American Journal of Traffic and Transportation Engineering
2016; 1(4): 39-46
http://www.sciencepublishinggroup.com/j/ajtte
doi: 10.11648/j.ajtte.20160104.11

Knowledge of the Concepts of "Black Spot", "Grey Spot" and "High Accident Concentration Sections" Among Drivers

Francisco Alonso[1], Mónica Alonso[2], Cristina Esteban[1], Sergio A. Useche[1]

[1]DATS (Development and Advising in Traffic Safety) Research Group, INTRAS (University Research Institute on Traffic and Road Safety), University of Valencia, Valencia, Spain

[2]MEng Civil Engineering-EQ, Department of Roads and Infrastructures, Council of Valencia. Valencia, Spain

Email address:

francisco.alonso@uv.es (F. Alonso), moalpla1@gmail.com (M. Alonso), cristina.esteban@uv.es (C. Esteban), sergio.useche@uv.es (S. A. Useche)

To cite this article:

Francisco Alonso, Mónica Alonso, Cristina Esteban, Sergio A. Useche. Knowledge of the Concepts of "Black Spot", "Grey Spot" and "High Accident Concentration Sections" Among Drivers. *American Journal of Traffic and Transportation Engineering.* Vol. 1, No. 4, 2016, pp. 39-46. doi: 10.11648/j.ajtte.20160104.11

Received: October 28, 2016; **Accepted**: November 8, 2016; **Published**: December 12, 2016

Abstract: One of the major problems related to road injuries and deaths are the presence of Black Spots. This problem has received a growing amount of attention from road managers thorough last decades, taking into account its importance for the safety of road users. In fact, knowledge about these strategic areas among drivers seems to be quite important, since this conceptualization may affect their behavior and assumed risks on the road. The main objective of this research was to assess the knowledge that drivers have on the concept of black spot and other closely related terms: "grey spot" and "high accident concentration sections". For this study, it was used a random sample of 200 drivers from the province of Valencia (Spain), between 18 and 64 years of age. Through data analysis it was found that, while most of drivers does know the concept of black spot properly (87.5% of them), this trend is not stable when knowledge of related concepts is assessed. In regard to the further technical terms addressed by this study (grey spot and high accident concentration sections), there is an elevated relative percentage of drivers who have very biased misconceptions about these concepts. With respect to the "grey spots", in which knowledge barely reached 13% of the driving population, unfamiliarity rate increased significantly. As conclusion, in regard to the concept of "high accident concentration sections", it was found that it is a really misunderstood, relativized and biased concept among population of drivers and, furthermore, in general, unknown to most of road users. Finally, it has been suggested that the public administrations should work to increase this knowledge, as it would allow drivers to adopt more cautious behavior when confronted with this potentially dangerous sections throughout their routes.

Keywords: Black Spot; Grey Spot; High Accident Concentration Sections; Drivers; Traffic Accident; Road Safety

1. Introduction

It is a well-known fact that road accidents are mainly influenced by three factors, among which we can mention the *human factor*. However, outside the aforementioned, the second most important factor implied in this process seems to be related to infrastructure and environmental issues [1], including within this group several circumstances and conditions of the road, especially those related to weather.

From driver's perception, there is a level of agreement with the above-mentioned fact, since drivers, after the driving behavior, attach greater importance in the causation of accidents significantly to "the highways and its state" and "signaling", above other factors such as the vehicle [1, 2].

It is not a striking fact that the road users represent several security and compatibility issues, even among themselves, according perhaps to the role(s) they play on the road, or the type of vehicle they use to drive [3].

One problem that has received increased attention from road managers and controllers, and coinciding with road users, is the problem of "black spots", an issue that is not surprising if we consider the accident rate accumulated within them.

The control and supervision of black spots is part of the "management of reactive systems of road safety", included in most of the existing road systems. This management system

has a long tradition in traffic engineering in various countries of the European Union, and many countries still consider this model as a fundamental and indispensable foundation of the operation of road safety regarding specific locations of the road network [4].

The concept of "black spot"

If we focus on the conceptualization of the term "black spot", we can conclude that there are different denominations and numerous related terms [4, 5].

The "black spots" (as we will call in this context) and some related phenomena are given different names in the scientific literature especially in the English-speaking world. To give some examples regarding this fact, it is possible to find references to this or similar elements [3, 6], such as "dangerous places", "hot spots", "hazardous locations", "high-risk locations," "sites with promising", "locations prone to accident", "black sections or zones" or "priority research areas."

