



Finnish novice drivers' competences

- compared to the Swedish, Dutch and Austrian novices

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FOREWORD

The study consists of three published manuscripts, one manuscript that was submitted for publication and a summary. The study is also a thesis for author's doctoral dissertation.

Helsinki, April 2010

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Finnish Transport Safety Agency

ALKUSANAT

Tutkimus koostuu kolmesta julkaistusta artikkelista, yhdestä julkaistavaksi lähetystä käsikirjoituksesta sekä yhteenvedosta. Tutkimus on myös tekijän väitöskirja.

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Abstract

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ABSTRACT

The purpose of this thesis was to examine Finnish novice drivers' competences to drive at the beginning of their driver career. In Finland, as in other countries, novice drivers are over-represented in the road accident statistics. Earlier findings indicate that realistic awareness of their own competences could be helpful for the novice drivers to overcome the risky period in traffic that follows immediately after they gain their licence.

In the first sub-study, Finnish and Swedish novice drivers' competences were assessed by examiners and by the candidates themselves. The method was to compare the candidate and the examiner assessments to see how accurately the candidates were able to assess their driving competences. The results were comparable regarding three competences (Vehicle manoeuvring, Economical driving and Traffic safety). The results showed that about 30 per cent of the Finnish and between 58 and 70 per cent of the Swedish candidates overestimated their driving competences. Furthermore, 40-50% of the Finnish and about 25-35% of the Swedish candidates were able to realistically assess their driving performance in the assessed competences. The findings indicate that a relatively large proportion of novice drivers are able to avoid overestimating their driving competence when a predefined criterion is used for assessment.

The second sub-study compared Finnish and Dutch driving test candidates. The method was comparable to the first sub-study but consisted of six comparable driving competences (Vehicle control, Recognizing hazards, Traffic Flow, Weaker Road Users, Control of the traffic situations and Economical driving). The results showed that about 30 per cent of the Finnish and about 50% of the Dutch candidates overestimated their competences. Moreover, 40-50% of the Finnish and Dutch candidates assessed realistically their own driving performance in the assessed competences. The findings complemented the results of the first sub-study.

In the third sub-study, the cohorts of all successful Finnish driving test candidates were assessed by the examiners over a period of ten years. The method was to compare the assessed performance between the cohorts to see any possible changes in the competences. The results showed that the only acceptable change during the period was a reduction in the successful candidates' vehicle control competence. The effects on the competences were tested by the ANCOVA analysis, which suggested that the youngest male participants had high vehicle manoeuvring scores. Success in the still-picture test related to the high scores of all but the vehicle manoeuvring competence. Males were assessed as being more competent than females in all of the competences. Furthermore, the high uniformity of the assessments related to high scores regarding all of the competences.

In the fourth sub-study, the second phase training courses' effects on the novice drivers' competences were examined in the Finnish and the Austrian samples. The method was to compare the participants who had taken the second phase training course to those who had not taken it. The results indicated that the Finnish second phase course may be beneficial in economical driving. The Austrian participants who had taken the second phase training course were reported to have been involved in fewer accidents and traffic violations than those who had not taken the course. Nevertheless, the questions related to safe driving behaviour did not indicate any significant differences.

To conclude, the successful Finnish driving test candidates' competences have remained rather unchanged from 2000 to 2009. The major change has been a continuous reduction in the vehicle control competence. Smaller proportion of the Finnish driving test candidates compared to the Swedish or Dutch candidates avoids assessing their own driving competences. Furthermore, most of the Finnish driving test candidates assess their own driving competences rather realistically, when the contents of the assessed competences are defined beforehand. Regarding the Finnish second phase training course, the positive effects seem to relate only to the novice drivers' competence to drive economically.

Keywords: novice drivers, driving competence, driving test, self-assessment

TIIVISTELMÄ

Tutkimuksessa selvitettiin suomalaisten uusien kuljettajien (noviisit) osaamista (kompetenssi) kuljettajauran alkaessa. Uudet kuljettajat erottuvat riskiryhmänä Suomen sekä muiden maiden liikenneonnettomuustilastoissa. Aikaisemmat tutkimustulokset osoittavat, että realistinen käsitys omasta kuljettajaosaamisesta voi auttaa uusia kuljettajia vähentämään riskiä joutua liikennevahinkoon onnettomuusalttiin kuljettajauran alussa.

Ensimmäisessä osatutkimuksessa suomalaisten ja ruotsalaisten ajokokeen suorittajien osaamista arvioivat kandidaatit itse sekä kuljettajantutkinnon vastaanottajat. Arvioita vertaamalla saatiin käsitys tulevien kuljettajien arviointien realistisuudesta. Tulokset olivat vertailukelpoisia kolmen osaamisalueen (Ajoneuvon käsittely, taloudellinen ajaminen ja liikenneturvallisuus) osalta. Tulosten mukaan noin 30% suomalaisista ja 58-70% ruotsalaisista ajokokeen suorittajista yliarvioi osaamisensa. Lisäksi 40-50% suomalaisten ja noin 25-35% ruotsalaisten tulevien uusien kuljettajien arvioista oli realistisia, kun arvioinnin kohteena olevat osaamisalueiden sisällöt määriteltiin etukäteen. Tuloksista voidaan päätellä, että käytetyllä menetelmällä suhteellisen suuri osa tulevista kuljettajista välttää yliarvioimasta omaa kuljettajaosaamistaan.

Toisessa osatutkimuksessa vertailtiin suomalaisten ja hollantilaisten ajokokeen suorittajien osaamista. Menetelmä oli sama kuin ensimmäisessä osatutkimuksessa, mutta sisälsi kuusi eri vertailukelpoista osaamisaluetta (Ajoneuvon käsittely, Riskien havaitseminen, Liikennevirtaan sopeutuminen, Kevyen liikenteen huomiointi, Liikennetilanteiden kontrollointi ja Taloudellinen ajaminen). Tulosten mukaan noin 30% suomalaisista ja noin 50% hollantilaisista ajokokeen suorittajista ei yliarvioi osaamistaan. Noin puolet suomalaisista ja hollantilaisista tulevista uusista kuljettajista arvioi realistisesti osaamisensa arvioiduilla kuudella osaamisalueella. Tulokset täydensivät ensimmäisen osatutkimuksen tuloksia.

Kolmannessa osatutkimuksessa tutkinnon vastaanottajat arvioivat kuljettajatutkinnon läpäisseiden (kuljettajauransa aloittavien) osaamista kymmenen vuoden ajalta. Menetelmänä oli vertailla kuljettajatutkinnon läpäisseiden kandidaattien osaamista eri vuosina, jotta mahdolliset muutokset kuljettajaosaamisessa havaittaisiin. Ainoa tunnistettu muutos oli kuljettajatutkinnon läpäisseiden kandidaattien ajoneuvon käsittelyn osaamisen väheneminen 1990-luvulla. Kovarianssianalyysiä käytettiin havaittujen erojen testaamiseen ja efektien suuruuden arvioimiseen. Ajoneuvon käsittelyssä nuoret mieskuljettajat arvioitiin osaavimmiksi. Liikennetilanteista otettujen pysäytyskuvien arviointimenestys oli yhteydessä muiden osaamisalueiden menestykseen paitsi ajoneuvon käsittelyyn. Miehet arvioitiin naisia pätevimmiksi kaikilla osaamisalueilla. Lisäksi tutkinnon vastaanottajien ja kandidaattien arvioiden yhtenevyys (tutkinnon vastaanottajien arvioimana) oli yhteydessä menestykseen kaikilla osaamisalueilla.

Neljännessä osatutkimuksessa tutkittiin suomalaisen ja itävaltalaisen kuljettajaopetuksen toisen vaiheen kurssin suorittamisen vaikutuksia uusien kuljettajien osaamiseen. Menetelmässä vertailtiin kurssin suorittaneita kurssia käymättömiin uusiin kuljettajiin. Tulosten mukaan suomalainen toisen vaiheen kuljettajakoulutus osoittautui hyödylliseksi vain taloudellisen ajamisen osaamisalueella. Itävaltalaiset kurssin suorittajat raportoivat olleensa mukana harvemmin liikenneonnettomuuksissa ja –rikkomuksissa kuin kurssia käymättömät. Sen sijaan itävaltalaisen uusien kuljettajien liikenneturvallisuusosaamisessa ei tunnistettu eroja kurssin käyneiden ja kurssia käymättömien välillä.

Johtopäätöksenä suomalaisten uusien kuljettajien osaaminen 1990-luvulla on ollut varsin muuttumatonta, lukuun ottamatta käsittelyosaamisen vähenemistä. Suomalaisista ajokokeen suorittajista suurempi osuus välttää yliarvioimasta omaa kuljettajaosaamistaan verrattuna ruotsalaisiin tai hollantilaisiin ajokokeen suorittajiin. Lisäksi noin puolet suomalaisista ajokokeen suorittajista arvioi kuljettajaosaamisensa realistisesti. Kuljettajaopetuksen toisen vaiheen hyöty suomalaisille uusille kuljettajille näyttää rajoittuvan taloudellisen ajamisen osaamisen kehittämiseen.

SAMMANFATTNING

I undersökningen undersöktes finska nya förarens körförmåga i början av förarbanan. I Finland, liksom i andra länder, är nya förare en riskgrupp i trafikolyckstatistiken. Tidigare forskning visar att en realistisk uppfattning om den egna förarförmågan kan minska olycksriskerna i trafiken under den olycksbenägna inledningen av förarbanan.

