Transportation Research Part F 26 (2014) 28–37

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Implementation of the driver training curriculum in Spain: An analysis based on the Goals for Driver Education (GDE) framework

J. Gabriel Molina [a,*], Rafael García-Ros [a], Esko Keskinen [b]

[a] Department of Psychology, University of Valencia, Av. Blasco Ibanez, 21, 46010 Valencia, Spain
[b] Department of Psychology, University of Turku, Assistentinkatu 7, 20014 Turku, Finland

ARTICLE INFO

Article history:
Received 30 September 2013
Received in revised form 13 May 2014
Accepted 21 June 2014

Keywords:
Driver education
Driver training curriculum
Driving behavior
Self-evaluation skills

ABSTRACT

The Goals for Driver Education (GDE) framework represents a conceptual outline of the goals to be satisfied in driver education (Hatakka et al., 2002). We aimed to analyze the implementation of the driver training curriculum in Spain, taking this framework as reference; the Spanish driving instructors was the target population from which to gather the information to be analyzed. For this purpose, we developed the DTCI (Driver Training Curriculum Implementation) scale as well as a number of questions concerning the driving instructors' opinions about their own training as instructors, and they were included in a survey that provided information for a probabilistic sample of 676 driving instructors. On the one hand, an analysis of the factor structure of the DTCI scale provided a two-factor solution that fitted the hierarchical levels of the first dimension of the GDE framework; however, no factor differentiation reflected the components of the second dimension of this framework. On the other hand, the survey results suggested that the Spanish driver education system places more emphasis on knowledge and skills related to the operative and tactical aspects of driving, whereas less importance is placed on risk-prevention and self-evaluation skills related to the strategic and personal levels of driving behavior. These results reveal a potential weakness in the driver training curricula from the point of view of the GDE framework and support the application of instructional methods and teaching tools that correct these potential flaws in the training of student drivers.

1. Introduction

The category-B (passenger car) driving license can be obtained in Spain after passing a two-stage test: a theory test, and a test of skills and behavior. Annex II of the Directive 2006/126/EC of the European Union establishes the contents to be considered in these two driving tests and, therefore, the main contents which are considered in the training given by the Spanish driving schools. Within Europe, several reports and congress presentations have underlined that, in general, driver training curricula focus on basic, operative driving knowledge and skills, whereas less attention is paid to the personal characteristics and motivations involved in driving behavior (CIECA, 2010; Bartl & Sanders, 2005; Gandolfi, 2009; Gregersen, 1999; OECD/ECMT, 2006; Vidal-Gomel, Boccara, Rogalski, & Delhomme, 2012). The above-mentioned studies, though, are mainly based

* Corresponding author. Tel.: +34 963983559; fax: +34 963864697.
E-mail addresses: gabriel.molina@uv.es (J.G. Molina), rafael.garcia@uv.es (R. García-Ros), esko.keskinen@utu.fi (E. Keskinen).

http://dx.doi.org/10.1016/j.trf.2014.06.005
1369-8478/

on expert opinions, not on empirical findings. In addition, very little research has generally been published into driving instructors, their concepts of goals and the achievement of those goals in driver education. Moreover, not only is there very little research into driving instructors, it is also highly dispersed (Gregersen, 2005). Even less has been published in international peer-reviewed scientific journals. However, as Gregersen (2005) points out: "A driving instructor needs knowledge about road safety, psychology, educational methods, etc. in order to meet the needs of learner drivers. They become a link between the goals of the curriculum for learner drivers and the national licensing tests. In this position they are expected to be structuring, teaching and coaching the learner drivers by selecting the appropriate methods and content for practical as well as theoretical education". Thus, this study aimed to obtain empirical evidence about to what extent driving instructors achieved their goals when teaching different areas of safe driving skills in the driver education process in Spain. For this purpose, we developed a questionnaire which was based on a theoretical model that took into account both educational and psychological aspects of the driver training process; so, a more comprehensive view of the implementation of the driver training curriculum in Spain was provided.

Traffic psychology has made an important effort to develop theoretical models of driving behavior. These models have made contributions towards explaining the behavior of the driver, guiding research in the field, and improving road safety by taking the human factor into account (Huguenin & Rumar, 2001). Some of these theoretical models rely on a hierarchical perspective, that is, they consider that the driver adapts his/her actions at different strategic levels on the basis of the driving situations and the psychological processes involved in responding to them. A comparative overview of various hierarchical theories was provided by Keskinen, Hatakka, Laapotti, Katila, and Peräaho (2004). A common characteristic to a number of these models is that they were constructed from three different hierarchical levels of driving behavior: a lowest operative level related to the basic handling skills of the vehicle, a second tactical level related to the management of traffic situations, and an upper strategic level related to the decisions of the driver, like the context of driving (when to drive, with whom...) and planning the trip (driving route, driving time...).