Curiously, on the other side, there are what we will call "white spots": tracts of the road in which the accidents occur in a very low proportion, not analyzing whether it responds to a set of features that can be contrasted [3]. It may be adopted the following definition for the aforementioned term, understanding as a *white spot in a road network* "this particular stretch of road length in which, for a certain period of time, there have been no fatal accidents" [7].

The philosophy underlying to the definition of "black spot"

Although, as stated above, there is no a single or standard definition on the concept of black spot, based on a report by the OECD [8] and the work of previous researchers in the field of road risk management [9, 10, 11], it is possible to make a distinction between different definitions of the term [12, 13].

Numerical definitions. They include: number of accidents; accident rate; or number and accident rate. As an example, the official Norwegian black spot definition is "any place with a maximum length of 100 meters in which at least four injury accidents have occurred over the last five years" [14]. No refers to the volume of traffic or the normal number of accidents or specify the type of place considered.

A definition that includes the accident rate would be "anywhere, such as an intersection, a section or a curve in which the estimated number of injury accidents per million vehicles or km/vehicle, taking into account the latest four, exceeds the value, for example, 1.5". This definition differs substantially from the previously mentioned, because it takes into account the volume of traffic, relative and weighted according thereof and, implicitly refers to normal number of accidents.

Statistical definitions. Use to be based on comparing the number of accidents recorded with the number of accidents normal to a place of similar characteristics.

As an example, an intersection spot is considered black if the registered number of accidents during a specific period is significantly higher than the normal number of accidents for this type of intersection. According to the normal number of accidents is estimated, the statistical definition will approach the black spot definition based on a model.

Definitions based on models. It is derived from a multivariate accident prediction model. As an example, we could use the empirical Bayes' black spot definition, provided by Persaud [9]. The models were developed at intersections and road sections, and it has been identified the 20 places higher in the ranking, according to the empirical Bayes estimate of the expected number of accidents.

Definition of a black spot from a theoretical point of view

In any case, from a purely theoretical point of view, a black spot can be defined as "any location or specific location of the track (generally not exceeding 0.5 km) which has a higher number of accidents than other similar places cause local risk factors [15].

This definition implies that the "black spots" are critical places, in which local risk factors related to the design of the route and/or traffic controls contribute substantially to the accidents. This is the reason why engineering improvements, progress in improving the infrastructure can be, despite being broadly useful in reducing accidents, it would not be the only determinants to be related to the user and vehicle factors its environment [16, 17]. From this point of view, that is, the basic premise for the management of the black spot strategies is that the road design plays an important role in the occurrence of many accidents. Consequently, we must assume that developing the suitable engineering elements in dangerous sites, it would be avoided a significant proportion or quantity of accidents.

Specifically, in Spain, public authorities and associated institutions have proceeded to signaling black spots, denominating these addressed areas as "high accident concentration sections" or "high accident concentration sections", even if the concept is not, exactly or rigorously, the same.

We know that media attention is often attributed to him deficiencies in infrastructure. Nevertheless, some authors consider that drivers maintain a certain level of independent objective of external conditions risk [18, 19]. If this is true, the application of treatments does not produce net benefits or advantages in terms of safety. However, this is not a general view.

It is also true conceiving that, for the user, too often there is no correspondence between the level of risk and warned having such a specific road. In this regard, there are proposals to associate the generic speed limits of the roads to the current accident records thereof [7].

Furthermore, the Council of Valencia, to study them, used to employ the definition established by the DGT (Directorate General of Traffic) as a "site belonging to a roadway of a road network in which during a calendar year have been detected three or more injury accidents (killed or wounded) with a maximum separation between the two hundred meters", and is the default that we used in our study.

In a previous publication, the study protocol "Research, development and innovation for the design and development of a comprehensive plan for elimination and eradication of

black spots on the roads" [5] describes the methodology of work developed in the field of contract T-558, that was an assignment from the administration to the University of Valencia for services for the realization of the project entitled "research, development and innovation for the design and development of a comprehensive plan for elimination and eradication of black spots on the roads of the Provincial Council of Valencia", developed by the DATS group (Development and Consulting Traffic and road Safety) INTRAS (University Institute of Traffic and road Safety) of the University of Valencia for the Department of roads of the Council of Valencia. In this description the philosophy of this plan was reflected, raising the principles on which it was based, highlighting in this publication both: the enhancement of knowledge through research, acting on the human factor, and consider this with his opinion and participation regarding measures to be implemented.

