

Lack of driving experience

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Please note: The studies included in this synopsis were selected from those identified by a systematic literature search of specific databases (see supporting document). The main criterion for inclusion of studies in this synopsis and the DSS was that each study provides a quantitative effect estimate, preferably on the number or severity of crashes or otherwise on road user behaviour that is known to be related to the occurrence or severity of a crash. Therefore, key studies providing qualitative information might not be included in this synopsis.

1 Summary

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1.1 COLOUR CODE: YELLOW

Novice driver and drivers with less years of experience in general are related to a higher accident risk than more experienced drivers. Studies confirmed that a lack of driving experience, in terms of kilometres driven, affects vehicle manoeuvring such as steering competence. It also increases the tendency to commit operative errors (e.g. hard braking or close following) and the probability to be involved in crashes and near miss accidents. However, the issue is often treated in studies covering larger topics (e.g. age, personal factors), and consequently its effect turns out to be confounded with that of other risk factors. Furthermore, the number of studies is limited.

1.2 KEYWORDS

Driving skills, driving experience, cognitive skills, professional experience, young drivers, novice drivers, truck drivers, driver error.

1.3 ABSTRACT

Driving experience plays an important role in the development of a number of cognitive and behavioural skills, like hazard recognition, information processing and vehicle manoeuvring. A lack of experience is linked to a higher probability of being involved in road accidents as well as in being fined for a traffic violation. It is recognised by several studies as a major risk factor for novice drivers, especially young drivers. The effects of the risk factor are influenced by age, especially in young drivers who have a tendency to overestimate their own ability and to underestimate traffic hazards.

1.4 BACKGROUND

What is lack of driving experience?

Driving inexperience constitutes a deficiency that can lead to operating errors. It can be expressed in terms of global mileage/kilometres driven or time since obtaining license and it affects both vehicle control skills and more complex, cognitive skills, such as information processing skills, self-calibration, hazard and risk perception and safety related motivation or attitudes (Harrison, 1999).

How does lack of driving experience affect road safety?

A lack of driving experience is translated into a greater probability of being involved in road accidents as well as in violations with consequent citations. The processes by which a lack of experience may affect accident risk are still under investigation. Driving experience plays an important role in the development of a number of cognitive and behavioural skills. One example is attention allocation. For a novice driver the traffic environment is full of events and relationships that are novel. It is likely that a novice driver needs to direct attention to a wide range of events, many of which are not relevant for driving safely. Another example is the automation of driving behaviour, the experience in the traffic environment allows the development of automatic behavioural responses to certain situations, allowing the performance of other tasks (Harrison, 1999).

Lack of driving experience

How frequently do lack of driving experience occur in traffic?

The risk related to poor driving skills is relevant especially for novice drivers, as competences are strictly related to the degree of driving experience. Novice drivers are more prone to errors and near crash events than experienced drivers, therefore, novice drivers are the most exposed category.

Which factors influence the effect of lack of driving experience on road safety?

The effects of the risk factor is influenced by age, especially in young drivers who have a tendency to overestimate their own ability and to underestimate traffic hazards. Beyond the amount of experience, for young drivers, Gregersen and Berg (1994) refer to the following factors contributing to a higher accident risk: actual knowledge and skills, individual level of development and maturity, social situation and lifestyle.

How is the effect of lack of driving experience on road safety measured?

The methodology used in most studies is the submission of questionnaires to road users in order to collect information about involvement in negative events (e.g. accidents, citations), specific behaviours assumed or related intentions, as well as socio-economic characteristics. Driving inexperience is usually measured in terms of global mileage/kilometres driven or time since obtaining license. Data collection from official statistics, driving simulation studies and naturalistic driving studies are also employed.

Data are treated through different types of regression analysis and through correlation analysis.

1.5 OVERVIEW OF RESULTS ON LACK OF DRIVING EXPERIENCE

Driving skills increase with the driver's experience. Studies confirmed that a lack of driving experience, in terms of kilometres driven, affects vehicle manoeuvring such as steering competence and increases the tendency to commit operative errors (e.g. hard braking or close following) and the probability to be involved in near miss accidents.

Novice driver and drivers with less years of experience in general are related to a higher accident risk than more experienced drivers.

2 Scientific details



2.1 METHOD

Literature review

Driving experience is a general concept linked with practice, it is a factor important for the development of driving skills. It is important both for relatively easy to master skills, like vehicle handling, and more complex cognitive skills such as anticipation of potentially hazardous traffic situations (DaCoTA, 2012). A lack of experience translates in not sufficiently developed driving skills.