Based on an earlier three-level proposal by Mikkonen and Keskinen (1980), Keskinen (1996) broke this three-level ceiling by incorporating a fourth upper hierarchical level called "Goals for life and skills for living", which tries to relate driving behavior with the subject's normal behavior in other contexts of life. Personality factors, lifestyle, motivations, social background, and attitudes are some of the pieces that shape this upper level in the hierarchy. Keskinen (1996) pointed out the importance of considering this fourth level of driving behavior in driver education as a way to develop an awareness of the personal characteristics and motivations involved in driving behavior. Awareness of such personal factors and their consequences on driving would serve to lessen their potential negative effects. Taking a step forward, Hatakka, Keskinen, Gregersen, and Glad (1999) proposed a conceptual framework of the goals to be satisfied in driver education which integrated both the hierarchical model proposed by Keskinen (1996) and also some contributions from traffic and educational psychology to driver education. This proposal, known as the Goals for Driver Education (GDE) framework, has a two-dimensional structure: (1) a driving behavior dimension with the four hierarchical levels described above; and (2) a training dimension which is established by the following three categories of contents to be considered in driver education:

(a) Knowledge and skills a driver needs to master in order to drive a vehicle and cope in normal traffic situations. Driver education has traditionally focused on this type of content, especially as far as the two lowest hierarchical levels of driving behavior are concerned. Let us provide an example of driver education goals for this type of training content through the four levels of the first dimension of the GDE framework: (a-1) to control the vehicle so as to maintain a safe distance; (a-2) to know the relationship between a safe distance and different road conditions and adapt driving behavior to it; (a-3) to be aware of the influence of social pressure inside the vehicle on maintaining a safe distance and to be able to manage this influence positively; and, at the top level of the hierarchy, (a-4) to be aware of the impact of certain personal characteristics on keeping a safe distance and to develop skills to manage this effect positively.

(b) Knowledge and skills related to risk-increasing factors when driving. In spite of the fact that they may be thought of as knowledge and skills from the preceding category, Hatakka et al. (1999) awarded them an independent position in the GDE framework in order to emphasize the types of risk associated with each of the hierarchical levels of driving behavior. As an example of this type of training content across the four levels of the driving behavior dimension, we may differentiate the following four driver education goals: (b-1) to know what the consequences of speeding on vehicle control and handling are, and to acquire skills in order to avoid the consequences of this risk factor; (b-2) to know the effect of speeding on the ability of the driver to adjust his or her driving to changes in traffic situations and to develop skills so as to manage this effect; (b-3) to be aware of the relationship between decisions on the planning of the route and speeding; (b-4) to be aware of how speeding and personal lifestyle are related so that the driver avoids the potential, negative effects of this interaction.

(c) Finally, the third category of training contents refers to self-evaluation as a process whereby the driver tries to obtain feedback from within himself/herself (Keskinen & Hernetkoski, 2011). Exactly as has occurred in other areas of education, realistic self-evaluation as a driver has the potential to improve the learning-teaching process in a meaningful way (Boccara, Delhomme, Vidal-Gomel, & Rogalski, 2011; Eby, Molnar, Shope, Vivoda, & Fordyce, 2003; Lajunen & Summala, 1995; Sundström, 2008). Let us see another example of driver education goals, specifically how this training content category intersects with the four categories of the driving behavior dimension: (c-1) to realize one's strengths and weaknesses about the basic driving skills required to maneuver the car when overtaking; (c-2) to be aware of

Table 1
Some examples of driver education goals associated with the GDE framework.

	(a) Knowledge and skills concerning...	(b) Knowledge and skills connected to risk-increasing factors like...	(c) Realistic self-evaluation about your own...
(1) Vehicle maneuvering	• Control of direction and position • Tire grip and friction • Vehicle characteristics • Physical phenomena	• Insufficient acquisition of automatisms • Poor brake technique • Low road friction • Bad car maintenance	• Knowledge about your car features and maintenance • Basic maneuvering knowledge and skills • Ability to control direction
(2) Mastery of traffic situations	• Traffic rules • Anticipation of development • Speed adjustment • Safety margins • Ability to manage hazardous situations	• Presence of vulnerable road-users • Not obeying rules • Information overload • Difficult conditions (rain, ice, darkness...)	• Knowledge of signs and traffic rules • Personal driving style • Ability to keep safety margins • Ability to manage hazardous situations
(3) Goals and context of driving	• How reason for the trip affects driving • Planning of the route • Planning of the requested driving time • Effects of social pressure	• Conditions that would impair driving (mood, fatigue, etc.) • Peer pressure • Driving environment (rural versus urban) • Going out and alcohol/drugs	• Knowledge and ability to plan a convenient, safe route • Ability to avoid peer pressure when going out
(4) Goals for life and skills for living	• Lifestyle • Motives • Self-control • Personal values	• Acceptance of risk • Emotional disorders • Alcohol/drug addiction • Sensation seeking	• Impulse control skills • Risky tendencies • Safety-negative motives and personal values

one's ability to overtake in different traffic situations; (c-3) to acquire self-evaluation skills about how one's decision to overtake is influenced by peer pressure; (c-4) to be aware of how personal lifestyle can affect our decisions to overtake.

Based on the illustration of the GDE matrix presented by Hatakka et al. (2002), Table 1 presents other examples of driver education goals for the twelve cells of the two-dimensional grid established by the GDE framework.

Theoretically-based driver education models, like the GDE framework, have aroused interest in some European countries (Keskinen & Hernetkoski, 2011), where some EU-funded research projects (i.e., GADGET, Siegrist, 1999; ADVANCED, 2003; MERIT, Bartl, Gregersen, & Sanders, 2005; SUPREME, 2007) have focused on the application of driver training models that emphasize "quality training", as it was called by Nyberg, Gregersen, and Wiklund (2007). This was the case of the NovEv research project (Sanders & Keskinen, 2004), which evaluated the implementation of a second-phase training programme for novice drivers that put the primary focus of the training on the higher hierarchical levels of driving behavior. When this intervention was put into practice, the results pointed to a positive effect on the participants' careful driving skills (Molina, Sanmartín, Sanders, & Keskinen, 2007). It must be noted that second-phase models are already in use in the driver education systems of Austria, Finland, Luxembourg, Slovenia and Switzerland.

