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# Evaluation of post-license Advanced Driver Training in Italy

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**Abstract**

Post-license advanced driver training addresses different categories of road users such as: novice drivers, professional drivers, company employers and recidivists. These training courses can be carried out on-track or on the road. On-track courses allow participants to gain knowledge on driving physics and experience limits in a safe road environment. On-road courses are more focused on hazard perception and situation awareness.
Although extensive research has been done in this field, knowledge of the effects of these courses on road accident risk remains unclear. Previous evaluation of on-track courses did not always show a positive effect on crash rate. For example, post-license training focused on mastery of driving skills can lead to an increase of accident risk, especially on young males.
However, research identified several factors that may enhance the effectiveness of driving training. In Europe a new framework for driver education and training has been proposed based on a safe driver hierarchical model (the GADGET model) and the development of a strategy for continuous learning.
According to this framework, an evaluation study of on-track post-license advanced driver training has been undertaken in Italy with the main goal of assessing the safety effects of these courses and identifying training aspects to be improved. Besides crash rate, the study aims at assessing also driver behavior, knowledge of risks, self-evaluation and training quality.
This paper presents the results of the possible effects of advanced driver training on driving behavior, considering in particular the number and type of violations. For each driver, data on age, gender and driving violations history were extracted from the platform and the national violations database.
Three cases were addressed through a before-after analysis with control group. Case 1 considers all drivers who attended an ADT course. Case 2 aimed at understanding the effects of the courses on a specific target group: the traffic violators. Case 3 is similar

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to Case 2, however the control group was selected in a way that drivers characteristics and the violation rate was similar to the violation rate of the treatment group in the before period.
The significance of the differences highlighted was assessed through appropriate statistical tests (i.e. paired t-test and the Wilcoxon signed-rank test).
The study showed in general a higher propensity to commit traffic violations after attending an ADT course. These results are in contrast to what expected and show the necessity to diversify the training classes according to the different needs of participants.


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*Keywords:* Advanced Driver Training; evaluation; traffic violation

## 1. Introduction

Post-license advanced driver training addresses different categories of road users such as: novice drivers, professional drivers, company employers and recidivists. These training courses can be carried out on-track or on the road. On-track courses allow participants to gain knowledge on driving physics and experience limits in a safe road environment. On-road courses are more focused on hazard perception and situation awareness.

Although extensive research has been done in this field, knowledge of the effects of these courses on road accident risk remains unclear. Previous evaluation of on-track courses did not always show a positive effect on crash rate. For example, post-license training focused on mastery of driving skills can lead to an increase of accident risk, especially for young males (Elvik et al., 2009). The conclusion is that driver training cannot be a substitute of driving experience for reducing accident risk (Harrison, 1997). Contrasting evidence comes also from studies assessing variation in traffic violations. Some US studies found that some programs may reduce traffic offence recidivism among those assigned to driver improvement programs, but this does not seem to translate into reduced crash involvement (Zhang, 2011), while another US study (Villaveces et al. 2011) found opposite results.

However, research identified several factors that may enhance the effectiveness of driving training. For example, Bartl et al. (2002) suggest that particular attention should be given to the message delivered to the trainee; this should focus on increasing risk awareness and self-consciousness of his/her driving limits and ensuring that the message does not lead to overconfidence of driving skills. These results lead in Europe to a new framework proposed for driver education and training based on a safe driver model: the Goal for Driver Education (GDE) matrix (Hatakka et al., 2002), and the development of a strategy for continuous education (Keskinen, 2014).

GDE matrix defines the training education according to four levels of driving behaviour (from vehicle control skills to higher the motivational and attitudinal aspects) and three columns defining the educational content (knowledge and skills, risk factors, and self-evaluation skills).

An evaluation study of on-track post-license advanced driver training has been undertaken in Italy with the main goal of assessing the safety effects of these courses and identifying training aspects that could be improved. Besides crash rate, the study aims at assessing also driver behavior, knowledge of risks, self-evaluation and training quality.

The evaluation involves all relevant Italian driving training centers. The participating training centers signed a protocol with the Ministry of Transport and Infrastructures where they agreed in undertaking the Advanced Driving Courses according to the criteria and standards established under the protocol, and in providing the necessary support to the Ministry for the detection of information for the purposes of experimentation.

Drivers participating to these courses have to complete four questionnaires: the first questionnaire before taking part to the training course, and the following three questionnaires after the course (one month, one year and two years later respectively).

