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An evaluation of the road safety impact of the obligation for motorists to have a safety kit in their vehicle

Nicolas Clabaux, Jean-Yves Fournier

Gustave Eiffel University, Transport, Health, Safety Department, Laboratory of Accident Mechanisms Analysis, 304 chemin de la Croix Blanche, F-13300, Salon de Provence, France

Abstract:

Introduction: Since the 1st October 2008, in France, all vehicles must be equipped with a safety kit including a high-visibility vest and a warning triangle. The main purpose of this measure was to improve the safety of pedestrians who are near vehicles that have broken down or have had a crash. The objective of the research presented in this paper was to study the evolution of pedestrian collisions occurred on rural roads near an immobile vehicle after the obligation.

Method: Investigations covered two French departments and the 2005-2011 period. The years 2005-2007 was chosen as the “before” period, whereas the years 2009-2011 was chosen as the “after” period. Change in the proportion of the crash scenario “undetected pedestrian near an immobile vehicle” (UPIV) amongst all the pedestrian crashes recorded outside urban areas after the obligation, was examined.

Results: A stagnation in the proportion of pedestrian crashes corresponding to the UPIV crash scenario throughout both departments was observed. The proportion went from 27% during the before period to 28% during the after period. The Cochran-Mantel-Haenszel test showed that there was no significant difference ($p=1.00$ and common odds ratio=0.982; 95% CI [0.439; 2.190]). Detailed study of crashes suggest that this lack of change could be explained by the fact that automobile drivers who have to get out of their vehicles after a breakdown or a crash rarely wear their high-visibility vest and do not put out their warning triangle.

Conclusions: Mandatory safety kit has not had the expected impact. Implications for prevention are discussed.

Keywords: Pedestrian crashes, pedestrian visibility, high-visibility vest, safety kit

1.Introduction

Since 1 October 2008, all vehicles¹ in circulation in France must be equipped with a safety kit including a high-visibility vest, usually yellow, and a warning triangle (decree 2008-754 of 30 July 2008 – art. 19). The main purpose of this measure, adopted by the CISR (Interministerial Road Safety Committee) in February 2008, was to improve the safety of pedestrians who are near vehicles that have broken down or have had a crash, notably outside urban areas and on motorways (CISR, 2008, p.12). This measure was implemented along with a communication campaign in the press. Since it was introduced, a vehicle that does not have a safety kit can be fined 135 euros.

According to the literature, wearing a high-visibility vest increases the pedestrian detection distance, both day and night. Fluorescent colours, notably fluorescent yellow, improves pedestrian detection and recognition by car drivers during the day, whereas retro-reflective markings improve pedestrian detection and recognition at night (on this point, see the Cochrane Reviews for Kwan and Mapstone (2009)). Concerning the effects on crashes, as far as we know there have been no studies assessing the safety impact of such an obligation for pedestrians. And yet this measure has been adopted in many European countries since the early 2000s. The

¹ Except for two or three-wheeled vehicles and motorized unbodied quads.

study by Elvik (1996) suggests that this measure may have a positive effect since Elvik observes that, at night, in Norway, the share of pedestrians wearing reflectors in collisions is lower than the proportion of pedestrians wearing reflectors in traffic.

This article is a report on research that studied the evolution of pedestrian crashes occurring at night or not, near vehicles that had broken down or had been involved in a crash between the period before the obligation and the period after the obligation.

2.Method and data

The analyses covered two French departments: the Bouches-du-Rhône department (2,019,717 residents, located on the Mediterranean coast) and the Nord department (2,603,723 residents, located in the far north of the country), for which the Accident Mechanisms Laboratory had all the Police reports. The investigations covered the 2005-2011 period. The year 2008, the year when the measure was implemented, was excluded. The years 2005, 2006 and 2007 comprise the “before” period, whereas the years 2009, 2010, 2011 comprise the “after” period.

The police and the gendarmerie recorded 142 pedestrian collisions occurred outside urban areas and/or on motorways during the years studied: 70 in the before period and 72 in the after period (see table 1). The evolution observed in the Nord department (-10 %) is similar to the evolution observed in France over the whole territory during the same period (-14,6 %). On the other hand, the evolution observed in the Bouches-du-Rhône department is quite different (+12,5 %). However, the difference is not significant.

Then, the approach consisted in studying the change in the proportion of pedestrian collisions occurring near vehicles that had broken down or were involved in a crash, amongst all the pedestrian collisions occurring outside urban areas. More precisely, we examined the change in the proportion of crashes corresponding to crash scenario 12 described by Brenac et al. (2003). This crash scenario describes crashes in which the driver did not detect a pedestrian near an immobile vehicle after breaking down or having a crash. These crashes usually occur at night and on high-speed infrastructures (motorways, main roads). We designate this crash type with the following formula: “undetected pedestrian near an immobile vehicle” (UPIV).

A Cochran-Mantel-Haenszel χ^2 test was used to compare the share of crashes observed between the two periods throughout the two departments (Agresti, 2002). An examination of any statistical heterogeneity of the results between the two departments was undertaken.