In literature, driving inexperience is recognised by several studies as a major risk factor for novice drivers (DaCoTA, 2012), especially young drivers. For young drivers, Gregersen and Berg (1994) mention lack of experience as a factor contributing to a higher accident risk in combination with actual knowledge and skills, individual level of development and maturity, social situation and lifestyle. Driving inexperience for young drivers is recognized to be a more important risk factor than age (Wells et al., 2008). In a US study (Eby, 1995), it was found similar accident rates for drivers with two years of experience between ages of 18 and 25, while for drivers with only one year of experience accident rate was found to be higher for those younger. Truck experienced drivers with more than 22 years of driving experience show a better performance compared to those with a driving experience from 11 to 22 years (Giroto et al., 2016). In general, the experience gained during the years is able to compensate some cognitive decrements due to age, supporting adaptive behaviour and therefore alleviating some negative effects of the environment complexity (McPhee et al., 2008; Bolstad, 2001). Therefore, it is expected that the consequences of a lack of experience are more serious in elder drivers.

The processes by which a lack of experience may affect accident risk are still under investigation. The experience affects visual search strategies and increases cognitive skills, which are more influential than the lack of vehicle control (Deery, 1999; Underwood, 2007). Lack of experience causes the failure to detect and recognize latent hazards in roads and traffic situations (Vlakveld, 2005). Therefore, the occurrence of near crash events¹ is more frequent in less experienced drivers (Hasan et al., 2017).

Description of studies

In Table 1 it is reported a description of the characteristics of the coded studies dealing with lack of experience (sorted by name).

Table 1. Characteristics of coded studies dealing with aspects related to insufficient skills and knowledge

Author, year, country	Sample and study design	Method of analysis	Outcome indicator	Main results
Giroto et al., 2016,	Cross-sectional study based on interview of 653 drivers with an	Multinomial regression	Accidents, near-miss	An evident relationship was observed between longer

¹ A "near crash" is considered in the study when parameters such as the acceleration of the vehicle reaches a pre-defined threshold value

Lack of driving experience

Brazil	average age 42.2 (± 11.1) year		accidents	professional experience and a reduction in reporting involvement in accidents and near-miss accidents, regardless of age
Hasan et al., 2017, China	1670 near crash events are collected over a naturalistic driving experiment conducted in three months and involving 29 drivers.	Logit regression.	Near-crash events	Significant positive effect based on driving years
Mayhew D. Et al, 2003, Canada	Analysis of record and crash data for 40,661 novice drivers.	Analysis of the crash rate trend	Monthly change in crash rate	Time since licensure is linked to a decrease in crash rates
Mc Cartt A. et al, 2002, United States	Survival analysis based on telephone survey for 911 senior high school students.	Multivariate Cox regression model	Involvement in road crash or citation	Months after licensure and mileage drive reduce the risk of involvement in road crash as well as in citation
Van Winsum W. et al, 1996, The Netherlands	Driving simulation for 16 drivers with an average age of 34.	Correlation analysis	Steering performance	Steering competence does not affect road safety as errors and speed are compensated

Description of main research methods

The lack of experience topic is addressed mainly by surveys through submission of questionnaires (via web or telephone). As appropriate, sampling is referred to the entire population of drivers (usually aged 18-65) or limited to young drivers or more specifically to newly licensed. In some cases, other methods like driving simulation, naturalistic study or survival analysis are employed.

Data collected are treated mainly through several types of regression analysis (e.g., Multinomial regression, Multivariate Cox Regression, Logistic regression). Correlation analyses are also conducted.

2.2 RESULTS

Driver's experience is expected to improve driving skills. In fact, a lack of experience is found to significantly affect the driver's steering performance (Van Winsum et al, 1996). Steering competence increases with kilometres driven and this reduces the tendency to commit operative errors (corr.coeff = -0,62; p-value = <0.01). A naturalistic driving study undertaken in China shows that near accidents events (e.g. hard braking, close following) are more likely in less experienced drivers (Hasan. A. et al., 2017).

Time since licensure (Mayhew et al, 2003) is significantly linked to a crash drop (% change) among novice drivers, in relation to all the type of accidents or conditions considered. Miles driven and months after licensure significantly reduce the risk of being involved in the first crash or being regarded by the first citation (Mc Cartt et al, 2002). Anyway, in this case, there is a neutral effect on road safety as operative errors are compensated by the assumption of a lower speed.

Experience continues to play a role even after many years after obtaining the driving licence. A study in Brazil confirmed that the longer the professional driving experience of truck drivers, the lower the reported involvement in accidents and near-miss accidents, regardless of age, substance use, working conditions and behaviour in traffic (Giroto et al., 2016).

Lack of driving experience

Table 2 reports the main outcomes of the coded studies on insufficient skills and knowledge (sorted by year of publication).