Within the plan of the Council for the elimination and eradication of black spots set as one of its actions "signaling of black spots", and we must also consider that unlike all similar initiatives launched in our country in other road networks, in this case, a specific assessment of it which is not limited to the investigation of the evolution of the accident rate pre-post signaling arises.

Thus, the above mentioned project had a transversal objective that was to evaluate the perception of drivers regarding the extent of signaling and its influence on driver behavior at these points and the impact on road incidents and accidents [4, 5].

Summarizing a little the history of approaching to the work with black spot issues, we might mention that in 2008, a local television channel, the "Antenna 3 Foundation", and more specifically its platform "Put Brakes" developed a communication campaign, claiming to signaling blackheads or *hazardous* locations. The campaign defended the principle that drivers should be informed of the existence of them when they are circulating along an area that is identifiable as such. Indeed, the research group DATS (Development and Consulting Traffic and Road Safety) of the University Institute of Traffic and Road Safety (INTRAS) of the University of Valencia, which the authors of this publication are, made to the Directorate General of traffic a report on implementation of this measure signaling of black spots, in order that it could analyze the opportunity of it with officials of the Ministry of Development.

In early 2009, signaling bullets began on the roads of the state by implementing an information panel that warned the driver that was before an "high accident concentration sections" [6].

Purpose of the Study

The objective of this research was to establish the level of knowledge of drivers with reference to the concepts of "black spot", "grey spot" and "high accident concentration sections", in order to establish measures and countermeasures that contribute to achieve, at first, their elimination and ultimately their eradication. Regarding to the significance of the study, given that the concept of black spot and related terms have been characterized as "key issues" to for the prevention of road traffic accidents, it is important to understand in which measure the population using pathways have an accurate knowledge of these concepts and identify them correctly on the road.

2. Methods

2.1. Participants

The sample was composed of *n*=200 drivers of the Province of Valencia with an age range between 18 and 65 years, of which *n*=101 were men (56%) and n=99 were women (44%); very roughly adjusting the percentage distribution of census forms.

The selection of drivers surveyed was made from a random sampling quota proportional to population age and gender segments. The sample size starting was 200 surveys, 97 of them residents in the capital and 103 in the rest of the province, 13 professional and 187 non-professional drivers, representing a margin of error for the overall data ± 7.1 with confidence interval 95% in the worst case of p=q=50%.

2.2. Design and Instruments

With the intention to provide clear information about the objectives in research and profiling of drivers involved, a questionnaire composed of a series of structured questions, which included applied: character issues sociodemographic (age and gender), habitat (Capital/province) and type of driver (professional/non-professional).

The questionnaire used to gather information contains a series of semi-structured open questions in different sections, with the intention to provide clear information about the objectives in this study. the survey questions were used to obtain socio-demographic information of the participants (age and gender) and for the characterization of the sample in relationship to knowledge, perceptions and opinions concerning blackheads and measure signaling the same. participants of the spontaneous knowledge of what a "black spot" was also asked, whether or not options as possible answers. Then participants had to define what a "black spot". It was also asked about the spontaneous knowledge of what a "grey spot" and an "high accident concentration sections" were for participants.

2.3. Procedure

The application of instruments was conducted by personal interview. It was clarified that in some cases there were no right or wrong answers and participants to respond sincerely requested, explaining that their responses would be used for statistical and research purposes. The only selection criterion was that participants had any kind of driving license, and to be currently active drivers.

2.4. Data Processing

Once the data was obtained, the relevant statistical analyses (i.e. frequencies, aggrupation models and other relevant descriptive analyzes) were performed using ©IBM SPSS (Statistical Package for Social Sciences), version 23.0.

2.5. Ethics

For this type of study, ethical approval and formal consent are not required. The research type described in the

manuscript did not required the official intervention of the Ethics Committee in Experimental Research (consultative and advisory body of the University of Valencia), as no personal data are used and the participation was anonymous. However, the *Research Ethics Committee for Social Science in Health* of the University Research Institute on Traffic and Road Safety at the University of Valencia was consulted, certifying that the research subject to analysis responds to the general ethical principles, currently relevant to research in Social Science, and issued a favorable opinion to carry out such research in Spain.