From the analysis of questionnaires the results showed a general appraisal of ADT courses, an increase in awareness of important risk factors (e.g. speeding, driving under the influence of alcohol and driving without a seatbelt or helmet) and a higher confidence in the own driving skills.

This paper focuses on the effects of post-license advanced driver training on driving behavior, in particular in terms of the number and type of violations. Two aspects were investigated:

- The effects on drivers participating to an Advanced Driver Training (ADT) course
- The effects on drivers charged with a traffic violation in the 6–12 months before undertaking the ADT course.

## 2. Methodology

The proposed assessment methodology is based on the monitoring of traffic violations of drivers divided into two main groups: a "treatment group" of users who undertake an ADT course in the period 2011–2012 and a so-called "control group", a group of users who did not undertake any ADT course.

The monitoring took place both through questionnaires administered to participating users to ADT, and by querying the national database of drivers.

### *2.1. Driver training course characteristics*

The study promoted by the Ministry aimed at assessing the effects of four types of ADT courses: for passenger cars, heavy duty vehicles, mopeds and motorcycles.

The training program includes both theoretical lesson(s) delivered in class and a practical driving session delivered on-track in dedicated centers. The two sessions had to meet the requirements of duration and contents listed in Table 1. An attempt was made to link the exercises in the practical session to the contents of the theoretical session.

Table 1. Duration and contents of the training courses.

| **Theoretical session (2 hours)** | **Practical session (5 hours)** |
|---|---|
| 1. Introduction to the basic concepts of road traffic, the most common causes of road accidents and analysis of the risk factors; | - |
| 2. Main factors affecting driving ability and self-evaluation of the psycho-physical conditions; | a. Effects on the dynamics of load transfer of the vehicle; |
| 3. Driving position and proper use of vehicle controls; with reference to the knowledge and correct use of active/passive safety systems; | b. Correct driving position and controls of the vehicle; |
| | c. Comparison of the behavior of the vehicle in the absence and in the presence of intervention of security technologies; |
| 4. Correct driving: trajectory and dynamic management of the vehicle; | d. Braking technique and road; |
| | e. Correct setting of the trajectory of the curve; |
| 5. Driving techniques specific to different road conditions; | f. Driving on low friction surfaces; |
| | g. Technical emergency braking; |
| | h. Dodge a sudden obstacle; |
| | i. Effects of understeer and oversteer in road curves; |
| 6. Correct maintenance for the safety of the vehicle; | - |
| 7. Indications useful for energy saving and pollution prevention; | - |
| 8. Information behavior and first responders in case of accident. | - |

### *2.2. Analysis of violations*

The assessment of the effects of the ADT courses in terms of violations committed by drivers has been addressed by examining three cases through a before-after analysis with control group. Case 1 considers all drivers who attended an ADT course. Case 2 aimed at understanding the effects of the courses on a specific target group: the traffic violators. Since it has been ascertained that the violation rate in the treatment group is on average higher than the violation rate of the control group a third case was explored limiting the drivers of the control group to those that showed a violation rate similar to the violation rate of the treatment group in the before period.

A more specific description of the three cases analysed is provided below.

- *Case 1*: Drivers participating to an ADT course.

- Treatment group: drivers who undertake an ADT course during the period 2011–2012 (6,932 drivers).
- Control group: drivers who did not undertake any ADT course during the period 2011–2012 (8,469 drivers).

- *Case 2*: Drivers who have committed a traffic violation before participating to an ADT course.
  - Treatment group: drivers who undertake an ADT course during the period 2011–2012 and committed a traffic violation in the 12 months before completing the ADT course (491 drivers).
  - Control group: drivers who did not undertake any ADT course during the period 2011–2012 and was selected among 10,000 drivers who have committed a violation in the same period during which they were paid the CGSA (9,216 drivers).
- *Case 3*: Drivers who have committed a traffic violation before participating to an ADT course with similar violation rate in treatment and control group.
  - Treatment group: drivers who undertake an ADT course during the period 2011–2012 and committed a traffic violation in the 12 months before completing the ADT course (491 drivers).
  - Control group: (3,686 drivers) drivers who did not undertake any ADT course selected so that the distribution of the number of violations committed in the period prior to the CGSA was similar to that of the treatment group.

A statistical test was applied to check for significant differences between the two groups in terms of number of violations per 100 drivers before and after the course.

A Shapiro-Wilk test was preliminary used to check if the distribution of differences between pairs was normally distributed. The requirements for normality were not respected, so the Wilcoxon signed-rank test was used as an alternative to the paired Student's t-test. The tests checks whether the median difference between pairs of observations (difference in the number of violations before and after the course) is zero.