With the introduction of the GDE framework (Hatakka et al., 1999; Hatakka et al., 2002), the overriding significance of the higher levels of driving behavior was stressed, as was the consideration of the training contents related to risk awareness and realistic self-evaluation. In practice, though, not much is known about how driving instructors assess how the training educational goals established by the GDE framework are met in their current driver education system. Thus, the aim of this work was to explore the correspondence between the theoretically constructed concepts of the GDE framework and the teachers' perceptions concerning the implementation of the driver training curriculum in Spain. We planned the collection of this information by means of a survey which was based on a questionnaire built by us for this purpose, so this study involved analysis of the psychometric properties of this instrument as well.

2. Method

2.1. Participants

Participants were driving instructors randomly sampled from a database owned and managed by the Spanish General Directorate of Transport (DGT), which contains records of the Spanish driving instructors on active service. The size of the driving instructor population was over 21 thousand, so a random sample was drawn with a target sample size of nearly 800 participants so that the error bound for 95% confidence intervals was set at 4% in the worst case of estimation of the proportion with maximum variance ($p = .5$). The involvement of the driving instructors who were invited to participate

was quite high (84%), so we finally obtain data on 676 participants in order to achieve our analysis objectives. The age range of the sample was between 21 and 70 years old, with a mean of 44.8 years and a standard deviation of 10.3; 81.7% were male and 18.2% female. As for the participants' experience, they had worked as driving instructors for between 1 and 49 years, with a mean of 15.8 years and a standard deviation of 10.2. Most of them (83%) worked in driver education, teaching people to obtain automobile driving licenses, while the remaining 17% also gave classes on obtaining licenses for the transport of dangerous goods, driving buses and/or trucks. Around one third of the participants ($n = 213$) were managers of the driving school while also being driving instructors in it.

2.2. Materials

Empirical evidence about the correspondence between the GDE framework and the knowledge and skills taught in the Spanish driver education system came from a questionnaire that we specifically built for this purpose, as there was previously no such kind of measuring instrument. The scale created is hereafter called the DTCI (Driver Training Curriculum Implementation) scale. This scale was composed of twelve Likert-type items (see Appendix A) which were written by taking the grid resulting from crossing the categories of the two dimensions in the GDE framework as reference, in such a way that each item mapped one of the cells in the four-by-three GDE matrix. This correspondence is shown in Appendix A by using the same abbreviations (written in brackets) as those we used in the examples presented in the introduction section. In the application of the DTCI scale, the driving instructors were asked to assess to what extent they considered that the educational goals stated in the scale items were achieved in the driver training process. The response scale for all the items ranged from 0 (''Not achieved at all'') to 10 (''Fully achieved''), Two things must be noted: on the one hand, that no clue to the GDE framework was included in the questionnaire and, on the other hand, that hardly any participant was expected to know about this theoretical framework given its lack of dissemination in Spain at the time this study was carried out.

Given the objectives of this study, the strategy employed to develop the items of the DTCI scale considered two supplementary criteria: on the one hand, to specify clearly and unambiguously the four hierarchical levels of driving behavior featured in the GDE framework and, on the other hand, to consider item wordings that were essential and representative of each training content (knowledge and skills, increasing risk-factors, and self-evaluation). This strategy, eminently pragmatic, was intended not only as a means of obtaining a global vision of the teachers' perception of road safety from the perspective of the GDE framework, but also to develop a relatively short assessment instrument, which was to be included in a wider survey the purpose of which was to assess the situation of driving schools in Spain. Therefore, the length of the parts of this survey was limited in order to avoid respondent fatigue and poorer quality responses.

The initial version of the DTCI scale was proposed by the authors of this study; then, expert opinion about the scale was obtained from some representatives of the National Confederation of Driving Schools and the Spanish Directorate of Traffic, which suggested some changes to the specific wording of the items. Once the agreed changes were discussed and introduced, a pilot application of the DTCI scale was carried out on a reduced group of driving instructors and technicians in charge of the field work. This pilot application provided us with feedback on the difficulty the interviewers encountered when administering it, the design and layout of the questionnaire, and the question structure (e.g., unclear instructions, too long a question, the overly complex syntax of an item). After the pilot application, some information about the content of the items was also requested from the driving instructors:, more specifically, about the correspondence of each item and the cell of the GDE framework that it was supposed to represent. Their suggestions led to some minor changes in the version of the scale finally administered to the sample of participants.

Apart from the DTCI scale, other questions were considered in our survey because of their potential relationship with the variables concerning the implementation of the driver training curriculum. Thus, they were asked for their opinion about how they currently see their own training as instructors with regard to the following topics: (1) driving school organization and management; (2) driving norms and legislation; (3) teaching methods; (4) integration of new technologies in teaching; and (5) the human factor in road safety. These opinions were stated in a response scale with three response choices (i.e., ''Very good'', ''Good'' and ''Fair''). Finally, information on the following socio-demographic variables was also gathered through the survey: the instructor's sex and age; the population of the town where the driving school is located (in thousands, <50, 50–100, 100–500, >500) and working activity (instructor vs. instructor plus driving school manager).

2.3. Procedure

The DTCI scale was applied in a face-to-face interview in which other related scales, directed at satisfying other road safety research goals, were also considered. The interview took place in the participants' own workplace after previously agreeing with them about a date and a period of the working day in which they were free to answer the questionnaire. Fifty-eight trained interviewers from a survey research company were responsible for carrying out the interviews in the different Spanish towns where the selected sample participants were working. The quality control of the fieldwork was telephonically supervised in 25% of the driving schools involved in the survey, chosen at random. The feedback of this quality control was positive for all the 239 participants who were contacted after the interview.