It is the first time that the notion of prototypical accident scenario developed by Fleury and Brenac (2001) is used in a before-after evaluation of road safety effects of a countermeasure. It’s another objective of the study: showing that this concept can be useful in the context of evaluation studies seeking to determine the impact of a safety measure on certain crash types.

Table 1: Number of pedestrian collisions outside urban areas recorded by the police and gendarmerie in each department, “before” and “after” periods

	Number of crashes in the “before” period	Number of crashes in the “after” period	Total
<i>Bouches-du-Rhône</i> Department	40	45	85
<i>Nord</i> Department	30	27	57
Combined	70	72	142

3.Results

Amongst the 142 collisions recorded in the two departments, 39 (or 27%) corresponded to the UPIV crash scenario. These 39 crashes resulted in the death of 11 pedestrians and injury to 39 others. 32 cases out of 39 occurred on a motorway (or sometimes on roads with the same features as a motorway) and 29 cases occurred at night. The detailed results are presented in Table 2.

Table 2: Number of UPIV crashes in each department, “before” and “after” periods

	Number of UPIV crashes in the “before” period	Number of UPIV crashes in the “after” period	<i>p-Value</i>
<i>Bouches-du-Rhône</i> Department	14	11	0,28 ^a
<i>Nord</i> Department	5	9	0,14 ^a
Combined	19	20	1,00 ^b

^ap-value (chi-square test), ^b p-value (χ^2 Cochran-Mantel-Haenszel test)

The pedestrian’s presence on the road or roadside can be explained by a vehicle breakdown (13 cases), or a crash (10 cases), usually with property damages. In 11 other cases, the pedestrian was helping the occupants of a vehicle that had broken down (3 cases) or had been involved in a crash (8 cases). The remaining cases involved other situations.

We can observe a near stagnation in the proportion of pedestrian crashes corresponding to the UPIV crash scenario throughout both departments, as the proportion went from 27% during the before period to 28% during the after period (19 to 20 cases). The Cochran-Mantel-Haenszel test showed that there was no significant difference ($p=1.00$ and common odds ratio=0.982; 95% CI [0.439; 2.190]). The heterogeneity test did not call into question the homogeneity hypothesis for the results between the two departments.

4. Discussion

The results presented above suggest that the obligation for all automobile drivers to have a safety kit available in their vehicle has not had the expected impact, at least in the two departments studied. The pedestrian crashes that this measure was supposed to prevent have not decreased with the obligation.

This lack of change could be explained firstly by the fact that car drivers who have to get out of their vehicles after a breakdown or a crash rarely wear their high-visibility vests and do not put out their warning triangles. Indeed, a detailed study of the police reports showed that in the after period, amongst the 20 cases corresponding to the UPIV scenario, 2 involved a driver wearing a high-visibility vest and who had set up a warning triangle, two other cases involved a driver wearing a high-visibility vest but who had not set up a warning triangle; one case involved a driver who has set up a warning triangle but who was not wearing a high-visibility vest. There are a variety of reasons for not wearing a high-visibility vest. In 4 cases (all involving a breakdown) the absence of a high-visibility vest was the result of a clear lack of prudence by the automobile driver and a strong illusion of visibility; in four other cases, it was due to the urgency of the situation (cases of drivers immobilised in the middle of the road who had got out of their vehicle after a crash to get to safety or to help other people); in two cases, it was because the vehicle was not equipped with a safety kit or it was in the boot (the driver was headed to the boot when hit). In the other cases, the reason for not wearing the vest could not be determined.

However, the study of all 39 cases that occurred in the “before” period and in the “after” period and which corresponded to the UPIV crash scenario suggests that the conditions under which most of these crashes occurred made it hard to avoid them just because they were wearing a high-visibility vest and used a warning triangle. Indeed, these crashes usually involved vehicles driving at high speeds, often late at night with light traffic conditions (19 cases occurred between 11 pm and 6 am) and on high-speed infrastructures (on motorways or roads with the same features as a motorway in 32 cases out of 39) where the presence of a pedestrian was quite unexpected, even one wearing a high-visibility vest. The study by Shinar (1985), which was carried out on a closed track, shows that, on rural roads at night, the detectability of a pedestrian equipped with reflective strips varies strongly depending on drivers’ expectations. When the subjects are not forewarned of the presence of a pedestrian on the side of the road, the distance from which a pedestrian wearing reflecting markings is detected does not appear to be any greater than for a pedestrian wearing dark clothing. On motorways, the presence of pedestrians is by definition unexpected, as these infrastructures are reserved to automobile traffic. Other studies on motorway crashes involving police vehicles stopped to provide protection in a dangerous situation and equipped with reflective yellow stripes and flashing lights also showed that a high level of detectability, on the sensory level, does not necessarily ensure a good level of detection and a good understanding of the situation by automobile drivers (Langham et al. 2002). According to Shinar (1985), the big difference between the number of publications demonstrating a positive effect of visibility-enhancing equipment on the detection and recognition of pedestrians in an experimental context and the absence of publications demonstrating a positive effect on collisions, appears to come from the decisive role of automobile drivers’ expectations concerning pedestrians in rural environments. These crashes also usually occur under poor visibility conditions (at night in 29 cases, with poor weather conditions in 6 cases, during the day with bad weather in 2 cases, or with the sun at a low angle in one case). In two other cases, the presence of a cloud of smoke from a burning vehicle also kept the driver from detecting the pedestrian.