I den första delstudien utvärderades finska och svenska nya förarens kompetens av examinanderna själva och av förarexamensmottagarna. Genom att jämföra bedömningarna fick man en uppfattning om hur realistiska de nya förarnas bedömningar är. Resultaten var jämförbara inom tre kompetensområden (fordonshandling, ekonomisk körning och trafiksäkerhet). Resultaten visade att omkring 30% av finska och 58-70% av svenska blivande förarna överskattade den egna körfärdigheten. Ytterligare, bedömningarna gjorda av 40-50 % av de finska och 25-35 % av de svenska blivande förarna var realistiska när innehållet i de kompetensområden som bedömdes definierades på förhand. Resultaten indikerar att en relativt stor andel av nybörjarförarna kan göra en korrekt bedömning av den egna körförmågan med den använda metoden.

I den andra delstudien jämfördes kompetensen hos finska och holländska körkortselever. Samma metod användes som i den första delstudien, men omfattade sex jämförbara kompetensområden (fordonshandling, identifiering av risker, anpassning till trafikflöde, uppmärksamhet vid gång- och cykelbanor, kontroll över trafiksituationer och ekonomisk körning). Resultaten visade att omkring 30% av finska och omkring 50% av holländska blivande förarna överskattade den egna körfärdigheten. Ytterligare, omkring 50 % av både de blivande finska och de blivande holländska förarna kunde göra en realistisk bedömning av den egna körförmågan inom de bedömda sex kompetensområdena. Resultaten kompletterade resultaten från den första delstudien.

I den tredje delstudien utvärderade examensmottagarna kompetensen hos de personer som hade godkänts i förarexamen (inlett sin förarbanan) under en tioårsperiod. Metoden var att jämföra kompetensen hos de förare som hade godkänts vid förarexamen under olika år för att upptäcka eventuella förändringar jämfört med godkännandet som förare. Den enda identifierade ändringen var en försämring i fordonshandlingen under 1990-talet hos de förare som godkänts vid förarexamen. Kovariansanalys användes för att testa de upptäckta skillnaderna och bedöma effekternas storlek. Unga manliga förarna bedömdes ha bästa färdigheten i fordonshandling. Framgångsrik bedömning vid stillbilder i trafiksituationer hade samband med framgång inom andra kompetensområden förutom fordonshandling. Männerna uppnådde bättre resultat än kvinnorna inom samtliga kompetensområden. Överensstämmelse i bedömningarna mellan examensmottagarna och kandidaterna hade också ett samband med framgång inom alla kompetensområden.

I den fjärde delstudien undersöktes effekten av andra skedet i den finländska och österrikiska förarutbildningen på nya förarens kompetens. Metoden var att jämföra deltagare som hade genomgått kursen med nya förare som inte hade genomgått utbildningen. Resultaten indikerade att det andra skedet av den finska körkortsutbildningen endast har positiv inverkan på ekonomisk körning. De österrikiska deltagare som hade genomgått kursen var inblandade i färre trafikolyckor och trafikförseelser än de förare som inte hade genomgått utbildningen. Däremot identifierades inga skillnader i trafiksäkerhetskompetensen mellan de österrikiska nya förare som deltagit i kursen och förare som inte deltagit i kursen.

Slutledningen är att nya finska förarens kompetens har varit relativt oförändrad under 1990-talet förutom en försämring i fordonshandlingen. En större andel av de finska förarexaminanderna undviker att överskatta den egna körfärdigheten jämfört med svenska eller holländska förarexaminander. Dessutom kan ca hälften av de finska uppkörningseleverna realistiskt bedöma den egna körförmågan. De positiva effekterna av andra skedet i förarutbildningen hos finländska nya förare verkar enbart gälla en utveckling av de nya förarnas förmåga att köra ekonomiskt.

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Sami Mynttinen
Helsinki, April 2010

List of original publications

This thesis consists of the summary and the following publications:

- Mynttinen, S., Sundström, A., Koivukoski, M., Hakuli, K., Keskinen, E. & Henriksson, W. (2009). Are novice drivers over-confident? A comparison of self-assessed and examiner-assessed driver competences in a Finnish and Swedish sample. *Transportation Research Part F: Traffic Psychology and Behaviour*, 12, 120-130.
- Mynttinen, S., Vissers, J., Sundström, A., Koivukoski, M., Hakuli, K., & Keskinen, E. (2009). Self-assessed driver competence among novice drivers – a comparison of driver candidate assessments and examiner assessments in a Dutch and Finnish sample. *Journal of Safety Research*, 40, 301-9.
- Mynttinen, S., Koivukoski, M., Hakuli, K., & Keskinen, E. (In Press) Finnish novice drivers' competences – successful driving test candidates 2000-2009 evaluated by driving examiners. *Submitted for publication*.
- Mynttinen, S., Gatscha, M., Koivukoski, M., Hakuli, K., & Keskinen, E. (2009). Two-phase driver education models applied in Finland and Austria. Do we have evidence to support the two-phase models? *Transportation Research Part F: Traffic Psychology and Behaviour*, 13, 63-70.

1 Introduction

In Finland, as well as in other countries, novice drivers are over-represented in the road accident statistics (OECD/ECMT 2006: 34). The purpose of the study was to examine Finnish novice drivers' competence to drive. The novices' awareness of their own strengths and weaknesses could importantly help them to overcome the high accident risk period that follows immediately after gaining their licence. Furthermore, knowledge of the novice drivers' competences could be valuable when developing drivers' activities in education, practice and testing.

It takes several years before the novice drivers reach the average drivers' risk level regarding serious traffic accidents (Carstensen 2002; Maycock, Lockwood and Lester 1991). Katila, Peräaho, Keskinen, Hatakka and Laapotti (2000) found that the Finnish novice drivers' achieve the average drivers' risk level after three years of independent driving practice. The novices' crash liability quickly decreases during the first months after gaining their licence (Gregersen 2000; Katila et al. 2000; Sagberg 2000) and the reduction especially relates to their age, gender and driving experience (Laapotti 2003; Maycock 2002; Vlakveld 2004). Thus, paradoxically, to be able to reduce the high traffic accident risk, novice drivers have to practice driving independently in real traffic, even though it is known to be the riskiest period in their driver career.

Among other safety measures, learning the necessary driving competences and a realistic understanding of their own driving abilities could reduce the novice drivers' accidents during the risky early driving practice period. By focusing on the novices' observable driving behaviour (output competences), it is possible to assess their strengths and weaknesses as drivers. Moreover, comparison of national activities may reveal more and less advanced licensing practices in developing the novice drivers' competences.

Basically, the driving task and the necessary novice driver competences should be similar in all of the European Union member countries, since formal requirements for drivers have been laid down at European level in the EU Driving Licence Directive (EU Parliament and Council Directive 2006). To be allowed to drive, drivers have to meet the stated competences, which (besides health and age requirements) include detailed requirements related to knowledge, skills and appropriate driving habits. Initial driver competences are assessed in national theoretical and practical tests. The necessary knowledge, skills and driving style may be acquired very differently from one country to another (Twisk and Stacey 2007). Furthermore, even within the countries, the competences may have been achieved differently. For example, Finnish nonprofessional candidates practice driving with an instructor more (about 30%) than their driving school counterparts (Mynttinen, 2007). It is likely that the competences of the novice drivers are dissimilar in different member countries.

2 Development of the novice drivers' competences

2.1 Expertise metaphor

While psychological research on expertise focuses on exceptional performers (Ericsson and Charness 1994), the notion of expertise appears to provide a useful *metaphor* for understanding the development of the processes, mechanisms and competences related to everyday activities (Hancock and Scallen 1999). Driving was one of the examples of

Dreyfus and Dreyfus' (1986) highly regarded analysis of expertise. Novices have often been compared to experienced drivers according to their driving performance. It appears useful to think that the experienced drivers have acquired considerable expertise when they have continuously and sustainably taken part in various road-using activities (Anderson 1982; Groeger 2000). However, even after considerable training, a temporary length of experience alone does not guarantee high expertise for everybody (Bereiter and Scardamalia 1993). Rather than focusing on outstanding performers, the present study addresses the expertise required for safe adaptation and participation in demanding traffic activities that are characteristic of society today. In the following pages, the concept of expertise is utilized in this metaphorical sense to assist in examining various aspects of novice drivers' competences.

Many of the experts' behavioural characteristics would be desirable in any driver. Experts are seen to be more aware of what they are doing, what they are able to do, and, importantly, what they are not able to do. Experts know when they need to review errors, when they do not understand something, and what is needed to solve a problem if the situation changes and they assume responsibility for their actions. Novices, in contrast, do not stop to assess their understanding, do not evaluate or control the quality of their actions and do not try to relate events to their earlier experiences (Chi, Glaser and Resch 1982; Ericsson and Charness 1994; Ericsson and Smith 1991; Ertmer and Newby 1996; Keskinen 2002; Perkins 1993). Thus an ability that develops with increasing competence is meta-cognition (Brown 1987; Flavell 1979; Glaser and Chi 1988; Sternberg 1988). An essential part of meta-cognition is self-assessment (Hakkarainen, Lonka and Lipponen 2004, 233-234; Keskinen 2002). This refers to an ability to self-monitor the progress of one's own learning and readiness to change behaviour and learning strategies when necessary.