Table 2: Main outcomes of coded studies dealing with insufficient skills and knowledge

Author, Year, Country	Study type	Exposure variable	Outcome variable	Effects on road safety	Main outcome description
Girotto, et al., 2016, Brazil	Cross-sectional	Timing working as a driver	Accidents, Near miss accidents	↘	Significantly positive effect
Hasan. et al., 2017, China	Naturalistic driving study	Driving years	Near crash events	↘	Significantly positive effect
Mayhew et al., 2003, Canada	Observational	Time since licensure	Crash percent change	↘	Time since licensure is linked to a reduction of all type of crashes for novice drivers
Mc Cartt. et al, 2002, United States	Observational	Miles driven	First crash	↘	The larger is the amount of miles driven the smaller is the risk of the first crash for beginning drivers
		Miles driven	First citation	↘	The larger is the amount of miles driven the smaller is the risk of the first citation for beginning drivers
		Months since licensure	First crash	↘	The longer is the period since licensure the smaller is the risk of the first crash for beginning drivers
		Months since licensure	First citation	↘	The longer is the period since licensure the smaller is the risk of the first citation for beginning drivers
Van Winsum et al, 1996, The Netherlands	Simulation	Total kilometrage driven	Steering performance	↘	The driver's competence, expressed in total kilometrage driven, significantly reduce the tendency to commit operating errors

*Effects on road safety are coded as: significantly positive (↘), significantly negative (↗), non-significant

Additional studies

The experience increases driver's skills in terms of visual abilities, modifying the eye movement strategies and increasing their effectiveness (Underwood, 2007). For example, more experienced drivers show a greater number of short fixations distributed widely across the driving scene, with the result of collecting a large amount of information. More experienced drivers also need less processing time (indicated by mean fixation duration). For a novice driver the traffic environment is full of events and relationships that are novel. It is likely that a novice driver needs to direct attention to a wide range of events and process many events which are not relevant for safe driving.

However, the increase of skills and knowledge through simulator training (Rosenbloom et al, 2013) is found to induce less safe intentions in novice drivers as a better perception of personal abilities induces overconfidence.

Lack of driving experience

Modifying conditions

A lack of experience is strictly related to driver age, which affects the driver's maturity and the technical abilities. It is expected that a higher effect

Conclusion

Driving inexperience is investigated in relation to driver's skills and accident risk. A lack of experience is linked to a higher probability of being involved in road crashes or being cited. Technical abilities and competence increase with experience, expressed in terms of miles/kilometres driven or time since licensure. Significant differences between experienced and not experienced drivers are found in relation to visual strategies, the former showing greater ability. In relation to speed, technical aversion and poor competences induce safer behaviours (lower speed) compensating in this way scarce abilities.

The studies coded largely referred to a specific context, generally to a single country, with specific class of road users considered (mainly young drivers). No meta-analysis are available and sometimes samples are small. Furthermore, multivariate regression models might be affected by omitted variable "bias" (i.e. variables other than those investigated might influence the issue considered) as well as correlations between characteristics that might limit the clear identification of the effect of specific variables.

For questionnaire-based studies, results might be affected by "social desirability bias", with a consequent underreporting of some not socially desirable behaviours by people interviewed.

3 Supporting documents

3.1 METHODOLOGY

Literature Search strategy

Literature search was conducted in March 2016 using the Scopus Database. It was initially focused on "lack of skills and knowledge" risk factor and carried out separately for skills and knowledge and for each specific risk factor (vehicle, traffic, trip, life goals and personal tendencies). Subsequently only papers relevant to "lack of driving experience" were considered. Other already known or during the literature search occasionally (e.g. via Google) found studies were added as additional studies (3). In the following tables are reported the search details (terms, linkage with logical operators, queries). The criteria assumed were the following: search for the fields of title, abstract and keywords, works published from 1990, document types confined to article or report, source type limited to journals, English language, engineering and social sciences as subject areas.

Insufficient skills (life goals and tendencies)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("life goal*" OR "personal tendenc*" OR "personalit*" OR "lifestyle*" OR "personal value*" AND ("skill*" OR "ability*" OR "competence*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	60,871
#2	("road casuallit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	290
#6	#1 AND #3 AND #4	427
#7	#5 OR #6	438

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	438
Total number of studies to screen title/ abstract	438

Screening

Total number of studies to screen title/ abstract	438
-exclusion criteria (no risk factor)	415
Remaining studies	23

Lack of driving experience

Not clear (full-text is needed)	16
Studies to obtain full-texts	23

Eligibility

Total number of studies to screen full-text	23
Full-text could be obtained	21
Reference list examined Y/N	N
Eligible papers	21

Screening of the full texts

Total number of studies to screen full paper	
no codable data - excluded	4
Full texts not screened due to limited time resources	15
Remaining studies	2

Insufficient skills (Vehicle manoeuvring)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("vehicle maneuvering*" OR "manoeuvre*" OR "speed control*" OR "position control*" AND ("skill*" OR "ability*" OR "competence*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	1,236
#2	("road casualt*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	51
#6	#1 AND #3 AND #4	78
#7	#5 OR #6	84

