Explaining Senior Drivers' Road Near Misses Using Both Self-reported and Automatic Collected Data

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Abstract. This paper reports on part of the French MEDOC Project that was supported by Foundation MAIF, Paris, France [grant number RP4-F14140]. The main goal of this project was to understand near miss situations using both objective and subjective methods for data collection: the vehicle dynamics and registered driver's actions; and the self-reported conditions that led to the occurrence and self-reported road users' actions to avoid an accident. The collected data allowed for comparing reported ones. The project involved a total of 154 drivers. However, this paper just addresses the group of 27 older drivers. Although older drivers are generally considered safe and cautious drivers, age-related perceptual and cognitive declines might have an impact on self-perception of their own abilities and behavior leading some of them to be under or over-estimators, which will influence their perception of any sudden event. Thus, this study is important to compare their self-reports with the collected data from sensors.

Keywords: Ageing · Driving · Near miss · Self-reported data
Board diaries · Automatic collected data

1 Introduction

Studies addressing the analysis of road accidents are numerous but few research work is devoted to near-miss incidents. However, such studies can provide useful information on unsafe behavior to improve license-related improved training and behavioral change towards a safe and sustainable mobility. Thus, the present study is centered on the analysis of data related to occurred traffic incidents aiming at identifying how drivers from different ages report an incident and the way they avoided the accident, a research project has been setup, the MEDOC project (MassE de DOnnées de Conduite pour modélisation d'un feed-back).

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The project was focused on the occurred incidents with the aim of increasing the understanding of critical driving situations that could lead to an accident without the appropriate and on time intervention of the driver. The project was led by IFSTTAR in collaboration with the High School of Technology – ETS. The selected drivers authorized the installation of the Data-Capture Device in their cars with the aim of comparing the collected data provided by both the driver and the automatic system.

The MEDOC Project aimed at providing a better understanding of driving incidents on the basis of variables related to the vehicle dynamics and the driver's actions, as well as exploring the relation between road incidents and accidents and providing recommendations to reduce the occurrence of such incidents. This project involved a sample of 154 licensed drivers distributed by three age groups: 19–30, 31–50 and over 50 years old. This paper is just focusing the group of 27 older drivers (14 women and 13 men), which has the highest growing representation in the population in the most industrialized countries.

When compared with younger age groups, older drivers have relatively fewer crashes. With increasing age, a decrease of the involvement of drivers in crashes is observed, indicating that older drivers are involved in fewer crashes than younger drivers. However, when crash data are compared to distances driven in different age groups, old drivers are over-represented. They drive less but their crash risk is high. Due to these considerations, the authors decided to analyze separately each group of the selected drivers. Thus, the present paper addresses the group of the selected older drivers for the MEDOC project. Due to the reduced number of drivers over 60 years, this group involves drivers over 50 years old.

2 The Older Drivers

Older adults represent the most rapidly growing segment of the driving population. According to an OECD publication (2001), one in four persons will be aged 65 or over in 2030 in many OECD member countries. The proportion of older drivers is increasing in society and is expected to enlarge even more [1–3]. In most of OECD countries, it is expected that by the year 2030 one person out of four will be 65 years old and over. Furthermore, with the increasing trend towards sub-urbanization, people of all ages, and especially older people, are becoming more dependent on their cars. In the more developed countries, where the use of private cars is more widespread, an increase in the number of older people combined with a decreasing proportion of younger members of society is more marked. These demographic trends together with older drivers' particular characteristics and mobility needs, require a great attention to this growing group of drivers.

Older drivers are generally considered safe and cautious drivers and it is known that they self-regulate their driving behavior to minimize the risk of crashing [4]. However, their age-related perceptual and cognitive declines lead older drivers to change their driving habits. They continue driving safely compensating their failures by using their remaining abilities in a deeper way. Although their increasing individual diversity with age, it seems that, for the same task performance, they develop the same self-regulatory behaviors for functional declines. This leads to common behavioral patterns among older drivers to compensate their age-related impaired perceptual-motor functioning. Such self-regulation behaviors include the insight to one's own limitations and related compensatory behaviors [5], reducing the stress and anxiety felt by older drivers in some driving situations, as well as the related risk [3, 6]. Avoidance behavior is a self-regulatory behavior that depends on high-level strategic choices requiring efficient meta-cognitive abilities. As pre-conditions for an effective self-regulatory behavior, the use of experience, as well as a more stable and user-friendly road environment are required. However, the nowadays roadway system is increasingly dynamic and complex, and the diversity of in-vehicle technologies could increase the task complexity, reducing the possibility of using previous experience, which they don't have as such technologies are recent.