2.2 Two viewpoints on the development of competences

Hakkarainen, Palonen and Paavola (2002) analysed different perspectives of expertise research, and, among other things, separated the knowledge acquisition view of expertise from the participation view. The former perspective, the traditional *acquisition view*, accounts for achieving exceptional competence via cognitive processing of the acquired knowledge structures. The findings related to acquisition of basic cognitive processes, skills and competence show that skilled performers only excel in their own domain. This may be explained by the long (Newell and Rosenbloom 1981; Ericsson, Krampe and Tesch-Römer 1993) and intensive practicing aimed at improving the competence needed to adapt to the specific domain's demanding requirements and constraints (Chase 1973; Ericsson and Charness 1994; Ericsson et al. 1993). The second and more recent perspective in expertise research is a process of *cultural participation* that highlights the fact that competences develop through participating in various real-world, social and cultural activities (Hakkarainen et al. 2002). As an output of this participation process, the corresponding individual skills, practices, norms, identities and responsibility develop gradually.

The analysis by Hakkarainen et al. (2002) also illustrates the adaptive nature of learning to drive, as well as why development of self-assessment is important in novice drivers' learning. Related to the acquisition view of expertise, various studies have shown the importance of basic cognitive functions such as perceiving, processing, storing and recalling information, as well as automated routines and problem-solving procedures. In addition, the impact of practice has been well demonstrated (Gregersen 2003; Groeger 2000, 2002; Groeger and Rothengatter 1998). Findings indicating that learned outcomes may be surprisingly domain-specific and context-dependent (Keskinen 2002). Duncan, Williams and Brown (1991) showed that a simple task of

gear changing may be domain and context-specific, especially with novices but also with experienced drivers. Verwey (1991) demonstrated that a secondary task interfered with manoeuvring in different driving situations, and the reduction in performance depended on the situation concerned. Furthermore, Groeger and Clegg (2000) found that the relationship between the amount of practice and the learned driving performance was stronger if the special driving situations rather than driving experience in general were used as a measure of the experience. This suggested limited transfer of learning between the different (relatively simple) driving situations.

Compared to novices, experienced drivers have been shown to use more effective visual search skills (Chapman and Underwood 1998; Falkmer and Gregersen 2001; Mourant and Rockwell 1972), detect hazards faster (Ahopalo, Lehtikoinen and Summala 1987; Soliday and Allen 1972), detect more hazards (McKenna and Crick 1994), and recognize more relevant hazards (Renge 1998; Underwood, Chapman, Bowden and Crundall 2002). In addition, Gregersen (1996) showed that experienced drivers are better at adjusting their driving behaviour according to environmental cues and demands.

Related to the perspective of cultural participation, daily participation in traffic activities ultimately changes the novice drivers' behaviour to resemble the behaviour of other road users. In other words, novice drivers adapt to the surrounding traffic. During the adaptation process it is also possible to learn unwanted behavioural models. Therefore, a real challenge but an important ability for the novice drivers is to be able to reflect their own behaviour in real traffic situations. This may be very difficult to learn if the contents of the driver practice are based on abstract knowledge structures rather than real-world activities. Moreover, a social and responsible way of acting has been shown to develop with participation in cultural activities (Moreland 1999, Wenger 1998). This is also emphasized in the novice drivers' learning, education and testing (Gregersen and Berg 1994; Hernetkoski, Katila, Laapotti, Lammi and Keskinen 2007; Keskinen, Hatakka, Katila and Laapotti 1994; Keskinen and Peräaho 2008; Keskinen, Peräaho, Katila, Hernetkoski and Laapotti 2009; Møller 2004; SRA regulations 2006; Svenson 1981). In addition, awareness of the situational factors has been one of the research areas of the cultural participation perspective (Endsley 1995; Lave and Wenger, 1991; Moray 2004; Sarter and Woods 1991; Wenger 1998). Regarding the novice drivers, rather than representing a general, uniform ability across contexts, driving competence depends on familiarity with and awareness of the heterogeneous traffic situations and environments (Kuiken and Twisk 2001; McKenna and Crick 1994; Mikkonen and Keskinen 1980; Parker 1992; Vissers, Mesken, Roelofs and Claesen 2008; Wells, Tong, Sexton, Grayson and Jones 2008).

2.3 Necessary competences for safe driving

In the fields of occupational and educational psychology, the process of competence development has been described as a continuum starting with the basic competence and ending with the highly specialized competences that are needed for operating in complex situations. Cognitive, functional and social competences, supplemented by the meta-competence (self-assessment) have been identified as important characteristics in the development process (Delamare-Le Deist and Winterton 2005; Eraut 1994; Winterton, Delamare-Le Deist and Stringfellow 2005). The level at which predefined task standards have been met (while individuals still have the potential to develop further) has been called a threshold competence (Burgoyne 1988). One advantage of the predefined output competences is that they may be assessed independently of the process of learning and different educational practices (Delamare-Le Deist and Winterton 2005).

Comparable to the occupational and educational findings, in learning to drive the threshold where incompetence develops into competence has been referred to by the adjectives ‘suitable’ (Groeger 2001), ‘satisfying’ (Hancock, Parasuraman and Byrne 1996) and ‘sufficient’ (OECD/ECMT (2005: 83)). Furthermore, the basic competency refers to newly licensed drivers, whereas experts can be considered drivers who have gained driving experience over several years. Evidently, safe participation in traffic depends on the definition and explanations of the driving task (Hatakka, Keskinen, Gregersen, Glad and Hernetkoski 2002). Depending on how much the driving context restricts the driver’s behavioural choices, the driving task has been described as self-paced (Brown 1986; Evans 1991, 133; Näätänen and Summala 1974) or as partly self-paced (Gregersen 1996; Groeger 2001, November; OECD/ECMT 2006, 83). The balance between the driver’s self-assessed and actual competence has been dubbed ‘calibration’, in which motives, driving purpose and self-assessment skills are important behavioural regulators (Gregersen 1996; Kuiken and Twisk 2001; Logan 1985; Milech, Glencross and Hartley 1989; Mitsopoulos, Triggs and Reagan 2006). Unbalanced calibration (Gregersen 1996) or a biased ability for self-assessment (McKenna 1982) has been associated with the high accident involvement of novice drivers (Gregersen 1996, 2003; De Craen, Twisk, Hagenzieker, Elffers and Brookhuis 2007; De Craen, Twisk, Hagenzieker, Elffers and Brookhuis 2008). Different explanations exist for these biased self-assessments (Brown 1982; Brown and Groeger 1988; Deery 1999; Gregersen and Berg 1994; Horswill, Waylen and Tofield 2004; Matsuura 2005; McKenna 2003; Mayhew and Simpson 1995; Sundström 2008; Svenson 1981; Tronsmoen 2007; Waylen, Horswill, Alexander and McKenna 2004), likely due to differences in premises, research designs and research methods. However, the importance of the realistic awareness of their own abilities has been widely accepted.

2.4 Hierarchical driver behaviour models

Hierarchical driver behaviour models describe different functions of driving on various hierarchical levels (Hatakka, Keskinen, Baughan, Goldenbeld, Gregersen, Groot, Siegrist, Willem-Lenz and Winkelbauer 2003; Michon 1985; Mikkonen and Keskinen 1980; Ranney 1994; Rasmussen 1980; Summala 1985, 2005). Despite the different premises, contents and purposes of the hierarchical models, all of them emphasise the higher level behavioural control over the lower ones. Besides, typical of the development of expertise is that conscious behavioural control moves to the higher levels (Anderson 1983; Hacker 1982; Miller, Galanter and Pribram 1960). Furthermore, some of the lower behavioural levels are considered important prerequisites to learning the higher levels, such as automation of manoeuvring skills prior to anticipating traffic situations.

The Hatakka et al. (2003) GDE model (Goals for Driver Education) has been chosen as a theoretical framework for this study. It consists of goals for the drivers’ safe driving behaviour as well as contents for their efficient competence development (See Table 1). Besides drivers’ *knowledge and skills*, it addresses awareness of the *risk increasing factors* and *self-evaluation* on four behavioural levels of driving: *vehicle manoeuvring, mastery of traffic situations, trip-related goals and context of driving, and general goals for life and skills for living*. Hatakka et al. (2002) and, recently, Keskinen (2007, 2009) have suggested that cultural, sub-cultural and societal requirements could comprise the highest (fifth) level of the framework.

