 5, to assess his/her basic knowledge and skills with regard to theoretical knowledge, teaching ability, and driving ability.

The order of the above tests shall be determined by each Member State.

Testing of driving ability and/or teaching ability can be integrated into the training process.

Persons responsible for testing applicant instructors must possess sufficient knowledge and skills to test in the specific area in question.

As pointed out in the final comments in the Merit report (2005), the minimum requirements do not determine a volume or length of initial training and testing of DI:s, only a common basis, which allows for national differences.

Quality assurance and ongoing training

Continuous training, how to keep up and develop the acquired teaching skills. The learning progress should also be monitored and reviewed on a regular basis. The recommendations were as follows:

1) Ongoing training

Driving instructors are required to attend a minimum of 5 days of ongoing training every 5 years.

Persons who have ceased pursuit of the profession **for a period of 5 or more years**, and have missed ongoing training requirements during the period of absence, shall undergo a course of sufficient periodic training before resuming the profession.

2) Observation / Quality Checks (with feedback)

Driving instructors shall undergo a minimum of 1 observation, by an appropriately qualified and accredited observer, every 5 years. This observation shall, in particular, assess the instructor's interaction with the learner driver(s) and provide feedback to the instructor on positive performance and areas in need of improvement. The observation shall take place during a practical on-road driving lesson and/or in a theory lesson, if relevant to the member state in question.

Instructors found to be seriously under-performing during such observations shall be required to obtain specific training to correct the observed shortcomings.

3) Periodic medical testing

Ongoing medical testing for instructors, including an eyesight test, shall be required at least every 5 years.

Content requirements for training and testing

a) Comprehensive knowledge of the Goals for Driver Education, in the form of the GDE matrix

The driving instructor candidate shall be fully familiar with the hierarchical approach to safe behaviour, according to the GDE matrix (Goals for Driver Education), and shall be able to provide understanding to the learner driver about how abilities and preconditions on a higher level influence the demands, decisions and behaviour on a lower level. In order to emphasise the comparative importance of the higher levels of the matrix, training for instructors should begin with level 4 and work downwards to level 1.

The contents relating to each level in the GDE-matrix were also specified.

b) Communication, teaching and motivational skills

The instructor shall have knowledge and skills relating to the following educational skills:

- Lesson planning, goal-setting and lesson evaluation
- Professional communication (establishing the appropriate relationship for learning)
- Basic teaching methods (demonstration, informing, setting tasks, checking)
- Advanced teaching methods (active learning methods such as coaching, moderating group activities, questioning & developing and giving feedback, etc)
- Selection of specific teaching method according to specific educational goal and driver's needs
- **The need to adapt to different learning styles**
- Motivational techniques

c) Assessment skills (driving skills, personal characteristics)

The instructor shall be able to:

- assess driving skills of learner driver, identify shortcomings and address them
- assess the effects of the personal characteristics of the learner driver on safe driving
- encourage self-assessment on the part of the learner driver with regard to his/her driving motives and ability

d) Driving ability

The instructor shall possess a high and consistent driving standard, with particular emphasis on:

- a social and defensive driving style
- environmentally-friendly driving techniques
- **ability to intervene safely while a learner driver is at the wheel**

e) Knowledge of curriculum and/or test requirements

The instructor shall have a full understanding and familiarity with:

- the goals of the national training curriculum for learner drivers (if appropriate)
- the requirements of the driving test for driving licence candidates.

As to teaching methodology, it was concluded that DI:s should gain proficiency in using not only instructional teaching methods such as demonstrations but also more advanced and active methods such as “coaching”. More focus should be put on the higher levels of the GDE-matrix, ie. motives, personality factors, emotions etc. The principles of coaching in the context of driver training, as well as examples of other active teaching methods, may be found in e.g. Christie et al. (2004) and Hermes (2007).

The minimum standards outlined above are extensions of previous recommendations put forward in other EU projects focusing on driver training: GADGET (Siegrist, 1999), DAN (Bartl, 2000), ANDREA (Bartl et al., 2002), ADVANCED (2002) and BASIC (Hatakka et al., 2003). The guidelines set down in ADVANCED were sharpened in the NOVEV-project (2004), both focusing on post-license training.

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1.2. European Directives

- [Directive 2006/126/EC \(Third Directive\)](#) of 20 December 2006 on driving licences (Recast) (Text with EEA relevance)
- [Directive 2003/59/EC](#): on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC) No 3820/85 and Council Directive 91/439/EEC and repealing Council Directive 76/914/EEC
- [Directive 2000/56/EC](#) amending Council Directive 91/439/EEC on Driving Licenses
- [Council Directive 91/439/EEC](#) on driving licences
- [COUNCIL DIRECTIVE 97/26/EC](#) amending Directive 91/439/EEC on driving licences
- [COUNCIL DIRECTIVE 96/47/EC](#) amending Directive 91/439/EEC on driving licences
- [COUNCIL REGULATION \(EEC\) No 3820/85](#) on the harmonization of certain social legislation relating to road transport
- [First Council Directive 80/1263/EEC](#) on the introduction of a Community driving licence