Other aspects are less represented but they also play a prominent role in these crashes. These include, for example, sometimes high alcohol levels in the driver (exceeding the legal threshold in 9 cases, exceeding 1g/l in 7 cases) and/or in the pedestrian (2 cases). In one other case, the pedestrian was under the influence of cannabis. A curve contributed to the driver’s very late detection of the broken down vehicle and the pedestrian in 7 cases (6 of which at motorway interchanges). In two cases a heavy goods vehicle in front of the vehicle that crashed, totally blocked visibility of the situation ahead and of the pedestrian. Sometimes the driver’s attention was focused on the vehicle that was broken down or had been involved in a crash, and so couldn’t detect quickly enough the nearby pedestrian who was not easy to see (at least 5 cases). Sometimes detection of the pedestrian was made difficult by his position (at least 13 cases: squatting and changing a tyre in 3 cases, bent down collecting debris on the carriageway or examining the vehicle or pushing it in 7 cases, in the middle of the carriageway making hand signals to other drivers to slow down (3 cases)). Furthermore, in four cases, the driver’s attention was focused on another task (text message discussions in 2 cases, a telephone conversation in one case, and adjusting the radio in one case), which also contributed to very late detection of the pedestrian located near the vehicle on the hard shoulder. Lastly, the lack of an emergency stopping lane or shoulder that is large enough for the vehicle to stop without remaining partially on the traffic lane was also observed in 7 cases.

The nearly systematic accumulation of several of these risk factors in each of the cases studied makes these crashes hard to avoid by wearing a high-visibility vest and the use of a warning triangle. This may help to explain why we do not observe any decrease for these crashes in the “after” period.

This study, however, have a certain number of limitations. First of all, it only covers two departments. And it is based on a limited number of years (three years before the requirement and three years after). So number of crashes in question is fairly small. Secondly, this study only deals with the changes in pedestrian collisions. It is possible that the requirement for all vehicles to be equipped with safety kits has affected collisions not involving pedestrians such as, for example, collisions between a moving vehicle and a broken down vehicle, since the warning triangle can contribute to detecting an immobile vehicle.

Despite these limitations, this study does teach us a few lessons. From a methodological point of view, this study suggests that the notion of prototypical crash scenario developed by Fleury and Brenac (2001) can be useful in the context of evaluation studies seeking to determine the impact of a safety measure on a crash category. Concerning prevention, it first of all appears that reinforcing police checks of the use of high-visibility vests and warning triangles outside urban areas by drivers getting out of their vehicles after a breakdown or a crash, could contribute to reducing some of these crashes. A reduction in nighttime speeds outside urban areas, notably on motorways, could be another measure to be investigated. Nighttime speeds of private passenger vehicles on motorways in France did decrease between the before period and the after period but, as we have seen, without any reduction in the number of collisions corresponding to the UPIV crash scenario. The average speed for private passenger vehicles on motorways, for example, dropped from 114km/h in 2005 to 108 km/h in 2011 (ONISR, 2008 and 2012). This goes back to what we said earlier, i.e. that even if they have dropped, the speeds driven on motorways make it difficult to detect and avoid a pedestrian on the carriageway, especially at night, even if the pedestrian is wearing a high-visibility vest. Increased police patrols for preventing alcohol-impaired driving would probably have a positive impact as in 10 cases out of 39, the driver of the vehicle that hit the pedestrian and/or the pedestrian himself were under the influence of alcohol, often heavily so. The effect of such a strategy is usually positive (Blomberg and Cleven, 2000; Elvik et al., 2009).

Nevertheless, making compulsory for all drivers to have a safety kit in their vehicle has probably contributed to the widespread dissemination of high visibility vests among the French population. In particular, free distributions of safety kits were undertaken as part of road safety campaigns. It could be that this indirectly contributed, for example, to increased use of this kind of enhanced detectability equipment by cyclists. For cyclists, wearing a high-visibility vest appears to have had a positive effect on the risk of having a crash, since according to the randomised trial by Lahrman et al. (2018), cyclists equipped with high-visibility vests are significantly less involved in collisions with a vehicle (some 48% less often) compared with cyclists not wearing this equipment, all else being equal.

5. Conclusion

Most European states have made compulsory the safety kit in all the vehicles. The main purpose of this measure was to improve the safety of pedestrians who are near vehicles that have broken down or have had a crash, in particular outside urban areas. This study reveals that, in France, this countermeasure has not had the expected impact. Indeed, there was no change in the proportion of pedestrian crashes occurring near vehicles that had broken down or were involved in a crash after the obligation, at least in the two studied departments. This lack of change could be explained by the fact that car drivers who have to get out of their vehicles after a breakdown or a crash don't use their safety kit. But, detailed study of crashes also show that the conditions under which most of these crashes occurred (high speed roads, poor visibility conditions, alcohol-impairment) made it hard to avoid them just with a safety kit. More research is needed to measure the effect of this measure on road safety.

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