Table 1
The Goals for Driver Education (GDE) model plus the fifth level of cultural requirements

Hierarchical level of behaviour	Essential contents (examples)		
	Knowledge and skills	Risk-increasing factors	Self-evaluation
<i>Cultural, sub-cultural and societal requirements</i>			
Goals for life and skills for living (general)	Knowledge of/control over how life-goals and personal tendencies affect driving behaviour - lifestyle / life situation - group norms - motives - self-control, other characteristics - personal values	Risky tendencies - acceptance of risks - self-enhancement through driving - high level of sensation seeking - complying with social pressure - use of alcohol and drugs - values, attitudes towards society	Self-evaluation/ awareness of - personal skills for impulse control - risky tendencies - safety-negative motives - personal risky habits
Goals and context of driving (trip-related)	Knowledge and skills concerning - effects of trip goals on driving - planning and choosing routes - evaluation of requested driving time - effects of social pressure in car - evaluation of necessity of trip	Risks connected with: - driver's condition (mood, BAC, etc.) - purpose of driving - driving environment (rural/urban) - social context and company - extra motives (competing, etc.)	Self-evaluation / awareness of - personal planning skills - typical goals of driving - typical risky driving motives
Mastery of traffic situations	Knowledge and skills concerning - traffic rules - observation/selection of signals - anticipation of course of situations - speed adjustment - communication - driving path - driving order - distance to others / safety margins	Risks caused by - wrong expectations - risk-increasing driving style (e.g. aggressive) - unsuitable speed adjustment - vulnerable road users - not obeying rules / unpredictable behaviour - information overload - difficult conditions (darkness, etc.) - insufficient automatism/skills	Self-evaluation / awareness of - strong and weak points of basic traffic skills - personal driving style - personal safety margins - strong and weak points for hazard situations - realistic self-evaluation
Vehicle manoeuvring	Knowledge and skills concerning - control of direction and position - tyre grip and friction - vehicle properties - physical phenomena	Risks connected with - insufficient automatism/skills - unsuitable speed adjustment - difficult conditions (low friction, etc.)	Awareness of weaknesses - strong and weak points of basic manoeuvring skills - strong and weak points of skills for hazard situations - realistic self-evaluation

Note: From "From control of the vehicle to personal self-control; broadening the perspectives to driver education", by Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., and Hernetkoski, K., 2002. Transportation Research Part F: Traffic Psychology and Behaviour, 5, 201-215 and from Keskinen, E. (2009, September). Safe driver. Presentation at the 1st Nordic dimension conference in Helsinki, Finland. Chair: Sami Mynttinen.

In the present study, the most competent drivers are considered to be those who belong to the safest group of drivers. Moreover, it is expected that the safest group of drivers behave according to the competences of the GDE model. It is assumed that the novices' awareness of their own strengths and weaknesses as drivers could significantly improve their chances of overcoming the exceptionally risky practice period that follows immediately after gaining their licence. The contents of the cells of the GDE

matrix can be called *GDE competences*, since all of them present the required competences for safe driving (Hernetkoski and Keskinen 2003). All of the contents should be addressed in driver education. However, the focus in driving education has tended to be on the lower left cells (Hatakka et al. 2003; Hatakka et al. 2002; Mayhew, Simpson, Singhal and Desmond 2006). The main (and at the same time the minimum) challenge for learner drivers, as well as their instructors and examiners, is to be aware of the higher level GDE competences, risk increasing competences and self-assessment competences (Hatakka et al. 2002; Tronsmoen 2007).

Because of the limited resources in driving education and practice, the structure and order of learning the GDE competences are important. Some content areas have to be learned before the others can develop, and the development of different competences takes a different amount of time (Anderson 1982; Fitts and Posner 1967; Groeger 2000, 84; Mikkonen and Keskinen 1980; Keskinen 2002). This is especially the case with the two lowest GDE levels (vehicle manoeuvring and mastery of traffic situations). It is necessary to learn to control the car before effective learning in traffic situations is possible. However, learning the higher GDE competences (within the limited time) may require that these are addressed immediately at the beginning of the driving practice (Keskinen 2007).

In enhancing the learning of the higher level GDE competences, the self-assessment practices can be helpful by providing feedback for learning. Higher order factors (like values, goals, attitudes, planning the trip or choosing the company you drive with) are important behavioural motivators and regulators (Hernetkoski and Keskinen 2003). But once they have been activated for the driving task, they may not be activated again (and the feedback is not obtained) unless something unexpected happens during the driving. In contrast, the executive lower level GDE competences, like gearing, steering or recognizing hazardous situations, are active and prone to feedback all the time during the driving task. The important thing here is that the *amount* of feedback may go a long way towards explaining why learning the lower level GDE competences typically proceeds so much faster than learning the higher level competences. However, cultural and societal factors, general goals for living, and trip-related goals and contexts of driving cannot be learned and understood as important requisites for safe driving behaviour if they are not addressed in the training and practice (Keskinen and Peräaho 2009).

The GDE competences are important for safe driving, but it is difficult to define explicitly the necessary competences for safe solo driving. Considering the national differences in driver training and testing (Twisk and Stacey 2007), as well as the differences in traffic environments, novice drivers' national output competences are unlikely to be identical either. However, by comparing the output competences, national and cultural similarities and differences could be identified, as well as the accuracy of the novice drivers' self-assessments. Furthermore, the assessment of output competences may reveal whether the expected national learning outputs have been met or not.

2.5 Improvement of the achieved competences

Achieving an average drivers' safe behaviour level requires several years of extended practice after gaining a licence (Deery, H. 1999; Katila, Keskinen, Hatakka and Laapotti 2004; Maycock et al. 1991). The safety of novices' solo driving practice can be enhanced with graduated licensing models (Ferguson 2003; OECD/ECMT 2006: 124). However, educational safety measures that take place after the driver is licensed have not been shown to be very effective (Ferguson 2003; OECD 1990; OECD/ECMT 2006: 136), including the contradictory results of the second phase driver training courses

(Glad 1988; Keskinen et al. 1992). A recent analysis (Gatscha & Brandstaetter 2008) showed that the number of personal injury accidents among 18-year-old novice drivers reduced (by about 28%) in all regions of Austria after renewal of the second phase. On the contrary, the number of comparable accidents among older drivers (24–30 years) did not change significantly. However, the effects of other variables could not be controlled because the comparison was made between the age groups.

Because of the lack of safety evidence (Glad 1988), Norway has given up the obligatory second phase training. Nevertheless, they have not given up the obligatory driving in darkness and slippery driving lessons in the curriculum. However, the goals and contents of the lessons have changed from the slippery driving practices to demonstrations of the risk increasing aspects of driving. Recently, some of the new European member countries (Lithuania, Slovenia and Croatia) have announced that they are going to introduce second phase driving training courses in the near future. During the approximately 30 years history of the second phase training courses, the goals and contents have been renewed, especially in the case of the newest models (Switzerland, Austria). The effects of the current second phase models are currently under discussion.

2.6 Assessment of the novice drivers' competences

Driving licence tests offer one possibility to assess novices' driving competences. Although examiners' observations have restricted validity due to biases related to the driving test's demonstrative nature (Fairclough, Tattersall and Houston 2006), and they typically focus only on the lower GDE levels (Mikkonen 2007), the strengths and weaknesses of the observed output competences seem to provide a reasonable reference to the candidates' self-assessments (Laapotti, Keskinen, Hatakka and Katila 1998). When the assessments are carried out independently from the test's pass/fail decision, the content of the assessment may even exceed the testing limitations and address the higher level GDE competences. However, factorability of the examiner assessments has shown to be poor because of the high internal correlations of the assessed competences in Finland (Mikkonen 2007) and England (Grayson, Maycock, Groeger, Hammond, and Field 1998).

Recently, applications of the driving competency assessment have been experimented in Sweden, where self-assessed learning outcomes have been related to the candidates' expected success in the driving test (Sundström 2008). In Finland and The Netherlands, the self-assessed learning outcomes have been related to the candidates' expected competence to drive independently after the driving test (Vissers et al. 2008). In the UK, the competence-based approach has also been recognized as a promising practice in driving education and driver testing (Johnsson 2008).

2.7 Purpose of the study

The purpose of the present study was to examine Finnish novice drivers' competence to drive at the beginning of their driver career. The study includes four complementary sub-studies.

The purpose of the first sub-study (Mynttinen, Sundström, Koivukoski, Hakuli, Keskinen and Henriksson 2009) was to examine the expected and observed driving test candidates' competences in Finland and Sweden. Toward that end, whether or not the candidates were able to accurately assess their own driving in three competences (Vehicle manoeuvring, Economical driving and Traffic safety) was analysed.

In the second sub-study (Mynttinen, Vissers, Sundström, Koivukoski, Hakuli and Keskinen 2009), the expected and observed driving test candidates' competences were examined in Finland and The Netherlands. The accuracy of the candidates' assessments

was assessed in six comparable competences (Vehicle control, Recognizing hazards, Traffic Flow, Weaker Road Users, Control of the traffic situations and Eco-driving).

The purpose of the third sub-study (Mynttinen, Koivukoski, Hakuli and Keskinen, in press) was to examine the change in the successful Finnish driving test candidates' driving competences in the long run. The examiners assessed the driving competences of all age cohorts that passed the Finnish driving test at the first attempt between 2000 and 2009.

The purpose of the fourth sub-study (Mynttinen, Gatscha, Koivukoski, Hakuli and Keskinen, 2009) was to examine whether the achieved novice drivers' competences could be improved by the Finnish or Austrian further driver training courses (second phase driver training). Because different questionnaires were used, the analysis was done separately for the two countries.

3 Method

3.1 Participants

The first (Finnish and Swedish) study

The Finnish and Swedish study focused on whether the driving test candidates were able to accurately assess their own driving competences. Both passed and failed candidates were included in the samples.

The Finnish participants in this study consisted of 2 739 category B driving test candidates at five test centres in the province of Uusimaa. They had taken the test for the first time between September and December 2006. Of the participants, 51 per cent were female and the average age was 21.3 years (Mdn = 18, SD = 6.3). The participants' average driving practice was 16 hours and the average driving test pass rate was 80.2 per cent.