When compared with younger age groups, older drivers have relatively fewer crashes. With increasing age, a decrease of the involvement of drivers in crashes is observed, indicating that older drivers are involved in fewer crashes than younger drivers. However, when crash data are compared to distances driven in different age groups, old drivers are over-represented [7]. They drive less but their crash risk is high. The type of crash is an important variable to be considered in order to discover the specificities of older drivers group. Some authors observed an over-representation of crashes at intersections [8, 9]. The roadway design, particularly road interchanges, road curves, construction zones and railroad crossings, should be improved in order to accommodate the characteristics of older drivers. On the basis of a fatality risk established for the age group 20–50 years, Mitchellin, in [10] demonstrated an increasing frailty with age. This means that, for the same crash and physical injury, an older adult is more likely to be seriously injured or dead than a younger adult. This is valid as well for moderate crashes. Moreover, frailty greatly increases the risk for functional decline, institutionalization, morbidity, and mortality. In addition, once injured, recovery time is much longer for the elderly compared to younger people.

Furthermore, in addition to age-related functional limitations, a growing number of drivers may be affected by some health conditions with increasing age, which affect their fitness to driving. Moreover, the severity of some diseases may be progressive, and many older people may be affected by multiple health conditions and consequent impairment. This requires accurate evaluation procedures of older drivers' fitness to drive and the provision of appropriate mobility solutions to those who will face restrictions to drive.

3 The Empirical Study

The MEDOC project was centered on the study of incidents[1] with the aim of increasing the understanding of such driving critical situations that could lead to an accident. The project involved an experiment with a sample of 154 drivers from different age groups.

[1] An incident at the wheel is defined as a dangerous event that, in the absence of a corrective action performed by the driver or other road user, would lead to an accident. The corrective action could be a sudden break, an important acceleration and/or an abrupt wheel movement. The driver him/herself and/or any other road user could be at the origin of the incident.

The system was composed of a Data-Capture Device connected to an OBD-II port by means of a cable. This equipment allows for registering the vehicle behavior with an appropriate frequency for the study of incidents (min 1 Hz). The main interest is the data collection that will be useful to bring up some light on the study of "*incidentology*".

The automatic detection of events with a potential to lead to accidents is not easy once the data provided by the installed system for experimental purposes are limited to the dynamic parameters of the vehicle (acceleration, deceleration, direction), depending on the installed sensors. The system doesn't provide a complete information about the nature of the detected incidents once the origin of the driving situation giving rise to the incident is not detected by the system. So far, there is no reliable method to automatically detect safety critical events when driving. The most recent research results have shown that automatic detection methods provide less than 10% of light about the source and circumstances of incidents.

3.1 Objectives

The prime objective of this study was to bring up an understanding about occurred road incidents exploring the variables related to: (1) the vehicle dynamics and the driver's actions, which should be collected automatically by the installed system; and (2) the self-reported incidents focusing the conditions leading to the occurrence and the way the situation was managed by the driver to avoid the accident. These self-reported data were registered on the logbook.

A second objective was to increase the reliability of both detection methods: the self-reported and automatic collected data. A third general objective was to explore the connections between road incidents and accidents as no studies are known about this. Finally, the analysis of the collected data was expected to allow for a fourth objective, which was the provision of recommendations for the reduction of such road incidents.

3.2 The Sample

The selected sample for the MEDOC project was composed of 154 drivers (53,2% men). They have their driving license for an average of 18,9 years (min = 3; max = 49) and they have a yearly kilometers driven average of 16,368 km (min = 1,000; max = 60,000. The average age is 39,2 years old (min = 23; max = 77). This sample was split into three age groups: 19–30, 31–50 and over 51–77 years old. The participants distribution according to the gender is quite balanced for the three age groups ($\chi^2 = 0{,}74$, $p < 0{,}69$, not significant). However, as it is usually observed among drivers, there is a significant gender effect on the yearly kilometers driven [$F(1, 148) = 8{,}99$, $p < 0{,}004$] as men declared more yearly kilometers driven ($M = 18\ 338{,}9$; $\sigma = 8\ 546{,}35$) than women ($M = 14\ 123$, $\sigma = 8\ 614{,}4$).