3. Results

Faced with the question of spontaneous knowledge about it is a black dot, 87.5% say they know it is a black spot, compared with 12.5% declaring not to know the concept of "black spot", as shown in Table 1.

Table 1. *Spontaneous knowledge about what is a 'Black spot'(I).*

	Gender			Age			Area of residence	
	TOTAL	**Man**	**Woman**	**18 - 29 years**	**30 - 44 years**	**45 - 59 years**	**Capital city**	**Municipalities of the province**
Base:	(200)	(101)	(99)	(69)	(67)	(64)	(97)	(103)
Know what a Black Spot is	87.5	92.1	82.8	84.1	88.1	90.6	89.1	85.4
Do Not know what it is	12.5	7.9	17.2	15.9	11.9	9.4	10.9	14.6
	Type of driver			**Vehicle normally driven (Non-professional drivers)**				
	TOTAL	**Professional**	**Non-professional**	**Car**			**Motorcycle**	
Base:	(200)	(13)	(187)	(174)			(28)	
Know what a Black Spot is	87.5	100	86.6	87.4			89.3	
Do Not know what itis	12.5	-	13.4	12.6			10.7	

In general, the participants stated to have greater knowledge mostly males and the age groups of 30-65 years and residents in the capital/main city.

With regard to the definitions given for this concept we found that 54.3% define it as "accident zone/high frequency" 26.3% define it as "hazardous area/accident' hazard" 6.9% defined as "area of high probability of an accident", 5.7% defines it as "area of serious or fatal accidents", 3.4% defined it as "poorly signposted area" defined 3.4% as "poor visibility area", 2.3% defines it as "hot spot", 2.3% defined it as "wrong path area", 1.7% defines it as "zone with increased percentage of victims/dead", and 0.6% as an area in disrepair (see Table 2).

Table 2. *Spontaneous knowledge about what is a 'Black spot'(II).*

		Gender		Age			Area of residence		Type of driver		Vehicle normally driven (Non-professional)	
	TOTAL	**Man**	**Woman**	**18-29 years**	**30-44 years**	**45-59 years**	**Capital city**	**Mun. of province**	**Professional**	**Non-prof.**	**Car**	**Motorcycle**
Base:	(200)	(101)	(99)	(69)	(67)	(64)	(97)	(103)	(13)	(187)	(174)	(28)
Area with many accidents (high frequency)	54.3	64.5	42.7	58.6	52.5	51.7	56.3	52.3	61.5	53.7	52.6	68.0
Dangerous area (risk of accidents)	26.3	18.3	35.4	19.0	27.1	32.8	26.4	26.1	7.7	27.8	28.9	12.0
Poorly signed area	3.4	2.2	4.9	6.9	3.4	-	3.4	3.4	-	3.7	3.9	-
Area with a bad tracing	2.3	4.3	-	-	3.4	3.4	2.3	2.3	7.7	1.9	2.6	-
Area with increased percentage of victims/dead	1.7	-	3.7	1.7	1.7	1.7	2.3	1.1	-	1.9	2.0	-
Zone with high probability of an accident	6.9	6.5	7.3	5.2	8.5	6.9	4.6	9.1	15.4	6.2	5.3	16.0
Trouble spot	2.3	3.2	1.2	-	1.7	5.2	2.3	2.3	7.7	1.9	2.6	-
Poor visibility zone	3.4	3.2	3.7	1.7	6.8	1.7	2.3	4.5	7.7	3.1	3.9	-
Area in poor condition	0.6	-	1.2	1.7	-	-	1.1	-	-	0.6	0.7	-
Zone of serious - fatal accidents	5.7	6.5	4.9	6.9	6.8	3.4	5.7	5.7	-	6.2	5.3	8.0

Referring to spontaneous knowledge about what is a "Grey spot", 13% of participants said that if they know this concept means, compared to 87% who claims not to know the term based on their previous experience, as shown in Table 3.