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	84
Total number of studies to screen title/ abstract	84

Screening

Total number of studies to screen title/ abstract	84
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Lack of driving experience

-exclusion criteria (no risk factor)	67
Remaining studies	18
Not clear (full-text is needed)	12
Studies to obtain full-texts	18

Eligibility

Total number of studies to screen full-text	19
Full-text could be obtained	17
Reference list examined Y/N	N
Eligible papers	17

Screening of the full texts

Total number of studies to screen full paper	17
not the risk factor - excluded	2
Full texts not screened due to limited time resources	10
Remaining studies	5

Insufficient skills (Traffic situation)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("speed adjustment*" OR "observation" OR "communication" AND ("skill*" OR "ability*" OR "competence*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	142,693
#2	("road casual*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	273
#6	#1 AND #3 AND #4	462
#7	#5 OR #6	486

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	486
Total number of studies to screen title/ abstract	486

Screening

Total number of studies to screen title/ abstract	486
-exclusion criteria (no risk factor)	462

Lack of driving experience

Remaining studies	24
Not clear (full-text is needed)	20
Studies to obtain full-texts	24

Eligibility

Total number of studies to screen full-text	24
Full-text could be obtained	23
Reference list examined Y/N	N
Eligible papers	23

Screening of the full texts

Total number of studies to screen full paper	
not the risk factor - excluded	2
no codeable data - excluded	2
Full texts not screened due to limited time resources	19
Remaining studies	0

Insufficient skills (trip)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("trip planning*") AND ("skill*" OR "ability*" OR "competence*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	39
#2	("road casualit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,096
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,712
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,796
#5	#1 AND #2 AND #4	0
#6	#1 AND #3 AND #4	1
#7	#5 OR #6	1

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	1
Total number of studies to screen title/ abstract	1

Screening

Total number of studies to screen title/ abstract	1
-exclusion criteria (no risk factor)	1

Lack of driving experience

Remaining studies	0
Not clear (full-text is needed)	0
Studies to obtain full-texts	0

Insufficient knowledge (life goals and personal tendencies)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("life goal*" OR "personal tendenc*" OR "personality*" OR "lifestyle*" OR "personal value*" AND ("knowledge*" OR "training*" OR "consciousness*") AND ("traffic*" OR "mobility*" OR "driving*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	6,870
#2	("road casualit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	272
#6	#1 AND #3 AND #4	383
#7	#5 OR #6	393

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	393
Total number of studies to screen title/ abstract	393

Screening

Total number of studies to screen title/ abstract	393
- exclusion criteria (no risk factor)	384
Remaining studies	9
Not clear (full-text is needed)	5
Studies to obtain full-texts	9

Eligibility

Total number of studies to screen full-text	9
Full-text could be obtained	9
Reference list examined Y/N	N
Eligible papers	9

Screening of the full texts

Total number of studies to screen full paper	9
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Lack of driving experience

no codable data - excluded	3
Full texts not screened due to limited time resources	4
Remaining studies	2

Insufficient knowledge (vehicle properties)

Database: Scopus **Date:** 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("technical aspect*" OR "propert*" AND ("knowledge*" OR "training*" OR "consciousness*") AND ("Vehicle*" OR "car*" OR "truck*" OR "motorcycle*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	46,984
#2	("road casualit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	84
#6	#1 AND #3 AND #4	164
#7	#5 OR #6	183

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	183
Total number of studies to screen title/ abstract	183

Screening

Total number of studies to screen title/ abstract	183
-exclusion criteria (no risk factor)	183
Remaining studies	0
Not clear (full-text is needed)	0
Studies to obtain full-texts	0

Insufficient knowledge (traffic situation)

Database: Scopus **Date:** 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("rule*" OR "regulation*") AND ("knowledge*" OR "training*" OR "consciousness*") AND ("traffic*" OR "mobility*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	106
#2	("road casualit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099

Lack of driving experience

#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	36,730
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	32
#6	#1 AND #3 AND #4	34
#7	#5 OR #6	39

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	39
Total number of studies to screen title/ abstract	39

Screening

Total number of studies to screen title/ abstract	39
-exclusion criteria (no risk factor)	35
Remaining studies	4
Not clear (full-text is needed)	4
Studies to obtain full-texts	4

Eligibility

Total number of studies to screen full-text	4
Full-text could be obtained	4
Reference list examined Y/N	N
Eligible papers	4

Screening of the full texts

Total number of studies to screen full paper	4
No risk factor	2
Full texts not screened due to limited time resources	2
Remaining studies	0

Insufficient knowledge (trip)