The selected group for the present analysis (over 50 years old) was composed as a total of 27 drivers from 51 to 77 years old, being 14 of them female and 13 male). Table 1 presents the age and gender distribution for this group.

Table 1. Age by gender, descriptive statistics

Gender	N	Minimum	Maximum	Average	Standard dev.
Women	14	57	77	63,50	5,585
Men	13	54	70	63,23	4,604
Total	27	54	77	63,37	5,039

3.3 Methods and Tools

Two complementary methods have been used to the data collection:

1. An automatic method consisting of a Data-Capture Device Micro iBB connected to an OBD-II port by means of a cable. The device, a black case with the dimensions of 86 × 69 × 54 mm, collected the recorded data from OBD-II inertial sensors in binary format on a 16 GB micro-SD card having a theoretical capacity of 2,000 h. Then, a software allowed to convert the binary notation into CSV files, which were directly used for the statistical analysis. The black case is supplied by the in-vehicle OBD-II port having an alarm control of the platform for the accelerometer. After 2–5 min of the vehicle inactivity, the system will be in stand-by mode. The black case is also provided of an ON/OFF button allowing for cutting off its supply through the OBD-II port. The device is installed on the car by means of nonskid mat allowing for fixing it on the dashboard.
2. Self-reported measures.

Four self-report tools were developed for the study, as following:

An Introductory Questionnaire. Participants reported their age, gender, information about the vehicle they drive the most often, and their driving habits such as yearly driven kilometers, motives for uses their car, and the frequency of car trips.

A Weekly Questionnaire. Participants reported how many kilometers they had driven for different purposes during the past week and whether other individuals had driven the car in which the data capture system was installed. If so, the participants stated who had driven the car and for what time period so that the data corresponding to users other than the participant could be identified and eliminated. They also reported whether any important events, that could unsettle them, occurred during that week.

A Logbook. Here, the participant described the near-miss incident and its various contextual details, such as the time and date of occurrence of the near miss, the type of infrastructure where it occurred, the speed at which he/she was driving at that moment, how the situation was resolved so as not to result in a crash, what categories of road users were involved, the weather conditions, whether the participant felt angry about the situation or was under the influence of other prior stressful events, how familiar he/she was with the route, whether there were passengers in his/her car, what the motive for the trip was, and when the near-miss happened within the trip (shortly after the beginning, in the middle, close to the end, etc.). The advantage of the logbook is the possibility of combining its use with personality factors to study driving behaviors according to the road environment and the trip

purpose [11]. The collected information helped researchers to evaluate the severity of the event, i.e. the extent to which the situation could have ended in a crash.
A Final Questionnaire. It contained various measures of driver characteristics and past driving experiences such as comparative judgment of the risk of being involved in a crash and of getting a ticket, frequency of traffic violations [12], proneness to the distraction while driving, driving anger, drivers' stress, number of crashes and demerit points during the last three years, and kilometers driven the last three years and the last year. For most questions, the participants responded on five-point Likert scales ranging from low to high levels of frequency or agreement.

3.4 Data Collection and Procedure

The study was approved by the ethics committee of Ifsttar and registered at the French National Commission on Informatics and Liberty (CNIL). The representatives of the insurance company that financed the study established a targeted population of vehicle-insurance policyholders from the Ile-de-France region, then these representatives contacted drivers (men and women between 19 and 80 years old) at random on the phone to ask them whether they were interested in taking part in this study. Data was gathered between the end of March 2015 and mid-December 2016. Every motorist participated for about two months. During this period, each participant was driving his/her car with the Data-Capture Device installed. The data collection was automatic, and the device was activated with the vehicle activity. Regarding the self-reported data, the different tools were applied in different periods as following:

- The introductory questionnaire was filled in before starting the study with previous information about each participant.
- The weekly questionnaire, to be applied during the study period to collect data, was emailed to the researchers by each participant by Monday evening.
- During the participation period, every time a near miss occurred while the participant was behind the wheel, he/she had to push the "event" button as the danger was over; then, after arriving at his/her destination, he/she had to fill in a logbook about the event.
- At the end of the participation period, the participant filled in the final questionnaire.

The researchers took back the final questionnaire, the logbooks and the automatic data-capture device, and gave the participant a check for 50 Euros.

4 Results and Discussion

4.1 Results from the Self-reported Data

The group of 27 older drivers (over 50 years old) has reported a total of 81 incidents over the two months of driving, in average 3 incidents per driver (with variation from 1 to 9). This compares with the total group of participants in MEDOC project of 154 drivers reporting 439 incidents, in average 2.7 incidents per driver (with variation from 0 to 17).