The Swedish sample included 805 category B driving test candidates who had participated in a project conducted by the Swedish Road Administration. Three driving test centres participated in the project that aimed to integrate a self-assessment part into the driving test. Data from the Swedish sample was collected from the beginning of July to the end of October 2006. The female Swedish participants' (45 per cent) average age was 21.5 years (Mdn = 18, SD = 6.9). On average, the participants had practised driving for 62.6 hours and their driving test pass rate was 64 per cent.

The second (Finnish and Dutch) study

The Finnish and Dutch study completed the first sub-study by focusing on whether the Dutch and Finnish driving test candidates were able to accurately assess their own driving competences. The passed and failed candidates were included in the samples.

The Dutch sample included 239 category B driving test candidates who had participated in an experiment that aimed to renew the practical driving test. The candidates came from all parts of The Netherlands and all of them took their practical driving test in June 2007. Of the Dutch candidates, 50 per cent were female and the average age of the candidates was 21.6 years (Mdn = 19, SD = 7.1). On average, the Dutch candidates had practised driving for 32.3 hours and their driving test pass rate was 55.5 per cent.

The Finnish sample included the same participants as in the Finnish and Swedish study.

The third (Finnish) study

This Finnish study examined the change in the novice drivers' initial competences in the long run. Therefore, only successful driving test candidates were selected for the sample.

The Finnish participants included driving school or privately taught driving test candidates who passed their category B driving test at the first attempt between the years 2000 and 2009. The number of participants was 440,472. The mean age of the participants was 19.5 (Mdn=18, SD=4.4). The youngest participants were 18 years old (73% of all) and the oldest participant (N=1) was 81 years. The proportion of 18-year-old participants decreased by 0.4 per cent units from 2000 (10.4%) to 2009 (10.0%). Males were over-represented in the sample (53 %) compared to females (47 %). The proportion of females increased by 0.4 per cent units from 2000 (45.7%) to 2009 (46.1%).

The fourth (Finnish and Austrian) study

The Finnish and Austrian study examined whether the novice drivers' achieved competences could be improved by the Finnish or Austrian further driver education courses. Different questionnaires were used in the study.

The Finnish sample consisted of cohorts of 64,000 Finnish novice drivers who had been issued with a passenger car driving licence one year before between the years 2000 and 2007. The participants were randomly selected from the Finnish Driver Examination Register and they received the Finnish Novice Driver Questionnaire. Of the participants, 22,141 voluntarily replied to the questionnaire (response rate = 35%). Furthermore, 19.7% completed the second phase of the driver education 6-12 months after the licensing (=completed), while 80.3% delayed their participation (=not completed). The completed participants were a little younger ($m=20.44$, Mdn=18, SD=7.14) than the not-completed ones ($m=20.71$, Mdn=18, SD=6.64) and the completed group included more males (39.4%) compared to the not-completed group (30.6%). Most of the participants (84.8%) had completed their driver education's first phase in a driving school, while 15.2% had chosen the alternative private education (typically completed with their parents).

The Austrian sample included 2,500 Austrian passenger car drivers who were randomly selected from the Austrian Central Licence Register in the year 2007, and who received a questionnaire. They were 18 to 20 years old. The participants had completed the required obligatory second phase driving education modules. A total of 808 responded to the questionnaire (response rate = 32.3%) who then constituted an intervention group. The control group included a comparable group of participants from the BASIC project (Hatakka et. al. 2003) who had not been able to undergo second phase training. Additional data from the Austrian Federal Computing Centre included the number, age and sex of the novice drivers.

3.2 Instruments and Procedures

The Finnish and Swedish study

The candidates' accuracy in assessing their driving competences was assessed by self-assessments and examiner observations.

The Finnish self-assessment procedure that was used in the first sub-study had been integrated into the Finnish driving test in 2000. Thus the Finnish examiners and driving instructors had had seven years experience of using it. Before the first attempt at

the driving test, the Finnish candidates assessed their own strengths and weaknesses as a driver with regard to six competences: *Car manoeuvring*, *Control of traffic situations*, *Showing consideration to pedestrians and cyclists*, *Advance planning*, *Recognizing and avoiding risks* and *Economical driving*. The candidates assessed their own driving skills using a five-point Likert-type scale with the extremes labelled “poor” and “excellent”. The examiners used an identical scale to assess the candidates’ performance. The candidate and examiner assessments were then compared and used in a structured feedback discussion. The examiners were instructed not to look at the candidate’s self-assessment until the test result had been announced to the candidate.

The Swedish self-assessment procedure was part of an experimental project. Therefore, the Swedish candidates and examiners had very little or no experience of using it. In the present study, only the responses to the items concerning practical driving competence (10 items) were used, which corresponded to the practical driving training goals stated in the driver education curriculum. The participants responded to the self-assessment questions by rating how confident they were in successfully performing the tasks in the driving test. The response format consisted of a ten-point scale with the extremes labelled “not confident at all” and “completely confident”. The middle of the scale was labelled “fairly confident”. The examiner ratings were made using a three-point scale in which 1 indicated poor performance, 2 mediocre performance and 3 indicated good performance. For the comparisons, the candidate’s assessments were translated according to the examiners’ three-point scale. The participants gave their answers at the driving test centre before they took their first theory and practical driving test. The examiners’ and candidates’ assessments were compared after the practical test. The examiners were told not to look at the candidates’ self-assessments until the driving test result had been reported.

Based on the assessment descriptions, the contents of the three competences were considered comparable to the Finnish sample. These were referred to as *Vehicle manoeuvring*, *Economical driving* and *Traffic safety*.

The Finnish and Dutch study

In the Finnish and Dutch study the self-assessments and the examiners’ assessments were used to examine the candidates’ accuracy to assess their driving competences.

The Dutch assessment procedure was used in an experiment that aimed to include the GDE matrix’s elements in the new practical driving test. From the seven competences (*Vehicle manoeuvring*, *Safety - Possible hazards*, *Traffic flow*, *Social driving behaviour - Weaker road users*, *Social driving behaviour – situational control*, *Environmentally-aware driving*, *Safety margins*), six were found to be comparable to the Finnish procedure. The comparable competences were labelled *Vehicle control*, *Recognizing hazards*, *Traffic Flow*, *Weaker Road Users*, *Control of the traffic situations* and *Eco-driving*. Candidates indicated the extent to which they considered they had mastered these competences using a scale of 1 (poor) to 5 (excellent). The candidates’ assessments were compared to the examiners’ observations after the practical test. The Finnish assessment procedure was identical to the procedure that was used in the first sub-study.

The Finnish study

In the Finnish study, only the successful driving test candidates were selected to examine the changes in the driving competences during the long period. The assessments were conducted by the 433 examiners (candidates’ self-assessments were not used in this study) at 98 different test centres.

The instrument included the six competences assessed by the examiners, as described in the first sub-study. Because the purpose was to examine the changes in the competences, the effects of the competences were tested in a separate ANCOVA analysis. The variables included in the analysis were the candidates' age, gender and assessment year, N of faults in the still-pictures-test, answering time in the still-pictures-test, driving school or nonprofessional instruction and the uniformity of the candidates' and examiners' assessments (decided by the examiners).

The Finnish and Austrian study

In the Finnish and Austrian study, the second phase training's effects on the novice drivers' achieved competences were examined with two different questionnaires in Finland and in Austria.

The Finnish Novice Driver Questionnaire was posted four times a year between 2000 and 2007 to randomly selected novice drivers (N=2 000) who had had their category B driving licence issued one year earlier. The questionnaire included questions on the novice drivers' exposure, accidents and violations, as well as a retrospective question: 'What competences do you think you got from driving education?' The eight assessed competences (*Vehicle control, Driving in urban areas, Driving outside urban areas, Driving independently, Economical driving, Self-control, Recognizing risks and Driving in difficult conditions*) were identical to the eight main topics of the driving education curriculum. The used assessment scale was the five-point Likert-type with the extreme labels poor and excellent. The candidates who had completed their second phase training could be separated from those who had not completed it. The annual return rate of the questionnaire varied from 30 to 40%, finally reaching 50% after the reminder procedure since 2007. Every mailing included a prize of two 70-euro petrol vouchers that could be won by a questionnaire respondent.

The Austrian Questionnaire contained the same questions as the questionnaire that was used earlier (in 2002 and 2004). The self-report questionnaire included questions on driving style, safety relevant attitudes, accidents and violations. The participants were asked to assess their own driving style by rating several aspects of their behaviour on a bipolar scale (from 1 to 5) with opposing adjectives. From a total of nine opposite pairs, two factors were identified as factorable. The first factor "driving routine" was described as a safe, experienced and skilled style of driving. The second dimension "careful driving" was related to careful, non-aggressive driving behaviour.

3.3 Statistical Analysis

The Finnish and Swedish study

In the Finnish and Swedish study the statistical challenges related to the different assessment procedures and scales.