Table 3. *Spontaneous knowledge about what is a "Grey spot"(I).*

	Gender			Age			Area of residence	
	TOTAL	Man	Woman	18 - 29 years	30 - 44 years	45 - 59 years	Capital city	Municipalities of the province
Base:	(200)	(101)	(99)	(69)	(67)	(64)	(97)	(103)
Know what a Grey Spot is	13.0	14.9	11.1	11.6	14.9	12.5	14.4	11.7
Do Not know what itis	87.0	85.1	88.9	88.4	85.1	87.5	85.6	88.3

	Type of driver			Vehicle normally driven (Non-professional drivers)	
	TOTAL	Professional	Non-professional	Car	Motorcycle
Base:	(200)	(13)	(187)	(174)	(28)
Know what a Grey Spot is	13.0	-	13.9	13,2	14,3
Do Not know what itis	87.0	100	86.1	86,8	85,7

In the case of this lack of clarity, this is manifested mostly by women and those living in towns in the province.
With regard to the definitions given for the concept of grey spot, it was found that 53.8% define it as "black spot less dangerous", 34.6% define it as "fewer accidents than the black spot", the 3.8% defined as "any accidents happen" and 7.7% from other many different ways, as shown in Table 4.

Table 4. *Spontaneous knowledge about what is a "Grey spot"(II).*

		Gender		Age			Area of residence		Type of driver		Vehicle normally driven (Non-professional)	
	TOTAL	Man	Woman	18-29 years	30-44 years	45-59 years	Capital city	Mun. of province	Professional	Non-prof.	Car	Motorcycle
Base:	(200)	(101)	(99)	(69)	(67)	(64)	(97)	(103)	(13)	(187)	(174)	(28)
Less-dangerous black spot	53.8	53.3	54.5	50.0	80.0	25.0	50.0	58.3	-	53.8	56.5	50.0
Eventually occur accidents	3.8	6.7	-	-	-	12.5	7.1	-	-	3.8	4.3	-
Less accidents tan in black spot	34.6	33.3	36.4	50.0	10.0	50.0	35.7	33.3	-	34.6	30.4	50.0
Others	7.7	6.7	9.1	-	10.0	12.5	7.1	8.3	-	7.7	8.7	-

Regarding the spontaneous knowledge about what is an "high accident concentration section", 13% said that if they know this concept means, compared to 87% who states not to know. In the case of this unawareness, it is often manifested mostly by women and those living in towns in the province.

With regard to the definitions given for the concept of high accident concentration section, it was found that 40% defines it as "section with more accidents", 26.5% define it as the same than a "black spot", 4.5% as "dangerous section" 3% defines it as "accidents chain" 1% as "shabby stretch" 1% as "stretch of traffic jam" a 1% as "greater caution zone", 1% as "area with more black spots", 1% of other many different ways, and 3.5% do not know/no answer (see Table 5).

Table 5. *Spontaneous knowledge about what is an "High accident concentration section."*

		Gender		Age			Area of residence		Type of driver		Vehicle normally driven (Non-professional)	
	TOTAL	Man	Woman	18-29 years	30-44 years	45-59 years	Capital city	Mun. of province	Professional	Non-prof.	Car	Motorcycle
Base:	(200)	(101)	(99)	(69)	(67)	(64)	(97)	(103)	(13)	(187)	(174)	(28)
Section with more accidents	60.0	55.4	64.6	59.4	58.2	62.5	62.9	57.3	84.6	58.3	60.9	42.9
Black spot	26.5	32.7	20.2	27.5	31.3	20.3	27.8	25.2	15.4	27.3	25.9	39.3
Zone with more black spots	1.0	1.0	1.0	-	-	3.1	-	1.9	-	1.1	1.1	-
Dangerous section	4.5	5.0	4.0	2.9	3.0	7.8	3.1	5.8	7.7	4.3	5.2	3.6
Area to have major caution	1.0	1.0	1.0	-	-	3.1	1.0	1.0	-	1.1	1.1	-
Stretch of traffic jam	1.0	-	2.0	2.9	-	-	1.0	1.0	-	1.1	1.1	-
Area in poor condition	3.0	2.0	4.0	1.4	6.0	1.6	2.1	3.9	-	1.1	1.1	-
Occurrence of accident' chains	1.0	2.0	-	1.4	-	1.6	1.0	1.0	-	3.2	2.9	3.6
Others	1.0	2.0	-	1.4	-	1.6	1.0	1.0	-	1.1	1.1	-
No answer	3.5	4.0	3.0	4.3	1.5	4.7	3.1	3.9	-	3.7	2.3	10.7

4. Discussion

As mentioned in the introduction of this study, it is a proven fact that popular and media attention is often attributed to deficiencies in infrastructure. Nevertheless, some authors consider that specially the drivers maintain a certain level of objective risk, that is independent of external conditions [18]. Although is true that the application of treatments does not produce net benefits in safety. However, this is not a totally accurate view in a global perspective.