Database: Scopus Date: 25nd of March 2016

no.	search terms / logical operators / combined queries	hits
#1	("location*" OR "driving time*" OR "travel time*" OR "time pressure*") AND ("knowledge*" OR "training*" OR "consciousness*") AND ("traffic*" OR "mobility*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	7,150
#2	("road casualit*" OR "road fatalit*" OR "traffic accident*" OR "road crash*") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	10,099
#3	("road safety" OR "traffic safety" OR "crash" OR "accident") AND ("collision" OR "risk") AND DOCTYPE	36,730

Lack of driving experience

	(ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	
#4	("roadway*" OR "highway*" OR "intersection" OR "highway" OR "motorway" OR "built up area" OR "rural road" OR "urban road") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	100,847
#5	#1 AND #2 AND #4	258
#6	#1 AND #3 AND #4	418
#7	#5 OR #6	447

Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	447
Total number of studies to screen title/ abstract	447

Screening

Total number of studies to screen title/ abstract	447
-exclusion criteria (no risk factor)	439
Remaining studies	8
Not clear (full-text is needed)	8
Studies to obtain full-texts	8

Eligibility

Total number of studies to screen full-text	8
Full-text could be obtained	8
Reference list examined Y/N	N
Eligible papers	8

Screening of the full texts

Total number of studies to screen full paper	
No risk factor	2
Full texts not screened due to limited time resources	6
Remaining studies	0

All the studies identified have been coded according to the following rules:

- Prioritizing Step A (studies clearly addressing the risk factor)
- Prioritizing Step B (studies most recently published)
- Prioritizing Step C (studies from Europe)

Hereinafter are reported all the selected studies (see **Table 3**).

Lack of driving experience

List of references resulting from search strategy (sorted by year of publication, meta-analysis first)

Table 3: List of references resulting from search strategy

	Publication	Coded Y/N	Reason
1	Møller M., Haustein S. (2013). Keep on cruising: Changes in lifestyle and driving style among male drivers between the age of 18 and 23, <i>Transportation Research part F</i>	N	No codable data
2	Møller M. (2004). An explorative study of the relationship between lifestyle and driving behaviour among young drivers, <i>Accident Analysis & Prevention</i> , 36, 1081-1088	N	No codable data
3	Chliaoutakis J.E., Koukouli S., Lajunen T., Tzamalouka G. (2005). Lifestyle traits as predictors of driving behaviour in urban areas of Greece, <i>Transportation Research part F</i> , 8, 413-428	Y	
4	Chliaoutakis J.E., Darviri C., Demakakos P.T. (1999). The impact of young drivers' lifestyle on their road traffic accident risk in greater Athens area, <i>Accident Analysis & Prevention</i> , 31, 771-780	Y	
5	Sagberg F., Selpi, Bianchi Piccinini G.F., Engström J. (2015). A review of research on driving styles and road safety, <i>Human Factors</i> , 57, 1248-1275	N	No codable data
6	Kouabenan D.R. (1998). Beliefs and the perception of risks and accidents, <i>Risk Analysis</i> , 18, 243-252	N	No codable data
7	Cerniglia L., Cimino S., Ballarotto G., Casini E., Ferrari A., Carbone P., Cersosimo M. (2015). Motor vehicle accidents and adolescents: An empirical study on their emotional and behavioral profiles, defense strategies and parental support, <i>Transportation Research Part F: Traffic Psychology and Behaviour</i> , 35, 28-36	N	Not screened
8	Lheureux F., Charlois C., Auzoult L., Minary J.-P. (2015). Me have a traffic accident? The effects of core self-evaluations on the perceived likelihood and perceived undesirability of traffic accidents, <i>Transportation Research Part F: Traffic Psychology and Behaviour</i> , 34, 65-75	N	Not screened
9	Scott-Parker B., Goode N., Salmon P. (2015). The driver, the road, the rules... and the rest? A systems-based approach to young driver road safety, <i>Accident Analysis & Prevention</i> , 74, 297-305	N	Not screened
10	Foo K.Y. (2015). Effects of familial climate on the adolescents' driving habits: a recent literature, <i>International Journal of Injury Control and Safety Promotion</i> , 22, 127-135	N	Not screened
11	Nordfjærn T., Simsekoglu T., Zavareh M.F., Hezaveh A.M., Mamdoohi A.R., Rundmo T. (2014). Road traffic culture and personality traits related to traffic safety in Turkish and Iranian samples, <i>Safety Science</i> , 66, 36-46	N	Not screened
12	Coogan M.A., Campbell M., Adler T.J., Forward S. (2014). Examining behavioral and attitudinal differences among groups in their traffic safety culture, <i>Transportation Research Part F: Traffic Psychology and Behaviour</i> , 26, 303-316	N	Not screened
13	Nordfjærn T. Simsekoglu T. (2014). Empathy, conformity, and cultural factors related to aberrant driving behaviour in a sample of Urban Turkish drivers, <i>Safety Science</i> , 68, 55-64	N	Not screened