2.4. Analysis

Firstly, we obtained some descriptive statistics for the participants' response data to the DTCI scale items. Secondly, we proceeded to explore the factorial structure of the scale response data by means of Exploratory Factor Analysis (EFA) in order to identify the underlying variables that explained the pattern of correlations within our response data. We chose to use an exploratory approach rather than a confirmatory one because the DTCI scale was used in this study for the first time, so no empirical basis existed to make any sound assumption about the common factors underlying the measured variables. Thirdly, we performed some descriptive and psychometric analyses of the subscales that emerged from EFA. Lastly, we analyzed the relationship between the DTCI scale scores and a number of demographic and descriptive variables which are usually considered as relevant in driver education research. Data analysis was performed using the software SPSS 19 and FACTOR 8.1 (Lorenzo-Seva & Ferrando, 2006).

3. Results

3.1. Descriptive statistics

Table 2 shows the mean and standard deviation of the participants' responses for each one of the 12 items in the DTCI scale. The results have been arranged according to the frame of the GDE matrix so it is straightforward to identify the location of any item in the two dimensions of the matrix and, at the same time, to see how the central tendency and dispersion of the item scores vary across the levels of both dimensions. The last row and column show the mean and standard deviation for the groups of items associated with the levels of the two dimensions in the GDE framework.

3.2. Exploratory Factor Analysis

As a preliminary analysis to the application of EFA, we obtained the initial communality estimates (squared multiple correlations) for the scale items. It is well known that when the common factor model is fitted to measured variables with low communalities, there can be a substantial distortion in the results obtained (Velicer & Fava, 1998). The results (see Table 2) showed moderate communalities for the 12 items, ranging from .51 to .71 ($M = .58$). On the other hand, the results of the Kaiser–Meyer–Olkin measure of sampling adequacy ($KMO = 0.92$) and Bartlett's test of sphericity ($\chi^2(66) = 4947.6$; $p < .0001$) supported the application of the factor model as well. A parallel analysis (Horn, 1965) was computed in order to determine the number of factors to be retained. Zwick and Velicer (1986), among others, have shown that this factor-number procedure works fairly well in comparison with other classical methods like the Kaiser criterion or the scree-plot test. The result of parallel analysis for our data showed that two eigenvalues were greater than the eigenvalues expected from random data, so two factors were included in the common factor model to be fitted to our data.

The multivariate kurtosis coefficient was 276.5 ($Z = 76.9$; $p < .0001$). In this situation, a factor analysis method that assumes normal multivariate distribution is not advisable, so we chose Principal Axis Factoring (PAF) as the factor extraction method to be computed. On the other hand, given that we did not have any sound reason to assume that the factors to be extracted were orthogonal, the promax rotation was computed (kappa = 4) in order to obtain a final solution that could be more readily interpreted. Table 3 shows the pattern matrix with the factor loadings for the rotated solution. The EFA solution yielded a two-factor structure which accounted for 59.4% of the variance. The first factor consisted mostly of items related to the third and fourth hierarchical levels of the driving behavior dimension in the GDE framework (i.e., "Goals and context of

Table 2
Descriptive statistics and communalities for the 12 items in the DTCI scale.

	(a) Knowledge and skills	(b) Idem. connected to risk-increasing factors	(c) Self-evaluation	Total
(1) Vehicle maneuvering	Item 1 *M* = 8.61 *SD* = 1.34 *Comm* = .62	Item 5 *M* = 8.28 *SD* = 1.47 *Comm* = .57	Item 9 *M* = 7.99 *SD* = 1.60 *Comm* = .58	*M* = 8.29 *SD* = 1.46
(2) Mastery of traffic situations	Item 2 *M* = 8.50 *SD* = 1.42 *Comm* = .71	Item 6 *M* = 8.32 *SD* = 1.48 *Comm* = .62	Item 10 *M* = 7.74 *SD* = 1.61 *Comm* = .58	*M* = 8.19 *SD* = 1.50
(3) Goals and context of driving	Item 3 *M* = 7.32 *SD* = 1.80 *Comm* = .51	Item 7 *M* = 7.65 *SD* = 1.73 *Comm* = .55	Item 11 *M* = 6.64 *SD* = 1.97 *Comm* = .52	*M* = 7.19 *SD* = 1,83
(4) Goals for life and skills for living	Item 4 *M* = 7.14 *SD* = 1.89 *Comm* = .54	Item 8 *M* = 7.13 *SD* = 1.81 *Comm* = .55	Item 12 *M* = 7.04 *SD* = 1.86 *Comm* = .56	*M* = 7.09 *SD* = 1.85
Total	*M* = 7.88 *SD* = 1.61	*M* = 7.83 *SD* = 1.63	*M* = 7.34 *SD* = 1.74	

Note. *M* = Mean; *SD* = standard deviation; *Comm* = Communality.

Table 3
Item loadings for the rotated factor solution.