It is also true that for the user too often there is no correspondence between the level of risk and warned having such a specific road. In this line there are proposals to associate the generic speed limits of the roads to the actual accident records thereof [7].

With respect to the results obtained in this study in relation to the central concepts (i.e. "black spot", "grey spot" and "high accident concentration section"), it is necessary to discuss the levels of knowledge of the population in contrast to some theoretical developments that they have taken place in the area.

First of all, with respect to the concept of "black spot", it can be stated that it is a term widely diversified knowledge of Spanish drivers, concretely in the province of Valencia. From the total of participants, 87.5% said they knew this concept and, in general, 54.3% of them associated with the conception of a zone or area in which a higher rate of accidents takes place. 26.3% of them identified as a "dangerous area" and almost 7% associates with an area most likely to crash. The need to inform and sensitize drivers to the presence of black spots on the roads is directly related to the prevention of accidents at critical sections of the road [19, 20]. In other words, the information provided to drivers properly can directly impact the decreased likelihood of having an accident in the area of presence of black spots [21].

With respect to the "grey spots" in which knowledge barely reached 13% of the driving population and, as in the case of "black spots" are mostly associated with dangerous sections of the road, but less risky than blackheads (53.8%), one can say that this term, although important, is still unknown even among most of the civil engineers and professionals in road safety related areas.

Finally, about the "high accident concentration sections", this term was associated in 60% of cases with "sections with more accidents than others" in 26.5% of cases assumed that meant the same as a "black spot" and minority (4.5%) cases was simply treated as a dangerous section. These results reflect the importance and growing need to educate road users to recognize the elements and strategies that are used to promote their own safety.

Regarding limitations related to prevention through implementation of black spots, it has been described in previous studies that restricted funding for hot spot safety work implies the existence of a limit to the number of locations that may be treated in a referential area [22], such as (in this case) the province of Valencia. Therefore, it makes necessary to prioritize between different locations, according with the objective risk determined within them, and to conduct effective and efficient safety measures (such as low cost measures), in order to optimize the limited funds as accurately as possible.

Often, it has been observed that some measures of information to road users are very effective in reducing accidents, though (as mentioned earlier), the decrease in fatalities on the road depends not only on the levels of information proportionated to drivers and other road users, but is derived, also, from other equally complex processes, such as (e.g.) changing attitudes [23], reducing fatigue [24, 25], improving drivers' training and information sources [26], modifying risky behaviors and improving road safety education [27, 28]. While these alternatives are more expensive, they are part of a framework that necessarily must be addressed as a public health measure and structural improvements for roads [29].

In addition to individual factors such as experience and subjective risk assumption of each driver [30], which can vary the effectiveness of their interaction with black and grey spots and high accident concentration sections (even informed or not of its existence), any intervention on these elements should devise comprehensive intervention on the risk of accident, taking measurements that integrate both the structural component (i.e. well-maintained roads, excellent signage and variety of non-overstimulating information sources) as vehicular (i.e. more efficient, intelligent and safer cars, actively and passively) and human (i.e. to prepare different road users for road interaction) components, that are covering together a wide public health problem [31, 32].

5. Conclusion

Perceptions and opinions that drivers have on the measures and countermeasures are implemented to increase road safety should be mostly investigated as an important part of their success is determined that the driver modify their behavior and such behavior is clearly related with opinions and beliefs we have of them. Specifically, as far signaling blackheads prudence necessary to undertake a black spot, it is clearly determined by the perception that it is an objective and effective measure.

Although it is not possible to generalize, given the limitations of the data in this article, motivated by the range of the study, we can say tentatively that the fact that a measure is led by social partners such as the media, and supported by the population, can be a facilitator of knowledge of a measure and its acceptance.

However, from the point of view of the administration, it must make a greater effort to better explain the policy, reporting on the benefits they have for citizens. To fulfill this purpose, it can certainly help the media advertising, foundations and social programs with their communication actions, which despite having been intense over a period of time, according to the findings shown in this article, where knowledge gaps are evident, must continue in order to reach

a greater number of drivers.