Lack of driving experience

	Publication	Coded Y/N	Reason
14	Warner H.W., Özkan T., Lajunen T., Tzamaloukas G.S. (2013). Cross-cultural comparison of driving skills among students in four different countries, <i>Safety Science</i> , 57, 69-74	N	Not screened
15	Murphy L.A., Robertson M.M., Huang Y.-H. (2012). The development of a conceptual model regarding the role of social modelling in safety behaviour: An integrated literature review, <i>Theoretical Issues in Ergonomics Science</i> , 13, 286-302	N	Not screened
16	Nichols A.L., Classen S., McPeck R., Breiner J. (2012). Does personality predict driving performance in middle and older age? an evidence-based literature review, <i>Traffic Injury Prevention</i> , 13, 133-143	N	Not screened
17	Adrian J., Postal V., Moessinger M., Rasclé N., Charles A. (2011). Personality traits and executive functions related to on-road driving performance among older drivers, <i>Accident Analysis & Prevention</i> , 43, 1652-1659	N	Not screened
18	Di Milia L., Smolensky M.H., Costa G., Howarth H.D., Ohayon M.M., Philip P. (2011). Demographic factors, fatigue, and driving accidents: An examination of the published literature, <i>Accident Analysis & Prevention</i> , 43, 516-532	N	Not screened
19	Miller G., Taubman - Ben-Ari O. (2010). Driving styles among young novice drivers-The contribution of parental driving styles and personal characteristics, <i>Accident Analysis & Prevention</i> , 42, 558-570	N	Not screened
20	Orozova-Bekkevold I., Hels T. (2009) Road users' socio-economic status and road safety in Denmark, <i>Advances in Transportation Studies an international Journal</i>	N	Not screened
21	Mather R.D., DeLucia P.R. (2007) Testing for effects of racial attitudes and visual contrast on the speed of a driver's response to a pedestrian	N	Not screened
22	Lund J., Aarø L.E. (2004) Accident prevention. Presentation of a model placing emphasis on human, structural and cultural factors	N	Not screened
23	Kujala T., Mäkelä J., Kotilainen I., Tokkonen T. (2016). The Attentional Demand of Automobile Driving Revisited: Occlusion Distance as a Function of Task-Relevant Event Density in Realistic Driving Scenarios, <i>Human Factors</i> , 58, 163-180	N	No risk factor
24	Sadia R., Bekhor S., Polus A. (2015). Individual Selection of Driving Speeds: Analysis of a Stated Preference Survey, <i>Journal of Transportation Safety & Security</i> , 7, 291-306	Y	
25	Rosenbloom T., Eldror E. (2014). Effectiveness evaluation of simulative workshops for newly licensed drivers, <i>Accident Analysis and Prevention</i> , 63, 30-36	Y	
26	Kaber D., Zhang Y., Jin S., Mosaly P., Garner M. (2012). Effects of hazard exposure and roadway complexity on young and older driver situation awareness and performance, <i>Transportation Research part F</i> , 15, 600-611	N	No risk factor
27	Van Winsum W., Godthelp H. (1996). Speed choice and steering behavior in curve driving, <i>Human Factors</i> , 38, 434-441	Y	
28	Mayhew D., Simpson H., Pak A. (2003). Changes in collision rates among novice drivers during the first months of driving	Y	

Lack of driving experience

	Publication	Coded Y/N	Reason
29	Mc Cartt A., Shabanova I., Leaf W. (2002). Driving experience, crashes and traffic citations of teenage beginning drivers	Y	
30	Freeman P., Neyens D.M., Wagner J., Switzer F., Alexander K., Pidgeon P. (2015). A video based run-off-road training program with practice and evaluation in a simulator	N	Not screened
31	Cao S., Qin Y., Zhao L., Shen M. (2015). Modeling the development of vehicle lateral control skills in a cognitive architecture	N	Not screened
32	Li X., Yan X., Wong S.C. (2015). Effects of fog, driver experience and gender on driving behavior on S-curved road segments	N	Not screened
33	Markkula G., Benderius O., Wahde M. (2014). Comparing and validating models of driver steering behaviour in collision avoidance and vehicle stabilisation	N	Not screened
34	Pérez-Zuriaga A.M., Camacho-Torregrosa F.J., Campoy-Ungría J.M., García A., "Application of global positioning system and questionnaires data for the study of driver behaviour on two-lane rural roads", 2013,	N	Not screened
35	Adrian J., Postal V., Moessinger M., Rasclé N., Charles A. (2011). Personality traits and executive functions related to on-road driving performance among older drivers.	N	Not screened
36	Di Stefano M., Macdonald W. (2003). Assessment of older drivers: Relationships among on-road errors, medical conditions and test outcome	N	Not screened
37	Macadam C.C. (2003). Understanding and modeling the human driver	N	Not screened
38	Navon D. (2003). The paradox of driving speed: Two adverse effects on highway accident rate	N	Not screened
39	Taieb-Maimon M., Shinar D. (2001). Minimum and comfortable driving headways: Reality versus perception	N	Not screened
40	Comte S.L., Jamson A.H. (2000). Traditional and innovative speed-reducing measures for curves: An investigation of driver behaviour using a driving simulator	N	Not screened
41	Brookhuis K., De Waard D., Mulder B. (1994). Measuring driving performance by car-following in traffic	N	Not screened
42	Bélanger A., Gagnon S., Yamin S. (2010) Capturing the serial nature of older drivers' responses towards challenging events: A simulator study, <i>Accident Analysis and Prevention</i> , 42, 809-817	N	No risk factor
43	Trick L.M., Toxopeus R., Wilson D. (2010). The effects of visibility conditions, traffic density, and navigational challenge on speed compensation and driving performance in older adults, <i>Accident Analysis and Prevention</i> , 42, 1661-1671	N	No risk factor
44	Konstantopoulos P., Chapman P., Crundall D. (2010). Driver's visual attention as a function of driving experience and visibility. Using a driving simulator to explore drivers' eye movements in day, night and rain driving, <i>Accident Analysis and Prevention</i> , 42, 827-834	N	No codable data
45	Underwood G. (2007). Visual attention and the transition from novice to advanced driver, <i>Ergonomics</i> , 50, 1235-1249	N	No codable data