	Items (see complete item statements in Appendix A)	Factor 1	Factor 2
1	To control and handle the vehicle		.861
2	To understand and manage different traffic situations		.917
3	To analyze the influence of some personal decisions when driving	.460	
4	To recognize how some personal conditions affect driving behavior	.680	
5	To be aware of risk factors related to a poor automation of basic driving skills		.763
6	To identify risk factors associated with different traffic situations		.787
7	To be aware of some risk factors related to decisions taken when driving	.491	
8	To know how some personal traits may become risk factors when driving	.756	
9	To become aware of his/her strengths and weaknesses concerning issues related to the vehicle control and handling		.483
10	To become aware of his/her strengths and weaknesses concerning the knowledge and skills required to drive in different traffic situations	.527	
11	To become aware of his/her strengths and weaknesses concerning decisions related to planning the context of driving	.885	
12	To become aware of his/her strengths and weaknesses recognizing how one's own personal characteristics and way of life affect driving style	.871	

driving" and "Goals for life and skills for living"), so this factor was called "Strategic and Personal driving behaviors" (S&P factor). The second factor was defined by the questionnaire items related to the first and second hierarchical levels of the driving behavior dimension in the GDE framework (i.e., "Vehicle maneuvering" and "Mastery of traffic situations"); therefore, this second factor was labeled "Operative and Tactical driving behaviors" (O&T factor). The only exception was item 10 ("To become aware of his/her strengths and weaknesses concerning the knowledge and skills required to drive in different traffic situations"), which loaded higher in Factor 1 (.53) than in Factor 2 (.33) even though this item states driver behavior connected to the second hierarchical level (i.e., mastery of traffic situations). Internal reliability for the two subscales derived from our two-factor model was estimated by computing Cronbach's alpha: $\alpha = .89$ for the S&P factor items and $\alpha = .88$ for the O&T factor items.

As a consequence of implementing an oblique rotation, the results shown that both factors were highly correlated ($r = .65$). This value suggested that a high order factor could better explain the pattern of correlations among the measured variables and, at the same time, provide a more parsimonious conceptual understanding of the underlying factor structure. Thus, we submitted our data set to a one-factor EFA with PAF extraction, which produced a one-factor model that accounted for 49.6% of the variance and a factor structure with high loadings for all the items (*Min.* = .61 for item 11; *Max.* = .76 for item 7; $M = .70$). Cronbach's alpha coefficient for the 12-item response data was .92, which shows a high estimate of internal consistency for the whole scale. All these results provided evidence supporting the more parsimonious choice; which is, to consider this set of items as a one-factor scale in further analyses in this work. The scale scores of this unidimensional scale would provide, therefore, a global measure of the attainment of the training goals established in the GDE framework. It should be considered, though, that the subscales derived from the two-factor model might provide a better insight when assessing the educational goals achieved by teachers and learners in driving schools, given that they enable the differentiation between the achievement of low- and high-level goals (i.e., O&T vs. S&P factor) in the hierarchy established by the first dimension of the GDE framework.

Table 4
Comparison of the DTCI scores for the 3 subgroups defined by the teachers' opinion about their own current training as teachers.

Training subject	DTCI mean scores
Management	$M_1 = 7.89$, $M_2 = 7.78$, $M_3 = 7.67$ $F(2623) = 1.16$, $p = .313$
Norms and legislation	$M_1 = 7.96$, $M_2 = 7.63$, $M_3 = 7.68$ $F(2641) = 2.68$, $p = .069$
Teaching methods	$M_1 = 8.02$, $M_2 = 7.72$, $M_3 = 7.46$ $F(2664) = 8.10$, $p < .001$, $M_1 > M_2 > M_3$
New technologies in teaching	$M_1 = 8.25$, $M_2 = 7.82$, $M_3 = 7.67$ $F(2561) = 4.01$, $p = .019$, $M_1 > M_3$
Human factor in road safety	$M_1 = 8.08$, $M_2 = 7.65$, $M_3 = 7.49$ $F(2659) = 9.89$, $p < .001$, $M_1 > M_2$, $M_1 > M_3$

Note. Top cell line: Means (M) in the DTCI scale for the three groups established by the teachers' opinions about their own training as teachers (1, Very good; 2, Good; 3, Fair). Bottom cell line: ANOVA statistics and, when suitable, results of the post-hoc pairwise comparisons using Tukey's HSD (Honestly Significant Difference) test.

3.3. Differential analysis

This section shows the results derived from analyzing the relationships between the driving instructors' total scores in the DTCI scale and a number of variables reflecting some opinions and socio-demographic characteristics of the driving instructors. As regards the variables related to the participants' opinion about their own current training as teachers, Table 4 shows the ANOVA results for the five specific educational topics considered in the Measures section. These results showed that the driving instructors' opinions about their own training were directly related to the DTCI total scores (i.e., an indicator of the perceived driving competence of their trainees); however, this relationship was statistically significant only for the last three topics considered, that is, teachers' training about (a) teaching methods, (b) new technologies in teaching, and (c) the human factor in road safety.

We also analyzed the relationship of the DTCI scores and the following socio-demographic variables: teacher's sex and age, population of the town where the driving school was located, and working activity (teacher vs. teacher plus driving school manager). The only statistically significant relationship of the DTCI scores was found with "teacher's age" ($r = .131$, $p < .01$); so the older the driving instructor, the better his/her opinion about how well their student drivers have achieved the educational goals.

4. Discussion

Our survey study into the Spanish driving instructors' assessments of the extent to which they achieved their goals when teaching the different areas of safe driving skills showed that, in general, instructors have a rather positive opinion about their achievement of the educational goals considered in our questionnaire. It is important, though, to point out some specific aspects of the results obtained. The design of the DTCI scale was based on the GDE matrix and, according to this driver education framework, the contents and objectives related to acquiring basic skills and knowledge in the lower levels of the driver behavior hierarchy (upper-left corner of the GDE matrix in Table 1) appeared to be better covered than the contents related to risk-awareness and self-evaluation in the higher levels of the driver behavior hierarchy (bottom-right corner of the GDE matrix). These results suggest that the Spanish driver education system places greater emphasis on knowledge and skills related to the operative and tactical aspects of driving, whereas less importance is given to risk-prevention and self-evaluation skills related to the strategic and personal levels of driving behavior. This reveals a potential weakness in the driver training curriculum if we take into account the recommendations on the importance of the higher level goals of the GDE matrix in the training of future drivers (Siegrist, 1999).