Considering the roadway design (Table 2), three main situations account for the majority of older drivers' incidents: driving straight ahead (39.5%), or in intersections without (23.5%) or with traffic lights (19.8%). Roundabouts (7.4%) and turning right (3.7%) or left (4.9%) also have some importance. Comparing the older group with the total group we can observe that older drivers have fewer incidents in driving straight ahead, roundabouts and parking. However, they have more incidents at intersections (with or without traffic lights) and turning right or left.

Table 2. Number and percentage of incidents per type of road configuration. The whole sample vs. older drivers' group

Road configuration	All subjects (n = 154)		Older drivers (N = 27)	
	Number	%	Number	%
Straight ahead	210	47.9	32	39.5
Intersections without traffic lights	89	20.3	19	23.5
Intersections with traffic lights	59	13.4	16	19.8
Roundabouts	47	10.7	6	7.4
Turning right or left	23	5.2	7	8.6
In parking	9	2.1	1	1.2
Other types	2	0.5	0	0
Total	439	100	81	100

When asked about who was responsible by the incidents, the older group consider that others were responsible in 83.9% of the cases, while only 13.6% consider being themselves at the origin or partly responsible by the incidents. For the total group, the previous percentages were 71.3% and 23.5%, respectively, which can indicate that the older drivers group may have more tendency to blame others than him/herself by the incidents. In only one case (1.2%) a problem of the infrastructure was considered responsible by the incident.

Identifying the number of road users that were involved in the 81 incidents, the older driver was alone only in 4 cases (4.9%). For the remaining 77 incidents (95.1%) other road users were involved, 54 cases involving only a second road user and 23 cases involving more road users (19 cases with two road users and 4 cases with three road users).

Regarding the type of road users that were involved in the incidents with the older driver group (Table 3), other cars (one or more) were involved in 69 of the incidents with other road users, from which 10 were trucks (one case with 2 trucks simultaneously). Vulnerable road users were involved in 15 incidents with the older driver group, mostly pedestrians (10 cases) but also bicycles (3 cases) and motorcycles (2 cases).

For the 8 incidents involving the older driver together with only one vulnerable road user, 7 cases occurred with pedestrians and one case with a motorcycle.

Concerning the 23 incidents involving the older driver together with more two or three road users the following possibilities were reported (Table 4): 13 incidents with

Table 3. Type of road users involved in incidents with the older driver (number per type)

Type of road users	N
Other cars (one or more)	69
Vulnerable road users	15
Pedestrians	10
Bicycles	3
Motorcycles	2

Table 4. Incidents involving two or three road users together with the older driver (number per type)

Number and type of road users	N
With two cars	13
With three cars	3
With one car and one vulnerable road user	6
With two cars and one vulnerable road user	1
Total	23

two cars, 3 incidents with three cars, 6 incidents with one car and one vulnerable road user (3 cases with pedestrians, 3 cases with bicycles and one case with a motorcycle) and finally 1 incident with two cars and one vulnerable road user (bicycle).

The main causes at the origin of the incidents reported by older drivers (Table 5) were the incorrect behavior from other drivers, cutting the way (24.7%) or not respecting the priority rule (14.8%). Breaking because another driver breaks suddenly (12.3%) or a pedestrian cross the road suddenly (9.9%) are also causes frequently reported. With less percentage of reports are other driver deviation from trajectory (8.6%), distraction of the older driver with no respect of priority rule (6.2%) and other driver with excessive speed (2.5%). A group of other 17 causes appear with a frequency of only one case (1.2%) each, for example breaking due to obstacles on the road (an object, an animal and a door of other car opening in front), other car incorrect

Table 5. T number and percentage of incidents by type of cause.

Cause	N	%
Another driver cuts the way	20	24.7
Another driver does not respect priority rule	12	14.8
Another driver breaks suddenly	10	12.3
Pedestrian cross suddenly	8	9.9
Another user makes deviation from trajectory	7	8.6
Distraction with no respect to priority rule	5	6.2
Another driver with excessive speed	2	2.5
Other causes	17	21.0
Total	81	100.0

behavior (driving in forbidden direction, wrong use of indicator, incorrect overtaking), distraction errors of the older driver (cutting the way of other and deviation from trajectory), sudden insufficient visibility, car breakdown, etc.