The proportion of missing values was analyzed in the Finnish and the Swedish samples. As the level of measurement was ordinal, non-parametric statistics were reported where available. Descriptive statistics (mean, median and standard deviation) were calculated for the candidate and examiner assessments in each sample. In the Finnish sample, the candidates and examiners used a five-point scale for the assessment. In the Swedish sample, the candidate assessments ranged from 1 to 10, whereas examiner assessments were made using a three-point scale in which 1 indicated poor performance, 2 mediocre performance and 3 indicated good performance. For the comparisons, the Swedish candidate assessments were recoded on a scale ranging from 1 to 3, where 1 indicated low, 2 indicated medium and 3 indicated high perceived

competence. The Swedish candidates' average response to items in each competence was regarded as low (1) if between 1.0 and 3.4, medium (2) if between 3.5 and 7.4 and high (3) if between 7.5 and 10. The rationale for using a larger interval in the middle of the scale and smaller intervals on the ends was that the candidates' responses can be assumed to be normally distributed. In order to illustrate how the scaling procedures affect the results, the proportion of candidates who made a realistic, overestimated and underestimated assessment were reported using both of these scaling procedures, i.e. "normally distributed" and "equally sized intervals". The "normally distributed procedure" is referred to as method 1 and the "equally sized intervals" as method 2. The non-parametric Wilcoxon signed-rank test was used to test the differences between the candidate and examiner assessments. The internal consistency of the candidate and examiner assessments in both samples was assessed through coefficient alpha. The relationships between the candidate and examiner assessments were analyzed using Spearman's rank order correlation (r_s). Dependence between examiner and candidate assessments in the three competences was tested using Chi-square. Multinomial logistic regression was performed to examine whether gender, type of driving instruction and age were related to the accuracy of the self-assessments. Further, dependence between self-assessment accuracy and gender, age and driving instruction was tested with Chi-square.

The Finnish and Dutch study

Because similar assessment procedures were used in the Finnish and Dutch study, Univariate Analysis of Covariance (ANCOVA) models were used to analyse the main effects and interactions of the grouping variables and assessments.

In the Finnish and the Dutch samples, missing values were estimated using regression imputation with the driver examiner assessments in the six competences as predictors. Descriptive statistics (mean, median and standard deviation) were calculated for the candidate and examiner assessments in the two samples. The candidate and examiner assessment means were compared using a paired samples t-test. The effect size was assessed with Cohen's d , where 0.2 was interpreted as small, 0.5 as medium and 0.8 as large effect sizes. The internal consistency of the candidate and examiner assessments was assessed through coefficient alpha. The relationship between the candidate and examiner assessments was analyzed using Spearman's rank order correlation (r_s). ANCOVA models were performed to examine the differences between the Dutch and Finnish examiner assessments and the Dutch and Finnish candidate assessments when adjusting for differences in age and gender. Effect size was assessed with partial η^2 . For experimental and social/clinical psychology, guidelines have been presented for small ($\eta^2 = .01$), medium ($\eta^2 = .09$) and large ($\eta^2 = .25$) effects. However, larger values could be expected for non-experimental research. To examine the accuracy of the self-assessments, the examiner assessments were subtracted from the candidate assessments. Positive values were interpreted as underestimation, negative values as overestimation. Values of zero were interpreted as a realistic assessment (no difference between examiner and candidate). In addition, the under/overestimation groups were divided into two sub-groups, each depending on the magnitude of the examiner-candidate difference: *little underestimation* (-1 to -2) and *underestimation* (-3 to -4), as well as *little overestimation* (1 to 2) and *overestimation* (3 to 4). The Finnish and Dutch samples were compared with regard to the proportion of candidates making a realistic assessment or under/overestimating their competence using a test of proportions in different populations.

The Finnish study

In the Finnish study, the variables' descriptive statistics (mean, median and standard deviation, as well as multivariate skew and kurtosis of the distributions) were analysed after the missing values analysis. The internal consistency of the assessments was estimated using Cronbach's alpha coefficient; coefficient 0.7 was moderate, 0.8 was good and 0.9 was excellent. The relationships between the assessments' were analysed with the Pearson correlation coefficient.

The main effects and interactions of the grouping variables and assessments were analysed with the ANVOVA analysis, and effect sizes were estimated using the partial eta squared (η^2). The effect size $\eta^2 = .01$ was considered small, $\eta^2 = .06$ medium and $\eta^2 = .16$ large (Cohen 1988). Because of the selected sample and an exceptionally large sample size, practically all of the observed differences were statistically significant. Therefore, the partial η^2 was used as a significance criterion.

The Finnish and Austrian study

Because of the different assessment procedures, somewhat different statistical methods had to be used to analyse the effects of the Austrian and Finnish second phase driver training courses.

The proportion of missing values was analysed in the Finnish and Austrian samples. The descriptive statistics (mean, median, and standard deviation) were also calculated for the variables in both samples. Likewise in both samples, the candidate assessments' internal consistency through coefficient alpha and the dependency of the categorised variables by Chi-square were analysed. However, in the Austrian sample, non-parametric (Mann-Whitney tests) was used to achieve valid group comparisons. Furthermore, to increase the comparability between the samples, the individual Austrian questions were comprised of factors using the exploratory factor analysis. Finally, multiple group differences were tested in both of the samples by the Univariate Analysis of Covariance (ANCOVA).

4 Main results

4.1 The Finnish and Swedish study

Finnish and Swedish novice drivers' strengths and weaknesses were examined in three driving competences (*Vehicle manoeuvring, Economical driving and Traffic safety*). About 30 per cent of the Finnish and between 58 and 70 per cent of the Swedish candidates overestimated their driving competences. In this study the criterion of the assessment was defined beforehand (contents of the competences). In the studies that have used the average driver as an assessment criterion (for example Svenson 1981) the overestimation of the self-assessments has been recognised.

The proportions of underestimation as well as realistic assessment were greater in the Finnish sample than in the Swedish sample. Because the amount of driving practice with an instructor is four times more in Sweden compared to the practice in Finland, it suggests that the novice drivers' accurate self-assessments are not enhanced by only increasing the amount of driving. Moreover, the Finnish learner drivers had several possibilities to practice their self-assessment during the driving education, while self-assessment practices were not introduced in the Swedish driver training; therefore, the learner drivers did not have a possibility for self-assessment practice. This finding

suggests that self-assessment practice enhances the accuracy of the assessments, as has been found in the educational field (Hakkarainen et al. 1999).

4.2 The Finnish and Dutch study

The Finnish and Dutch study supplemented the earlier Finnish-Swedish study. The Dutch and Finnish novice drivers' strengths and weaknesses were compared in six driving competences (*Vehicle control, Recognizing hazards, Traffic Flow, Weaker Road Users, Control of the traffic situations and Eco-driving*) in the Finnish and the Dutch samples. The Dutch learner drivers had practiced driving with an instructor two times more than their Finnish counterparts, and the Dutch candidates had not practiced self-assessment before this study. Because similar procedures for assessment were used in the Finnish and Dutch samples, the results were reliably comparable. It was found that most of the candidates were able to realistically assess (40-50%) all of the driving competences. The proportion of overestimation (little overestimation + overestimation) was higher in the Dutch sample (48.9%) than in the Finnish sample (33.3%). The results support the findings of the Finnish-Swedish study. Likewise, the results can be explained by the Finnish candidates' better opportunities for self-assessment practice.

In both countries, the candidates and examiners gave the highest scores in the competences of *Vehicle control* and *Weaker road users*. Compared to the other assessed competences, these are concrete, and, as such, the candidates' behaviour may be relatively easy to assess. Consequently, it might mean that driver behaviour related to the abstract competences would be more difficult to assess. It is also possible that the variation in the assessments truly reflects the drivers' learning process, in which these concrete competences have been learned faster than the abstract ones. This topic would be interesting to study further in the future. Moreover, the findings suggest that in producing driver competences it would be desirable not to consider driver testing to be the only goal when learning to drive. For some competences, especially the abstract ones (whose contents are described in the higher levels of the GDE matrix), the easiest and most beneficial practices may be to count on high-quality driving instruction according to a transparent curriculum (Hatakka et al. 2003; Keskinen and Peräaho 2009). A good example of this approach is the Norwegian stepwise training programme, in which the goals of driving instruction have been defined according to the learner drivers' developing competences, based on the idea of the GDE matrix (OECD/ECMT 2006; Tronsmoen 2008).

4.3 The Finnish study

The main focus of the Finnish study was to assess the cohorts of successful Finnish driving test candidates' competences over a long (ten years) period. Only successful candidates were selected for the study because immediately after successfully passing the driving test they are allowed to start their risky solo driving period in traffic. The changes and the effects of the participants' initial competences (vehicle control, control of the traffic situations, vulnerable road users, adaptation to traffic flow and planning, recognising and avoiding risks and economical driving) were examined separately in ANCOVA analyses.

The results showed that the average level of the competences were high (on the one-to-five scale), which is reasonable because the participants were the successful ones in the test. The competence of vehicle control decreased during the ten years, while the other competences remained unchanged. This result is in line with the actions taken in the Finnish driving instruction and testing. In Finland, the risk-related higher behavioural level factors (Hatakka et al. 2003) have been emphasised while the lower

level manoeuvring skills have been given less attention. A good question remains: how to set an optimal balance between manoeuvring competence and the other competences. Another question relates to the relatively low score in recognising and avoiding risks, which suggests that the actions taken in Finland to improve this competence have not been successful.