As the earlier results were mainly obtained from expert reports and not from scientifically-based empirical findings, it was not possible to perform a critical comparison of the results now obtained. Thus, in the MERIT project (Sanders, 2005), experts from 30 European countries assessed their own curriculum using the GDE-framework. The results concerning how much emphasis there was in different areas of the GDE-framework in the various countries participating in the project showed that, similarly to the results of this study, the experts' evaluations were considerably on the lower levels of the matrix. The area of self-evaluation in particular seemed to be neglected in the driver training curricula. Of course, it is possible that differences in the instructors' opinions about the self-evaluation skills might be based on a different conception of self-evaluation skills. The main result, however, is similar: more emphasis is placed on teaching skills and knowledge, as well as risk-increasing factors in vehicle maneuvering and mastery of traffic situations.

This imbalance between the upper-left and the bottom-right corners of the GDE matrix could be weighted through the application of instructional methods and teaching tools that favor more active learning and the development of drivers' self-evaluation skills (Bartl et al., 2010). The integration of this kind of instructional techniques would help to make the student driver more aware of both their own characteristics as a driver as well as of how these characteristics relate with their lifestyle and their decisions related to the context of driving. On the other hand, the results have shown that teachers' perceptions of the implementation of the driver training curriculum were directly related to their opinion about their own training as teachers. More importantly, this relationship was statistically significant for the subjects concerning teaching methods and driving contents related to the human factor, which demonstrates the importance of these subjects compared to those concerning norms and legislations or those related to the management of the driving school.

As regards the DTCI scale, which was developed to achieve the goals of our survey, it has shown some interesting measurement properties. The most important issue concerning the validity of the DTCI scale is that it provides a theory-based measurement: it is grounded on a rational framework and the parts of this framework have then changed to measurable items. Each of the twelve items was derived from the twelve areas of the safe driving framework GDE. As the area of safe driving is so extensive, it was decided to use general level questions without going into details (e.g., driving environment, details of the situation). This approach contains a possibility of different interpretations concerning what is asked. Good experiences, however, have been reported when using these kinds of general level questionnaires (Hatakka, 1998; Molina, Sanmartín, & Keskinen, 2013; Molina et al., 2007). The analysis of the empirical evidence about the DTCI scale internal validity showed the existence of two underlying factors which match, respectively, the two lower- and the two higher-levels of the driver behavior hierarchy set by the first dimension of the GDE framework; however, no factor differentiation was obtained for the second dimension in the GDE framework (i.e., type of contents to be considered in driver education), so no empirical differentiation was found for its components. Thus, the DTCI scale may be used to obtain two differentiated

indicators of the degree of attainment of the educational goals related, on the one hand, to operative and tactical driving behaviors (O&T factor) and, on the other hand, to strategic and personal driving behaviors (S&P factor). We must admit, though, that item 10 did not load on the expected factor. This could simply be the result of an inconsistency in our factor solution; so, taking substantive reasons into account, we would suggest considering item 10 as an indicator of the O&T factor instead of the S&P factor when it comes to obtaining scores for both factors.

A piece of evidence about the convergent/discriminant validity of the DTCI scale came from our differential analysis, taking into account the five variables defined by the teachers' opinions about their own current training as teachers: as would be expected, the relationship of the DTCI total score variable was statistically significant for the variables directly related to teaching and safe driving skills (i.e., teaching methods, new technologies in teaching, and the human factor in road safety), whereas it was not significant for the two other issues considered (i.e., management, and the norms and legislation related to driving schools). Further research with other convergent/divergent scales and variables should be addressed so as to obtain additional evidence about the construct validity of the DTCI scale. Finally, reliability analysis provided good results for the two scales derived from the two-factor solution, as well as for the whole scale. The use of the latter can also be empirically supported if both the high correlation between the two factors in our initial factor solution is taken into account as well as the results of our high order factor analysis. In any case, the DTCI scale may represent a useful resource with which to gather information about the educational goals achieved in a specific driver training curriculum. However, it is important to note that it was designed to capture the point of view of the trainers, so complementary information about what is actually learnt by the trainees should also be gathered in order to obtain a more realistic view of the whole scene.

One important strength of this work was the use of a large representative sample of driving instructors. Moreover, the quality criteria associated with the design of the survey (i.e., state-wide sampling framework, random sampling, face-to-face administration by professional interviewers, high response rate) offered strong support to the external validity of our results. Of course, the results and conclusions of this study are limited to the population of Spanish driving instructors and, therefore, inferences to other populations of driving instructors might be inappropriate. Another contribution of this work which might be useful in future studies is the DTCI scale itself: although we can find some GDE-based questionnaires in the literature (Hatakka, 1998; Molina et al., 2013), no specific survey tools based on the GDE framework and directed at driving instructors were available at the moment of setting this study in motion. Of course, a longer questionnaire could offer a more precise, exhaustive picture of the knowledge and skills taught to the driver students; however, the DTCI scale provides not only a quick scan tool with which to analyze how the driver training curriculum matches the GDE framework but also, more importantly, the basis for suggesting how the driver training can be improved from the perspective of a theoretical model that emphasizes the role of the personal characteristics and motivations involved in driving behavior as well as the training of risk-awareness and realistic self-evaluation skills. Of course, an additional in-depth analysis would be necessary when more detailed information is requested or the focus of interest is on a specific area of the GDE matrix.