A fourth case was considered to assess whether ADT courses have a lasting effect in reducing violations. Survival analysis is applied to determine the period of time (number of days) during which the effects of the ADT courses (if any) remain significant. The analysis is based on monitoring of drivers who have committed a violation, by checking the time elapsed before committing a second violation. The analysis allows comparing the probability of committing a second offense in the two groups, treatment and control. The treatment group consists of drivers who have committed a violation in the 6 months before following the ADT course (334 drivers). The control group was selected among those drivers who have committed a violation in the same period of the treatment group and who have not followed a ADT course (6,705 drivers).

### *2.3. Data collection and processing*

Data was derived from three different datasets of drivers: (1) the datasets of all drivers participating to the evaluation study (over 13,000), (2) a dataset of 10,000 random selected drivers extracted from the national database of licensed drivers (3) a dataset of 10,000 random selected drivers who committed a traffic violation during period 2010–2012 extracted from the national database of licensed drivers.

The traffic violations considered in the study are those addressed by the national demerit point system.

The final sample size for the treatment and control groups in the three cases examined was calculated by removing records with missing or incomplete information and drivers who got their license before year 2008

The demographic characteristics and the number of violations in the before period for the treatment and control groups in the three cases are presented in Table 2. There are some differences between treatment and control for case 1 and 2, especially in terms of gender and violations in the before period. The treatment and control groups were similar for case 3.

Table 2. Characteristics of the treatment and control subjects in the three cases analysed.

| Variable | Case 1 – Treatment group | Case 2/3 – Treatment group | Case 1 – Control Group | Case 2 – Control Group | Case 3 – Control Group |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Female | 806 (12%) | 54 (11%) | 3,754 (44%) | 2,999 (33%) | 402 (11%) |
| Male | 6,126 (88%) | 437 (89%) | 4,715 (56%) | 6,217 (67%) | 3,284 (89%) |
| **Age** | | | | | |
| <22 | 61 (1%) | 36 (7%) | 22 (0%) | 212 (2%) | 129 (3%) |
| 22–44 | 4,632 (67%) | 313 (64%) | 4,124 (49%) | 4,624 (50%) | 2,485 (67%) |
| 45–64 | 2,186 (32%) | 138 (28%) | 3,339 (39%) | 3,374 (37%) | 1,036 (28%) |
| 65+ | 53 (1%) | 4 (1%) | 984 (12%) | 1,006 (11%) | 36 (1%) |
| **Before violations** | | | | | |
| 0 | 5,804 (84%) | 378 (77%) | 7,696 (91%) | 7,988 (87%) | 2,840 (77%) |
| 1–2 | 1,084 (16%) | 110 (22%) | 750 (9%) | 1,162 (13%) | 820 (22%) |
| 3+ | 44 (1%) | 3 (1%) | 23 (0%) | 66 (1%) | 26 (1%) |
| **TOT** | **6,932** | **491** | **8,469** | **9,216** | **3,686** |

## 3. Results

### *3.1. Case 1–3 main results*

The number of violations in the before period was compared to those reported in the after period both in the treatment and in the control groups. To assess whether there is a significant difference between the two periods the Wilcoxon signed-rank test was adopted. The results are presented in Table 3.

In case 1, there is a significant decrease of violations in the treatment group (p-value smaller than 0.05) and a not significant decrease in the control group.

In case 2 and 3 it is observed a not significant increase of the number of violations in the treatment group, while a significant reduction of traffic violation is observed.

Table 3. Wilcoxon signed-rank test results in the three cases analysed.

| Gruppo | Test | Treatment group (size) | p-value | Control group (size) | p-value |
|---|---|---|---|---|---|
| Case 1 | Before > After | 6,932 | 0.0018 | 8,469 | 0.1259 |
| | Before < After | | 0.9982 | | 0.8741 |
| Case 2 | Before > After | 491 | 0.9397 | 9,216 | 3.395e-05 |
| | Before < After | | 0.0605 | | 1 |
| Case 3 | Before > After | 491 | 0.9397 | 3,686 | 2.2e-16 |
| | Before < After | | 0.0605 | | 1 |

A before-after comparison by type of traffic violation was carried out to understand what type of violation mostly contributed to the increase or the decrease in violations observed in the treatment and control groups.

The violations were grouped in the following five categories:

- Failure to wear the helmet/seatbelt
- Phone use while driving
- Priority failure/Failure to obey to traffic sign or signal
- Speeding
- Other violations

Speeding was the major reason for a traffic violation (some 50% of cases). After speeding, priority failure/failure to obey to traffic sign or signal (some 15%) and failure to wear the helmet/seatbelt were frequent reasons (about 10%).