Young (18-year-old) participants scored better than their older counterparts in vehicle control and economical driving. This indicates that learning the automation of sub-tasks needed to control the vehicle is faster for young drivers than for older ones. Younger drivers have been shown to have faster reaction times than older ones in a laboratory test (Groeger et al. 1998), as well as faster object detection times in a field experiment (Olson and Sivak 1986). The nonprofessional participants scored better than the driving school participants in vehicle control as well in adaptation to traffic flow and planning. This might be explained by the greater (33 %) amount of driving practice with an instructor compared to the driving school participants.

The participants' low number of errors in interpreting 50 still pictures was related to competences other than vehicle control and adaptation to traffic flow and planning. The finding suggests that, with regard to the higher behavioural level competences (Hatakka et al. 2003), the same competences can be assessed by the examiner assessments and by the still-pictures-test. The result is interesting considering the future development of driver education and testing.

Finnish male participants' greater success in all of the competences compared to female participants is in accordance with the earlier findings (AKE 2010; Katila et al. 2006). It has also been previously shown that the males' success in the driving test does not necessarily guarantee their safe behaviour in Finland (Keskinen et al. 1992; Laapotti 2003), in England (Maycock and Forsyth) or in Japan (Renge 1998). This relates to the low predictive validity of the driving test by the criterion of traffic accidents or violations. As with the earlier findings by Katila and Keskinen (2003), the observed gender difference in this study suggests low predictive validity for the Finnish examiners' competency assessments. It is not known whether the gender difference is due to different preparation of the participants or the differences in the examiners' assessments or both. However, in an experiment Sweden, the gender difference was not observed in connection with the driving test success or the examiners' competence assessments (Mynttinen, Sundström, Koivukoski et al. 2009).

Realistic awareness of the driver's own abilities has shown to be an important factor for the novice drivers' safe independent practice (Gregersen 1996, 2003). De Craen et al. (2008) found that overconfident novice drivers reported more violating behaviour than well-calibrated or insecure drivers. Katila and Keskinen (2008) found that the low uniformity of the Finnish candidates' and examiners' assessments (decided by the examiners) related to the high number of novice drivers' self-reported offences in traffic. In this study, the high uniformity of the assessment scores related to high scores in all of the competences. The findings suggest that the uniformity of the assessments is a valid and interesting measure in novice drivers' behavioural assessments since it may show how realistically the drivers are able to assess their own abilities.

4.4 The Finnish and Austrian study

The Finnish and Austrian study examined whether the driver education's second phase training course would improve novice drivers' competences after gaining their licence. The expected safety effects of the second phase training programmes have been partly positive and partly negative in the earlier national follow-up studies (Glad 1988; Keskinen et al. 1992), mostly negative in some co-financed studies by the European Union (ADVANCED 2002; NovEv 2004) or partly positive (Hatakka et al. 2003; Katila

et al. 1998). The first Austrian follow-up study (Gatscha and Smuc 2004) showed no significant safety results. However, recent findings suggest some positive safety effects from the Austrian second phase training (Gatscha & Brandstaetter 2008).

Although the Finnish second phase education has been developed over the past twenty years, it includes the same basic structure as at the beginning. The Austrian second phase course was introduced in 2003, so they were able to learn from the earlier second phase practices and experiences. The content of the Austrian second phase course differs from the Finnish one. Although it includes slippery driving practice and demonstrations, the main focus of the Austrian second phase course is more clearly on the social and risk-avoidance behaviour of the novice drivers. Furthermore, the group discussions are held by specialist traffic psychologists in Austria. During the 30 years history, the second phase driver education's emphasis has shifted away from slippery driving practice. New practices aim to increase novice drivers' risk awareness more generally and emphasize the importance of social factors. At the same time, the teaching methods have changed to ones that concentrate on active, motivating and participative learning, such as group discussions, self-assessments and demonstrations in safety halls.

The findings of the Finnish and Austrian study indicated that the Finnish participants who had completed the second phase training programme had benefited more from the economical driving training than the not-completed participants. The other competences (related to various aspects of safe driving) were not considered beneficial by the completed group. Furthermore, the findings suggested that participants who had completed the second phase training reported fewer traffic accidents and violations than those who had not conducted the course. On the other hand, the questions related to safe driving behaviour and style did not indicate any significant differences. Because of the different questionnaires, the results were not comparable between the countries.

5 Discussion

The purpose of the first and second study was to examine Finnish and Swedish as well as Finnish and the Dutch driving test candidates' accuracy in assessing their driving competences. Realistic awareness of their own driving competences may be an important factor in helping novice drivers to safely overcome the risky solo driving period. The findings suggest that when the criterion of the assessment is defined beforehand (contents of the competences), novice drivers are able to avoid overestimation of their driving competences. Most of the Finnish and Dutch candidates, as well as about one-third of the Swedish candidates, were able to avoid overconfident assessments. Furthermore, it was suggested that participation in self-assessment practices may enhance awareness of one's own driving competences.

The purpose of the third study was to observe the cohorts of successful Finnish driving test candidates' competences over a long (ten years) period. Although it is important to acquire the necessary competences for the risky solo driving period, it is not known how stable the competences are in the long run. The competence of vehicle control decreased consistently over the ten years, while the other competences remained unchanged. The 18-year-old participants scored better than their older counterparts in vehicle control and economical driving. Nonprofessional participants scored better than driving school participants in vehicle control, as well in adaptation to traffic flow and planning. The participants' low number of errors in the test of interpreting 50 still pictures was related to competences other than vehicle control and adaptation to traffic flow and planning. Male participants' high scores and the high uniformity of the assessments were both related to high scores in all competences.

The purpose of the fourth sub-study was to examine the effects of the Finnish and Austrian second phase training courses. Earlier findings suggested that the effects of the second phase training courses depended on the goals, content and structure of the courses. Because some European Union countries are planning to introduce second phase training courses, their effects are currently under discussion. The results of this study suggest somewhat positive safety results in terms of accidents and violations regarding the Austrian second phase training course. The Finnish second phase training was shown to be beneficial with regard to ecological driving but not with the competences related to safe driving.

5.1 Competences can be acquired in different ways

It is known from the expertise studies that development in any domain of expertise demands more than ten years of intensive daily practice (Ericsson & Charness 1994). Thus the highest level of expertise in a domain is only reachable for a very low number of people. However, becoming a *relative* expert in everyday activities, like car driving, is possible for most people (Anderson 1982: 233). In Finland, Katila et al. (2000) found that Finnish novice drivers are able to achieve the average drivers' accident risk level after three years of solo driving. However, success at the beginning of solo driving depends on the novice's age, gender, and driving experience (Laapotti 2003; Maycock 2002; Vlakveld 2004).

A minimum amount of 120 hours of driving with an instructor has been suggested (OECD/ECMT 2006: 135) before solo driving. The actual amount of instructed driving varies a lot between countries, but in most countries it is much less than the suggestion. During the short instructed driving practice, it is important that the novices have acquired the necessary competences before the risky solo driving period in traffic, including a realistic awareness of their own strengths and weaknesses as drivers (GADGET 2002; Gregersen 1996).

The comparison of the Finnish and the Dutch driving test candidates shows that different driving instruction practices may produce similar assessment profiles. The highest assessment scores were obtained in the Vehicle control and Weaker road users competences in both countries. Considering that only the Dutch candidates had practiced driving with an instructor for double the amount of time the Finnish candidates had before the evaluation, the finding is interesting. In future studies it would be interesting to see whether this accounts for the similar expected outcomes of the driving education and practices, or whether the candidates simply learn the concrete contents faster than the abstract ones.

Furthermore, no difference in the accuracy of the assessments was observed among the Swedish or the Dutch candidates regarding gender and age, but modest differences were found among the Finnish candidates. This implies that the learners' individual strengths and weaknesses could be taken into consideration in the Finnish driver training and education, as, for example, Hatakka et al. (2003) have suggested earlier.

The findings also showed that 'what you practice is what you get'. Driving competence develops through practice, with a relatively low transfer of learning (Groeger 2000: 83). For example, if the goal of the driver training is to increase the novice drivers' self-evaluation skills, the amount of these practices should be increased in training. The same applies to the learning contents (Hatakka et al. 2003). If the goal is to increase novice drivers' readiness to understand the meaning of selecting safe and economical routes, these topics should be practiced. In other words, the learning should provide and make use of the different possibilities towards the stated goals and expected outcomes. The Finnish candidates' better self-assessment scores compared to the

Swedish or Dutch scores may be explained by the greater possibilities (and longer tradition) for self-assessment practice. Finnish driving school students have various possibilities to assess their strengths and weaknesses (Autokoululiitto 2009). Self-assessments take place at the beginning of the driving education (initial competences), twice during the education (development of the driving competences) and at the end of the education (ability to drive independently in traffic - in normal and in difficult conditions). Furthermore, the self-assessment practices are missing in the early solo driving period, but they are included in the second phase training course.

5.2 Finnish novice drivers' competences have remained rather unchanged

The competences of the successful driving test candidates remained remarkably stable during the ten years. The only acceptable change was the continuous reduction in the vehicle control competence according to the applied criterion (Cohen 1988). Furthermore, the order of the competences (other than vehicle control) remained unchanged, which suggests good criterion-referenced validity of the assessments. From 2000 to 2009, the average amount of driving practice diminished by about 1.5 hours.