One threat to the internal validity of our study stems from the fact that all the variables of interest were measured by means of the same survey. It is well known in literature that this practice can result in method factors that elicit irrelevant systematic variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Thus, effects of method factors on the covariation between item measures could have influenced the results of the EFA solution as well as the analysis of the relationship between the DTCI scores and the variables concerning instructors' opinion about their own training as instructors. Although common method variance has an inflationary effect on the observed relationships, some authors have reported that this effect is almost completely offset by the attenuating effect of measurement error (Lance, Dawson, Birkelbach, & Hoffman, 2010); however, it would be desirable in future studies to consider some of the procedural and statistical remedies which have been proposed to control this method bias (for a review, see Podsakoff, MacKenzie, & Podsakoff, 2012). Finally, the need to cross-validate our EFA results with other data sets in order to check the suitability of the obtained factor solution must be emphasized; on the other hand, future studies should consider, first, the application of confirmatory factor analysis after the factor structure of the DTCI scale has been explored and refined through EFA and, second, the application of statistical methods that take into account the categorical/ordinal nature of the dimensions of the GDE framework (e.g. latent class analysis).

Appendix A. DTCI scale

The following questions are aimed at obtaining your point of view on to what extent a number of Goals for Driver Education are achieved during the training of the students trying to obtain a type-B driving license in the driving schools. Please, express your answer in a 0–10 response scale, where 0 means "Not achieved at all", and 10 means "Fully achieved". [Show card]

1. To control and handle the vehicle (e.g., knowledge of the car controls; achieving the correct execution of different maneuvers; use of rear-view mirrors; controlling its position and direction). [a-1]
2. To understand and manage different traffic situations (e.g., identifying the specific problems present in each situation; identifying traffic signs and rules; adequately adjusting speed and safety margins to traffic circumstances). [a-2]
3. To analyze the influence of some personal decisions when driving (e.g., time planning, route planning; the reasons for habitual car use; with whom we drive; when we drive). [a-3]

4. To recognize how some personal conditions affect driving behavior (e.g., driver's lifestyle; self-control skills; driver's personal values). [a-4]
5. To be aware of risk factors related to a poor automation of basic driving skills (e.g., to drive in an inappropriate gear; lack of coordination with the accelerator and the clutch when changing gear). [b-1]
6. To identify risk factors associated with different traffic situations (e.g., bad visibility; presence of vulnerable users on the road-elderly people, cyclists-; other drivers' unforeseen behavior). [b-2]
7. To be aware of some risk factors related to decisions taken when driving (e.g., to drive when impossible to keep to schedule; driving when fatigued; driving in rush hours; driving with children as passengers). [b-3]
8. To know how some personal traits may become risk factors when driving (e.g., to be prone to taking risks in daily life; risk-acceptance and sensation-seeking traits; tendency to comply with social pressure; to be prone to getting angry). [b-4]
9. To become aware of his/her strengths and weaknesses concerning issues related to the vehicle control and handling. [c-1]
10. To become aware of his/her strengths and weaknesses concerning the knowledge and skills required to drive in traffic situations. [c-2]
11. To become aware of his/her strengths and weaknesses concerning decisions related to planning the route or the context of driving (e.g., when to drive, with whom, how). [c-3]
12. To become aware of his or her strengths and weaknesses recognizing how his or her personal characteristics and way of life affect his or her own driving style (e.g., awareness of self-control capacities; awareness of own proneness to risk, and safety attitudes). [c-4]

Note: the letters and numbers between brackets at the end of the items provide information about the correspondence between the items and the cells defined by the GDE framework. This information was not included in the questionnaire as there was no reference in the survey to the GDE framework.

References

ADVANCED (2003). Description and analysis of post-license driver and rider training. ADVANCED EU project Final report. The Hague (Netherlands): CIECA.

G. Bartl, N. -P. Gregersen, & N. Sanders (Eds.), (2005). EU MERIT project: Minimum requirements for driving instructor training (Final Report). Vienna: Institut Gute Fahrt.

Bartl, G., Sanders, N., Reikl, A., Schulte, K., Keskinen, E., Whitmore, J., & et al. (2010). EU HERMES project final report: High impact approach for enhancing road safety through more effective communication skills in the context of category-B driver training. Vienna (Austria): Alles-fuehrerschein.at GmbH.

Boccara, V., Delhomme, P., Vidal-Gomel, C., & Rogalski, J. (2011). Development of student drivers' self-assessment accuracy during French driver training: Self-assessments compared to instructors' assessments in three risky driving situations. *Accident Analysis and Prevention, 43*, 1488–1496.

CIECA (2010). Category B (passenger car) driver licensing in CIECA member countries. Brussels, BE CIECA. Available at: <http://www.cieca.eu/>.

Eby, D. W., Molnar, L. J., Shope, J. T., Vivoda, J. M., & Fordyce, T. A. (2003). Improving older driver knowledge and self-awareness through self-assessment: The driving decisions workbook. *Journal of Safety Research, 34*, 371–381.

Gandolfi, J. (2009). *Driver education – A blueprint for success? A review of the current state of driver education*. Milton Keynes, UK: Driving Research Ltd.