Lack of driving experience

	Publication	Coded Y/N	Reason
46	Stahl P., Donmez B., Jamieson G.A. (2016). Supporting anticipation in driving through attentional and interpretational in-vehicle displays	N	Not screened
47	Dadashova B., Arenas-Ramírez B., Mira-Mcwilliams J., Aparicio-Izquierdo F. (2016). Methodological development for selection of significant predictors explaining fatal road accidents	N	Not screened
48	Naujoks F., Purucker C., Neukum A. (2016). Secondary task engagement and vehicle automation - Comparing the effects of different automation levels in an on-road experiment	N	Not screened
49	Chen F., Wang J., Deng Y. (2015). Road safety risk evaluation by means of improved entropy TOPSIS-RSR	N	Not screened
50	Prat F., Gras M.E., Planes M., González-Iglesias B., Sullman M.J.M. (2015). Psychological predictors of texting while driving among university students	N	Not screened
51	Malik H., Larue G.S., Rakotonirainy A., Maire F. (2015). Fuzzy Logic to Evaluate Driving Maneuvers: An Integrated Approach to Improve Training	N	Not screened
52	Cicchino J.B., McCartt A.T. (2015). Critical older driver errors in a national sample of serious U.S. crashes	N	Not screened
53	Theofilatos A., Yannis G. (2015). A review of powered-two-wheeler behaviour and safety	N	Not screened
54	Cristea M., Delhomme P. (2015). Comprehension and acceptability of on-board traffic information: Beliefs and driving behaviour	N	Not screened
55	Baurès R., Oberfeld D., Tournier I., Hecht H., Cavallo V. (2014). Arrival-time judgments on multiple-lane streets: The failure to ignore irrelevant traffic	N	Not screened
56	Long K., Liu Y., Han L.D. (2013). Impact of countdown timer on driving maneuvers after the yellow onset at signalized intersections: An empirical study in Changsha, China	N	Not screened
57	Barton B.K., Lew R., Kovesdi C., Cottrell N.D., Ulrich T. (2013). Developmental differences in auditory detection and localization of approaching vehicles	N	Not screened
58	Scialfa C.T., Borkenhagen D., Lyon J., Deschênes M., Horswill M., Wetton M. (2012). The effects of driving experience on responses to a static hazard perception test	N	Not screened
59	Bromberg S., Oron-Gilad T., Ronen A., Borowsky A., Parmet Y. (2012). The perception of pedestrians from the perspective of elderly experienced and experienced drivers	N	Not screened
60	Meston C.N., Jennings M.B., Cheesman M.F. (2011). Older adults' views of their communication difficulties and needs while driving in a motor vehicle	N	Not screened
61	Crundall D. (2009). The deceleration detection flicker Test: A measure of experience?	N	Not screened
62	Hutton K.A., Sibley C.G., Harper D.N., Hunt M. (2001). Modifying driver behaviour with passenger feedback	N	Not screened
63	Renge K. (2000) Effect of driving experience on drivers' decoding process of	N	Not screened