Fig. 1, Fig. 2 and Fig. 3 report the variation in terms of number of violations per 100 drivers between the before and the after period for the five type of violations for the three cases examined. In general drivers belonging to the treatment group have a higher number of violations than drivers of the control group. This is linked to the fact that many drivers attending ADT courses are professional drivers or people who drive frequently (e.g. for work). However this should not affect the results, as the primary aim of the study was to compare the before-after variation in the number of violations rather than the comparison between the rate of violation in the treatment and control groups.

In case 1 (Fig. 1), the treatment group shows a reduction for all the violation types except for speeding for which an increase is observed. In the control group a similar pattern is observed. The solely difference is the (slight) increase observed for priority failure/failure to obey to traffic sign or signal.

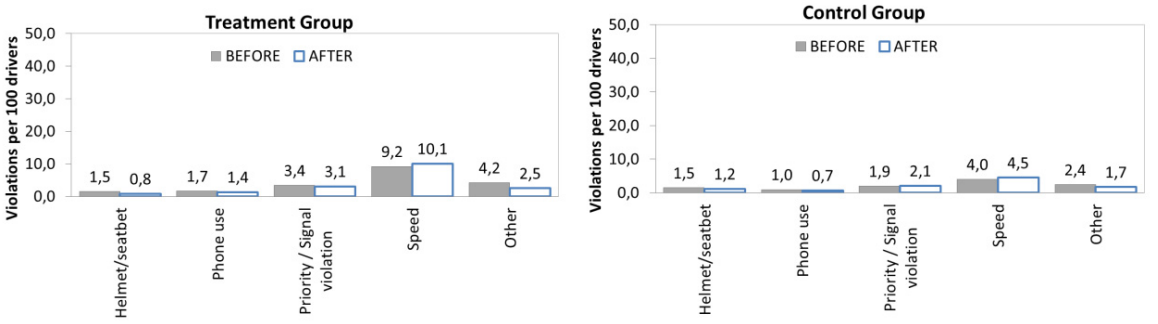


Fig. 1. Before-after traffic violations per 100 drivers by type in treatment and control groups (case 1).

Fig. 2 reports the before-after variation for the five types of violations for case 2.

Differently from case 1, a general increase in terms of the number of violations per 100 drivers is observed in the treatment group, while in the control group a decrement of all values of violations per 100 drivers is observed (except for speeding for which no variation is observed). In particular, the increase in speeding violators after attending the course is very high.

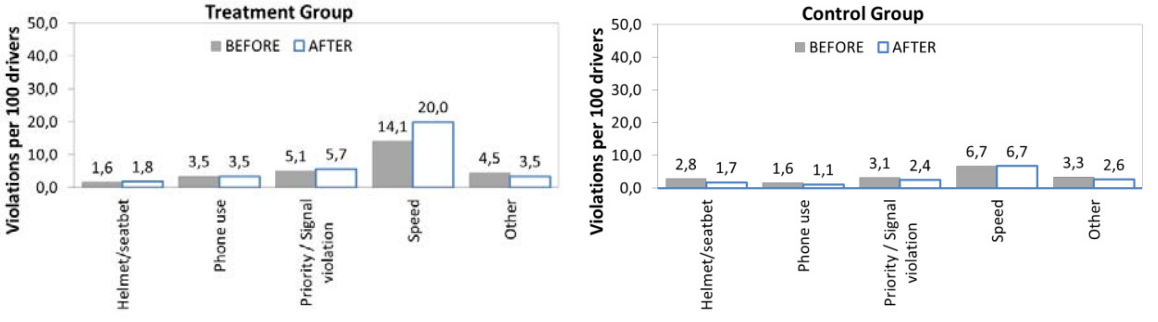


Fig. 2. Before-after traffic violations per 100 drivers by type in treatment and control groups (case 2).

In case 3 the comparison takes into account drivers with similar characteristics in the treatment and control group (especially in terms of violation rate). Fig. 3 reports the number of violations per 100 drivers in the before and after periods. Similarly to what found for case 2 and at the aggregated level, in the treatment group an increase in the violation rate is observed for each violation type in (solely exception for "Other" category"), while a general decrease is observed in the control group. This takes to the conclusion that the ADT courses may lead to an increase in the number of violations.