Based on the self-reported data, two categories of incidents have been identified:

- These incidents occurred at intersections or roundabouts when driving at high speed giving rise to conditions for a risk of lateral or rear collision. Both vehicles didn't stop completely but both drivers had to brake and maneuvers to avoid the accident. The participants involved in such type of accident tend to under-estimate accident risks and over-estimate their own driving abilities and competences compared to other drivers.
- The incidents occurred at low speed (≤ 30 km/h) at intersections or roundabouts giving rise to a risk of frontal or lateral collision, which were avoided by the complete stop of one of the involved road users. Most of these incidents result from a disrespect of priority.

The self-reported data referred frequently the importance of the following elements on the road environment that could avoid the incident:

- More road side information about priority rules and speed limits;
- Right use and timing for indicators;
- Blind spot information and the need for being displayed in due time;
- Different improvements in the infrastructure, particularly at roundabouts.

4.2 The Automatic Incident Detection Method

The automatic incident detection was based on the search for cases exceeding the defined critical limits in terms of vehicle dynamics. The implemented incident detection was setup to search situations involving exceeding limits according to the following criteria: deceleration, deceleration variation (jerk) and steering fast changes. Furthermore, the incident could be detected by the three criteria or just by one or two of them. This means that the detected incidents were very different, being some more blatant than others. Thus, it was decided to keep just the events detected by the criteria of deceleration and its variation.

Furthermore, having a binary notation, the automatically detected events do not provide qualitative information, which imposed the need for complementing the information with the self-reported data.

4.3 Links Between Self-reported and Automatically Collected Data

Due to some dysfunction of the installed Data-Capture Device, the information about the number of over thresholds was retained just for 131 participants from the total sample. Furthermore, for each one of those participants, the number of the detected incidents was weighted for 100 km. Moreover, the automatic recordings are just available for 73 declared incidents. Comparing the declared incidents with the automatically detected ones allowed for bringing up some lighting about the links between both data.

The automatic detection has shown an insufficient performance to identify some well described self-reported incidents. However, the frequency of such automatically detected incidents seems to be linked to a risky driving. Therefore, the self-reported data allowed for building an incident typology into three groups: 1. Calm and wise, mostly composed by the older group, particularly women; 2. Pragmatic, mostly composed by the age group 31–50; and 3. Reckless, mostly composed by the younger group. Just one of these groups had incidents that could be correctly identified by the automatic detection system: the group with incidents at intersections in an unusual route and following a sudden brake of the other vehicle. The other types of declared incidents have a different nature and it would be difficult to be detected by the automatic detection system.

5 Recommendations

The collected information related to the driving incidents in the frame of MEDOC allows to formulate a set of recommendations potentially useful to improve road safety. Firstly, despite a certain number of technical failures of the used equipment, it is possible to state that the automatically collected data were useful to assess one's risk level of being involved in an accident or committing a traffic violation. However, taking into consideration the limited number of reliable registrations, the use of such automatic indicators for evaluation purposes should be used very carefully, rather as a complement of other evaluation means. Several self-reported measures that have been used in the MEDOC project provided elements that can ease the evaluation of the individual risk. The following factors are associated to the probability of causing a driving incident:

- The driver's young age;
- The driver's under-estimation of the his/her own risk of being involved in an accident comparing to an average driver;
- The important speed limits exceeded;
- The sensitiveness to distraction;
- The stress induced by events before and during driving.

The results of this study allow for identifying the circumstances creating a path to risky situations. An important number of the occurred incidents during the experimental study occurred on straight ahead roads where higher speeds are allowed. It is possible that drivers won't be enough aware of the risks related to this type of infrastructure. This should be addressed in both initial and older drivers' training, together with the display of variable messages to moderate the drivers' behavior.

The following suggestions have been provided by the experimental drivers with the aim of avoiding some risky situations:

- The right and timing use of indicators;
- The visibility improvement with mirrors;
- A better information with panels with priority rules and speed limits;
- In-vehicle blind spot systems to alert for the presence of vehicles or vulnerable road users.

Besides the participants' suggestions, other recommendations can be added based on the experimental results. Firstly, the distraction behind the wheel represents one of the most important risk factors. The cell phone is the first source of such distraction, which imposes the need for an important reduction of this use. The second concern is the speed, which imposes an effective and automatic information and control. The possibility of getting information about the vehicle dynamics and being able to assess the risk level in each situation would help to reduce the average speed. However, this is part of a safety culture that is not yet a reality. Thus, the following actions should be setup:

- To increase and improve the level of information provided to road users;
- To setup and disseminate education and training programs addressing special groups of road users;
- To prepare road users to share the road environment under strict rules and respect for all and each other.