Gregersen, N. P. (1999). Description and assessment of measures. In S. Siegrist (Ed), *Driver training, testing and licensing: towards theory-based management of young drivers' injury risk in road traffic*. Results of EU-Project GADGET, Work Package 3 (pp. 49–183). BFU: Switzerland.

Gregersen, N. -P. (2005). Introduction. In G. Bartl, N. -P. Gregersen, & N. Sanders (Eds.), EU MERIT project: Minimum requirements for driving instructor training (Final Report). Vienna: Institut Gute Fahrt.

Hatakka, M. (1998). Novice drivers' risk- and self-evaluations (Doctoral Thesis). Annales Universitatis Turkuensis, ser. B – TOM. 228. Turku, Finland: University of Turku.

Hatakka, M., Keskinen, E., Gregersen, N. P., & Glad, A. (1999). Theories and aims of educational and training measures. In S. Siegrist (Ed), *Driver training, testing and licensing: Towards theory-based management of young drivers' injury risk in road traffic*. Results of EU-Project GADGET, Work Package 3 (pp. 13–44). BFU: Switzerland.

Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., & Hernetkoski, K. (2002). From control of the vehicle to personal self-control: Broadening the perspectives to driver education. *Transportation Research Part F: Traffic Psychology and Behaviour, 5*, 201–216.

Horn, J. L. (1965). A rationale and technique for estimating the number of factors in factor analysis. *Psychometrika, 30*, 179–185.

Huguenin, R. D., & Rumar, K. (2001). Models in traffic psychology. In P. E. Barjonet (Ed.), *Traffic psychology today* (pp. 31–59). London: Kluwer Academic Pub.

Keskinen, E. (1996). *Why do young drivers have more accidents? (Mensch und Sicherheit, Heft M 52). Junge Fahrer und Fahrerinnen Referate der Esten Interdiziplin&auml ren Fachkonferenz*. Köln Bergish Gladbach, Germany: Bundesanstalt für Strassenwesen.

Keskinen, E., Hatakka, M., Laapotti, S., Katila, A., & Peräaho, M. (2004). Driver behaviour as a hierarchical system. In T. Rothengatter & R. Huguenin (Eds.), *Traffic and transport psychology. Proceedings of the ICTTP* (pp. 9–24). Amsterdam: Elsevier.

Keskinen, E., & Hernetkoski, K. (2011). Driver education and training. In B. E. Porter (Ed.), *Handbook of traffic psychology* (pp. 403–422). Amsterdam: Elsevier.

Lajunen, T., & Summala, H. (1995). Driving experience, personality, and skill and safety-motive dimensions in drivers' self-assessments. *Personality and Individual Differences, 19*, 307–318.

Lance, C. E., Dawson, B., Birkelbach, D., & Hoffman, B. J. (2010). Method effects, measurement error, and substantive conclusions. *Organizational Research Methods, 13*, 435–455.

Lorenzo-Seva, U., & Ferrando, P. J. (2006). FACTOR: A computer program to fit the exploratory factor analysis model. *Behavior Research Methods, Instruments and Computers, 38*, 88–91.

Mikkonen, V., & Keskinen, E. (1980). Sisäisten mallien teoria liikennekäyttäytymisestä. General Psychology Monographs B1. Helsingin Yliopisto, Yleinen Psykologia.

Molina, J. G., Sanmartín, J., & Keskinen, E. (2013). Driver training interests of a Spanish sample of young drivers and its relationship with their self-assessment skills concerning risky driving behavior. *Accident Analysis and Prevention, 52*, 118–124.

Molina, J. G., Sanmartín, J., Sanders, N., & Keskinen, E. (2007). Post-license education for novice drivers: Evaluation of a training programme implemented in Spain. *Journal of Safety Research, 38*, 357–366.

Nyberg, A., Gregersen, N. P., & Wiklund, M. (2007). Practicing in relation to the outcome of the driving test. *Accident Analysis and Prevention, 39*, 159–168.

OECD/ECMT (2006). Young drivers. The road to safety. Paris: OECD Publications.

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*, 879–903.

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology, 63*, 539–569.

Sanders, N. (2005). Results of the EU MERIT project questionnaire survey: Driving instructor standards in Europe. In G. Bartl, N. -P. Gregersen, & N. Sanders (Eds.), EU MERIT project: Minimum requirements for driving instructor training (Final Report). Vienna: Institut Gute Fahrt.

Sanders, N., & Keskinen, E. (2004). *EU NovEV research project: Evaluation of post-license training schemes for novice drivers*. Amsterdam: CIECA.

S. Siegrist (Ed.), (1999). Driver training, testing and licensing: Towards theory-based management of young drivers' injury risk in road traffic. Results of EU-Project GADGET, Work Package 3. Berne: BFU.

Sundström, A. (2008). Self-assessment of driving skill – a review from a measurement perspective. *Transportation Research Part F: Traffic Psychology and Behaviour, 11*, 1–9.

SUPREME (2007). Summary and publication of best practices in road safety in the EU member states: Driver education, training & licensing. SUPREME EU Project Final Report (Part F2). Vienna (Austria): Kuratorium für Verkehrssicherheit (KfV).

Velicer, W. F., & Fava, J. L. (1998). Effects of variable and subject sampling on factor pattern recovery. *Psychological Methods, 3*, 231–251.

Vidal-Gomel, C., Boccara, V., Rogalski, J., & Delhomme, P. (2012). What are the consequences of sharing a trainee's driving course between different trainers? *Work: A Journal of Prevention Assessment, and Rehabilitation, 41*, 205–215.

Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin, 17*, 253–269.