The findings are in accordance with the recent actions taken in Finland. New elements of risk awareness have been introduced in driving instruction (AKE 2004) and testing (AKE 2005), mainly inspired by the GDE matrix (Baughan et al. 2005; Hatakka et al. 2002). At the same time, the candidates' vehicle manoeuvring competence has moved from separate testing grounds to public roads during the driving test. Since 'what is tested influences what is practised' (Baughan et al. 2005), it may have reduced the importance of the vehicle control competence among the driving instructors. However, sufficient automation of vehicle control is necessary before the novices can efficiently focus on the abstract issues in their driving practice (Baughan et al. 2005; Hatakka et al. 2003). This may be challenging, considering the low and reduced number of average driving practice hours in Finland. Therefore, possibilities to increase the total amount of driving practice should be considered. Nevertheless, a good question remains: how much vehicle control practice is sufficient?

It seems that the Finnish actions taken to improve the competence of recognising and avoiding risks have not been successful. This competence has remained the second lowest during the ten years. At the same time, the competence to recognise vulnerable road users has been the highest. Judging by the contents, these two competences in particular ought to be related. It may be that at the participants' stage of learning, the competence of recognising vulnerable road users is easier and more concrete to learn faster than the competence of recognising and avoiding risks.

The youngest (18-year-old) participants were more competent than the older ones only in the competences of vehicle control and economical driving. Hatakka (1998) has showed that the youngest drivers are interested in vehicle manoeuvring. According to the accident statistics (OECD/ECMT 2006), the youngest novices ought to be interested in the higher behavioural issues (Hatakka et al. 2003; Gregersen 2003). Furthermore, the nonprofessional participants' scores were higher than the driving school candidates' in vehicle control and adaptation to traffic flow and planning. The difference may be explained by the nonprofessional participants' greater (30%) driving practice with an instructor compared to the driving school participants' number of driving lessons.

Realistic awareness of the driver's own abilities has shown to be an important factor for the novice drivers' safe independent practice (Gregersen 1996, 2003). De Graen et al. (2008) found that overconfident novice drivers reported more violating behaviour than well-calibrated or insecure drivers. Katila and Keskinen (2008) found that the low uniformity of the Finnish candidates' and examiners' assessments (decided

by the examiners) related to the high number of the novice drivers' self-reported offences in traffic. In the Finnish study, the low uniformity of the assessment scores related to low scores in all of the competences. The findings suggest that the uniformity of the assessments is a valid, interesting and practical supplement to the novice drivers' behavioural assessment, and it may show how realistically the drivers' are able to assess their own abilities.

Furthermore, the finding of the relationship between the still-pictures-test success and high scores in the four competences (others than vehicle control and adaptation to traffic flow and planning) is valuable. It shows that the same competences can be assessed by the examiners and by the still-pictures-test. In the future, theory education, training and testing could be used even more to support the development of the novice drivers' competences; the competences that are difficult to address in the practical training or test could be addressed by the theoretical training and test (Katila et al. 2006).

5.3 Improving the achieved competences

Once the initial driving competences have been acquired, the focus shifts to the further developmental potential of the competences. At this point, the relatively short instructed driving practice changes to uninstructed solo driving practice. Furthermore, the participation in the surrounding traffic culture begins to instruct the development of the competences (Hakkarainen et al. 2002). Depending on the surroundings, the adaptation to the traffic culture may include safe or unsafe activities. Therefore, the initial competences that are achieved for the solo driving may help the novice drivers to resist the unsafe activities.

There are various possibilities to arrange safe circumstances for the solo driving practice (OECD/ECMT 2006). One possibility is to enhance the competences through further driver education, as in Finland and in Austria. The contents of the first second phase courses have mainly focused on the slippery track practices (Glad 1988). There is a risk that novice drivers may acquire an unrealistic impression of their driving skills (Gregersen 1996; Katila, Keskinen, Hatakka & Laapotti 2004). The risk relates to the challenge that on the slippery tracks it is difficult to simulate real slippery driving in traffic, in which social aspects of driving are important (Mikkonen 2004). This may explain why the slippery driving practices have focused on the technical aspects of driving (Katila et al. 2004). Furthermore, during the short period on the slippery track it is demanding for the driving instructors to ensure that the candidates do not feel overconfident regarding their slippery driving competences (Katila et al. 2004).

The safety effects of the second phase training's slippery practices have been negative (Glad 1998), partly negative (1992) or partly positive (Katila et al. 1998; Gatscha and Brandstaetter 2008). Moreover, the effects of the further training seem to relate to the courses' goals, construction, contents and methods (ADVANCED 2002; Katila et al. 2004), as well as the timing of the further training course (Hatakka et al. 2003). Recently introduced courses have been able to learn from earlier experiences. The contents of the second phase courses have shifted during the second phase training's thirty-year history, from simple slippery driving practices to others like increasing novice drivers' risk awareness and the importance of social factors. At the same time, the teaching methods emphasise active, motivating and participating learning, such as group discussions, self-assessments and demonstrative safety halls (Katila et al. 2004; Nyberg, Gregersen, Nolen and Engström 2005).

The findings of the Finnish and Austrian study suggested some positive safety effects of the Austrian second phase training in terms of the number of self-reported accidents and violations. Regarding the Finnish second phase training, it was found that

it may be beneficial in improving the novice drivers' economical driving competence but no positive effects on safety-related competences were found. This was expected, considering the resources that have been invested in economical driving training in Finland in recent years. However, this may have been influenced by the fact that relatively less time (in total) has been spent on safety-related practices. According to the result of the Finnish study, economical driving has stayed the lowest competence of all during the ten-year period.

5.4 Limitations

In the Finnish and Swedish study, in which the assessment procedure, design and assessment scales were different, the identical assessment criteria could not be controlled. This restricted the possibilities for international comparisons. Furthermore, the differences may be one explanation of the Swedish participants' lower self-assessment scores compared to their Finnish or Dutch counterparts.

The exceptionally large sample size in the Finnish study and the selected group of successful participants diminished the variation in the assessments. Therefore, the deviation of the means (within a half unit) and the effect sizes remained low, although practically all of the observed differences were significant. Considering that, according to the applied criterion (Cohen 1998), none of the interaction effects were acceptable, it is suggested that the criterion has been conservative in this exceptional sample.

The contents of the assessed competences were moderately related in all of the samples. Regarding the known assessment bias of the Halo effect (Thorndike 1920; Nisbett and Wilson 1977), it is important that the contents of the assessed competences are defined as clearly and as independently from each other as possible. For example, in the Finnish sample, the content of the competence Adaptation to traffic flow and planning includes two things (Mikkonen 2007), and it might be advisable to separate them in the future. Furthermore, considering the relationship between the competences, the importance of the examiners' and candidates' training cannot be over-emphasized.

The Finnish male participants' better success than female participants' in all of the competences is consistent with the earlier findings (Katila et al. 2006). Furthermore, it has been shown that the males' success in the driving test does not necessarily guarantee their safe behaviour in Finland (Keskinen et al. 1992; Laapotti 2003), in England (Maycock and Forsyth) or in Japan (Renge 1998). This relates to the low predictive validity of the driving test by the criteria of traffic accidents or violations. As Katila and Keskinen (2003) have suggested earlier, the observed gender difference in this study indicates the low predictive validity of the Finnish examiners' competency assessments. It is not known whether the gender difference is due to different preparation of the participants or to the differences in the examiners' assessments or both. However, in an experiment in Sweden, the gender difference was not observed with regard to the driving test success or the examiners' competence assessments (Mynttinen, Sundström, Koivukoski et al. 2009).

Keskinen et al. (2009) found a relationship between the uniformity of the candidates' and examiners' assessments and the number of self-reported offences in traffic. It would be interesting to study the relationship between the assessed competences and novice drivers' accident statistics. However, if the contents of the driver training are only defined by the driving test, the possibilities to introduce practices related to the higher behavioural level issues are limited (Baughan et al. 2005). Therefore, the initial driving training should also enhance competences other than those assessed in the driving test (Hatakka et al. 2003; OECD/ECMT 2006; Tronsmoen 2007). Nevertheless, as challenging as it obviously seems to be, it is important to keep

on looking for possibilities to assess the higher behavioural level competences in the driving test (Baughan et. al 2005).

5.5 Conclusions

The first conclusion is that since Finnish novices are facing the most dangerous period of their driver career with a very low amount of initial practice, it is important for them to know their own strengths and weaknesses as drivers. Most of the Finnish novice drivers are able to avoid overconfidence in their driving competences when the contents of the competences are defined beforehand. Moreover, the Finnish novices assess their competences more realistically than their Swedish or Dutch counterparts. Supporting the earlier suggestions, increasing the amount and improving the quality of the self-assessment practices are recommended ways to improve the novice drivers' awareness of their readiness as drivers.

The second conclusion is that the Finnish novice drivers' competences before the risky solo driving period have remained rather unchanged. During the ten years, the only observed change was a continuous reduction in the vehicle control competence.

The third conclusion is that different driver training courses may be differently beneficial. The Finnish second phase course has proved to be beneficial in improving the novice drivers' competency to drive economically, but not the other safety-related competences.

The fourth conclusion is that continuous and regular observations of the novice drivers' competences are valuable. These can be used to test whether the expected learning outcomes have been met independently from the educational practices. Furthermore, assessments over a long period of time may reveal whether the initial competences have changed or not.

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Appendix: sub-studies



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