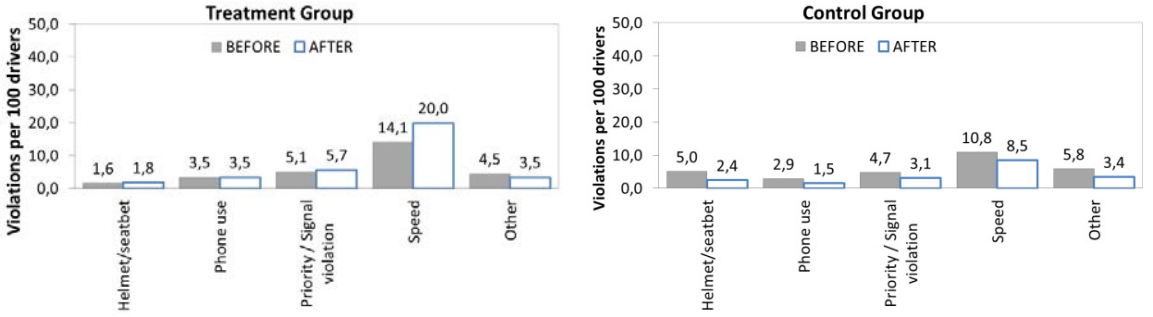


Fig. 3. Before-after traffic violations per 100 drivers by type in treatment and control groups (case 3).

### *3.2. Case 4 – survival analysis*

Fig. 4 shows the probability that the first violation will occur within t days after a traffic violation in the considered time frame. Two different hazard functions are shown, one for the treatment group (dashed line) and the other one for the control group (continuous line).

A lower probability of violation occurrence is observed for drivers who attended an ADT course during the first year after the first violation.

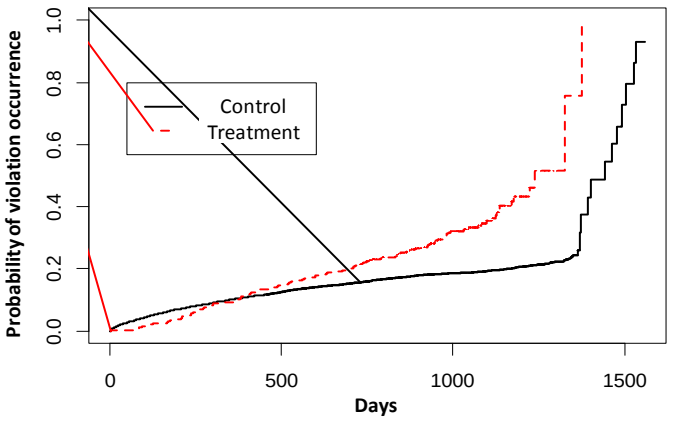


Fig. 4. Graph of hazard functions (number of days until first conviction) for the two groups.

## 4. Discussion and conclusion

From the analysis of the effects of ADT courses on driving behavior, in terms of number of traffic violations, the study showed in general a higher propensity to commit traffic violations after attending an ADT course.

These results are coherent with the study from Villaveces et al. (2011). In this study it was found that among drivers overall, exposure to driver improvement classes as a means to change drivers' behaviors is not significantly associated with fewer traffic violations but may be effective in reducing crashes.

The conclusions seem to be confirmed also by this study from a preliminary before-after comparison undertaken aimed to assess the change in the number of road accidents after completing an ADT course. A significant decrease of accidents was observed, however it was not possible to confirm the result through the evaluation of a control group.

The interpretation of results is that the increase in vehicle manoeuvring skills and the increase in driving skills confidence may lead to a different perception of accident risks. Research reinforces this idea that some forms of driver education and training can lead to overconfidence

This consequently may cause the driver to have a driving behaviour that could be in contrast to the rules of the Highway Code, in particular in relation to driving speed.

For all the elements there is an increase in the post-course of average, although lower than seen for the perceived risk. The increase indicates an increase in confidence in their own driving skills. On the other hand, an improved driving ability, in terms of control of the vehicle in hazard conditions, may have reduced the accident risk of a driver.

These results are in contrast to what expected and show the necessity to diversify the training classes according to the different needs of participants. Taking into account the GDE matrix, it was concluded that the ADT courses currently provided in Italy, mainly focus on the first two levels of education: vehicle control and mastering of traffic situations. The other two levels i.e. the goals and context of driving and the goals for life and skills for living, important to train drivers not only skilled, but also safe, are not adequately or marginally developed.

This is probably the consequence of sub-optimal results, especially in the aspects related to the violations. These considerations could give way to a process of ADT training improvement in Italy with comprehensive training programs in order to train safe drivers.

## Acknowledgements

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