Lack of driving experience

	Publication	Coded Y/N	Reason
	roadway interpersonal communication		
64	Katila A., Keskinen E., Hatakka M. (1996). Conflicting goals of skid training	N	Not screened
65	Holland C.A., Rabbitt P.M.A. (1994). The problems of being an older driver: comparing the perceptions of an expert group and older drivers	N	Not screened
66	Elias W., Toledo T., Shiftan Y. (2010). The effect of daily-activity patterns on crash involvement, <i>Accident Analysis and Prevention</i> , 42, 1682-1688	N	No codable data
67	Factor R., Mahalel D., Yair G. (2007). The social accident: A theoretical model and a research agenda for studying the influence of social and cultural characteristics on motor vehicle accidents, <i>Accident Analysis and Prevention</i> , 39, 914-921	N	No codable data
68	Melinder K. (2007). Socio-cultural characteristics of high versus low risk societies regarding road traffic safety, <i>Safety Science</i> , 45, 397-414	Y	
69	Nabipour A.R., Khanjani N., Nakhaee N., Moradlou H.Z., Sullman M.J.M. (2015). The relationship between religion and the on-road behaviour of adolescents in Iran, <i>Transportation Research Part F</i> , 29, 113-120	Y	
70	Factor R., Yair G., Mahalel D. (2010). Who by accident? the social morphology of car accidents	N	No risk factor
71	Fuentes C., Eugnia Gras M., Font-Mayolas S., Bertran C., Sullman M.J.M., Ballester D. (2010). Expectations of efficacy, social influence and age as predictors of helmet-use in a sample of Spanish adolescents	N	Not screened
72	Hedlund J., Compton R. (2005). Graduated driver licensing research in 2004 and 2005	N	Not screened
73	Vakili V., Danaei M., Askarian M., Palenik C.J., Abdollahifard G. (2012). Transportation Behaviors in Shiraz, Iran	N	Not screened
74	Zhao J., Mann R.E., Chipman M., Adlaf E., Stoduto G., Smart R.G. (2006). The impact of driver education on self-reported collisions among young drivers with a graduated license	N	Not screened
75	Al-Saleh K., Bendak S. (2012). Drivers' behaviour at roundabouts in Riyadh	N	Not screened
76	Arosanyin G.T., Olowosulu A.T., Oyeyemi G.M. (2013). An examination of some safety issues among commercial motorcyclists in Nigeria: A case study	N	No risk factor
77	Bassani M., Dalmazzo D., Marinelli G., Cirillo C. (2014). The effects of road geometrics and traffic regulations on driver-preferred speeds in northern Italy. An exploratory analysis	N	No risk factor
78	Hatfield J., Fernandes R., Job R.F.S., Smith K. (2007). Misunderstanding of right-of-way rules at various pedestrian crossing types: Observational study and survey	N	Not screened
78	Nævestad T.-O., Phillips R.O., Elvebakk B. (2015). Traffic accidents triggered by drivers at work - A survey and analysis of contributing factors	N	Not screened
79	Xu Y., Li Y., Jiang L. (2014). The effects of situational factors and impulsiveness on drivers' intentions to violate traffic rules: Difference of driving experience	N	Not screened

Lack of driving experience

	Publication	Coded Y/N	Reason
80	Polders E., Daniels S., Casters W., Brijs T. (2015). Identifying Crash Patterns on Roundabouts	N	Not screened
81	Bélanger A., Gagnon S., Stinchcombe A. (2015). Crash avoidance in response to challenging driving events: The roles of age, serialization, and driving simulator platform	N	Not screened
82	Öz B., Özkan T., Lajunen T. (2013). An investigation of professional drivers: Organizational safety climate, driver behaviours and performance	N	Not screened
83	Peer E. (2011). The time-saving bias, speed choices and driving behavior	N	No risk factor
84	Dogan E., Steg L., Delhomme P. (2011).The influence of multiple goals on driving behavior: The case of safety, time saving, and fuel saving	N	No risk factor
85	Marmeleira J.F., Godinho M.B., Fernandes O.M. (2009). The effects of an exercise program on several abilities associated with driving performance in older adults",	N	Not screened

Lack of driving experience

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- Dunbar, G., Hill, R., Lewis, V., (2001). Children's attentional skills and road behavior. *Journal of Experimental Psychology* (7), 227-234
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- Ferguson, S.A, Williams, A.F., Chaplin, J.F., Reinfurt, D.W., De Leonardis, D.M. (2001). Relationship of parent driving records to the driving records of their children. *Accident Analysis and Prevention* (33), 229-234.
- Gregersen, N.P., Berg, H.Y., (1994). Lifestyle and accidents among young drivers. *Accident Analysis and Prevention*, 26(3), 297-303.

Lack of driving experience

- Klidas, A., Vinken, H., Vulto, W., Lievense, P. (2003). Culture and Self-regulation. A Comparative Study on Cultural Contingencies and Self-regulation in Road Transport safety in the Netherlands. Main report. *Dutch Ministry of Transport, Public Works and Water Management*.
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- Wells, P., Tong, S., Sexton, B., Grayson, G., Jones, E., (2008). Cohort II: A Study of New Drivers. Road Safety Research Report No. 81. *Department for Transport, London*.
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