6 Final Remarks

The MEDOC project research results evidence the following factors linked to the occurrence of incidents:

- Distraction;
- Stress induced by events related or not with driving;
- The risk under-estimation of being involved, as a driver, in an accident.

As the group of older drivers had not the expected age composition to get more precise results about the older drivers on the road, the MEDOC group of older drivers has been identified as the calm and wise group. Actually, just one driver in this group was really representing such driving population (77 years old). Thus, in average, the age-related declines with impact in driving were not yet very present on this group. It is known that older people drive less than younger ones as they are usually retired. However, they have mobility needs and their age-related difficulties could be easily controlled with some help. For a healthy older person, some training addressing their cognitive abilities and helping them to understand and use some in-vehicle technologies, is a great solution for their safe mobility and the road safety improvement. Furthermore, the approaching era of automatic driving and autonomous vehicles requires a serious and accurate preparation of road users for such approaching future. So far, the representation that is provided by the media and cars advertising is far from reality and is not helping to build a safety culture in society.

The analysis of the vehicles dynamic developed under the MEDOC project allowed to test and validate the pertinence of some algorithms for incidents detection. Such algorithms are recent, and the project results allowed for the approach refinement:

- The events characterized by a sudden steering change, combined with an abrupt brake, can be identified as perceived road risks.

- The use of a stricter rule to detect abrupt brakes (with threshold suppression to 0,3 g for high speeds and keeping the absolute threshold at 0,65 g) allows for increasing the precision of the events detection, usually associated to a perceived high risk.
- The link between the frequency of abrupt brakes and accidentology has been highlighted by both the self-reported data and the historical accidents description by drivers.

Anyway, the data from the MEDOC project are important, particularly in what concerns a new application field for the future vehicle, which should be able to qualify the driving style of its owner in terms of road risk.

References

1. Boy, G.A.: Orchestrating Human-Centered Design. Springer, Heidelberg (2013). ISBN 978-1-4471-4338-3
2. Holland, C.A.: Older Drivers: A Literature Review. Report No. 25. Department for Transportation, London (2001)
3. OECD: Ageing and transport. Mobility needs and safety issues (2001). www.oecd.org/dataoecd/40/63/2675189.pdf
4. Charlton, J., Oxley, J., Scully, J., Koppel, S., Congiu, M., Muir, C., Fildes, B.: Self-regulatory driving practices of older drivers in the Australian Capital Territory and New South Wales. Accident Research Centre, Monash University (2006)
5. ERSO: Older drivers. European road safety observatory (2006). www.erso.eu/knowledge/content/06_drivers/20_old/olderdrivers.htm
6. Kostyniuk, L.P., Trombley, D.A., Shope, J.T.: The process of reduction and cessation of driving among older drivers: a review of the literature. Michigan University, Transportation Research Institute. Report No. UMTRI-98-23. UMTRI-91238 (1998)
7. Dellinger, A.M., Langlois, J.A., Li, G.: Fatal crashes among elderly drivers: decomposition of rates into contributing factors. Am. J. Epidemiol. **155**(3), 234–241 (2002)
8. Baldock, M.R.J., McLean, A.J.: Older Drivers: Crash Involvement Rates and Causes. Centre of Automotive Safety Research, The University of Adelaide (2005)
9. GAO. Older Driver safety. Knowledge Sharing Should Help States Prepare for Increase in Older Driver Population. United States Government Accountability Office (2007)
10. Oxley, J., Corben, B., Fildes, B., O'Hare, M., Rothengatter, T.: Older Vulnerable Road Users: Measures to Reduce Crash and Injury Risk. MUARC, Report No. 218, Australia (2004)
11. Delhomme, P., Villieux, A.: Adaptation française de l'échelle de colère au volant D.A.S.: quels liens entre colère éprouvée au volant, infractions et accidents de la route déclarés par de jeunes automobilistes? Eur. Rev. Appl. Psychol. **55**, 187–205 (2005)
12. Delhomme, P., Verlhiac, J.-F., Martha, C.: Are drivers' comparative risk judgments about speeding realistic? J. Saf. Res. **40**, 333–339 (2009)