Additionally, administrations should combine measures and countermeasures, not only because it from a strategic point of view will be achieved largely mitigate any problems related to road safety, but also because this way it can be achieved a greater involvement of all drivers to be attending bring their different perceptions and sensitivities.

Thus, specifically in the case of black spot treatment, management should make an effort to strengthen measures and countermeasures that allow for improved conditions signaling, marking, etc. in these areas, to which should in turn increase research and investment and for each of the variables addressed in this research.

The basic information to young people, the older' persuasion, and special emphasis on the groups of men and women is presented as a work in which traffic administration should have to work from the perspective of the road safety improvement. Complementarily data as the residence of the subject should be mostly explored as they open new possibilities of segmentation from the point of view of intervention especially in the field of communication.

Acknowledgments

The authors wish to thank the Department of Roads and Infrastructures of the Council of Valencia for supporting the basic research. Also thanks to Mayte Duce for revisions of the text and to Andrea Serge and Renata Autukevičiūtė for technical assessment.

References

[1] F. Alonso, J. Sanmartín, C. Calatayud, C. Esteban, L. Montoro, B. Alamar, et al., "Formación y Educación Vial: Una visión a través de la población Española". Cuadernos de Reflexión Attitudes. Barcelona, 2003.

[2] F. Alonso, C. Esteban, C. Calatayud, et al., "Proyecto de investigación, desarrollo e innovación para el "diseño y desarrollo de un plan integral de eliminación y erradicación de puntos negros en las carreteras de la Diputación de Valencia". Final report. Valencia, 2011.

[3] E. De la Peña, "Seguridad y compatibilidad entre usuarios. Algunas reflexiones". Securitas Vialis, 2008, 1. pp. 17–26.

[4] F. Alonso, C. Esteban, C. Calatayud, "La Gestión de los Puntos Negros en el marco de los Sistemas de Gestión de la Seguridad de infraestructuras viarias". Etrasa-Springer. Madrid, 2012.

[5] F. Alonso, M. Alonso, C. Esteban, C. Calatayud, "Protocolo del estudio "Investigación, desarrollo e innovación para el diseño y desarrollo de un plan integral de eliminación y erradicación de puntos negros en las carreteras". Securitas Vialis, 2013, 14, pp. 5-25.

[6] F. Alonso, C. Esteban, C. Calatayud, "Conocimiento y opinión de los conductores de la medida de señalización de los puntos negros". Revista Carreteras, 2014, 195, pp. 66-76.

[7] J. Díaz, "Hacia unos límites de velocidad más consistentes". Securitas Vialis, 2008. 1, pp. 3–9.

[8] OECD, "Hazardous road locations: identification y countermeasures". OECD Road Research Group. Paris, 1976.

[9] B. Persaud, C. Lyon, T. Nguyen, "Empirical Bayes procedure for ranking sites for safety investigation by potential for improvement". Transportation Research Record, 1999, 1665, pp. 7-12.

[10] E. Hauer, J. Kononov, B. Allery, M. S. Griffith, "Screening the road network for sites with promise". Transportation Research Record, 2002, 1784, pp. 27-32.

[11] D. Vistisen, "Models and methods for hot spot safety work", PhD thesis, Denmark. Copenhaguen, 2002.

[12] J. C. Overgaard Madsen, "Skadesgradsbasered sortpletudpegning – fra crash pre- vention til loss reduction i de danske vejbestyrelsers sortpletarbejde". PhD afhandling. Trafikforskningsgrupen, Institut for samfundsudvikling og planlaeging. Aalborg Universitet, Aalborg, 2005.

[13] M. Sorensen, "Best Practice Guidelines on Black Spot Management and Safety Analysis of Road Networks. Institute of Transport Economics – Norwegian Centre for Transport Research. Oslo, 2007.

[14] Statens Vegvesen, "Road Safety Audits and Inspections". Oslo, 2006.

[15] R. Elvik, "State of the art approaches to road accident black spot management and safety analysis of road networks". (TOI report 883/2007). Oslo, 2007.

[16] SWEROAD, "Black Spot Manual". General Directorate of Highways. Ankara, 2001.

[17] Duarte, B. Corben, "Improvement to Black Spot Treatment Strategy. Accident Research Centre – Monash University. Victoria, 1998.

[18] G. J. S. Wilde, "Risk homeostasis theory and traffic accidents: propositions, deductions and discussions of dissension in recent reactions". Ergonomics, 1988, 31(4), pp. 441-468.

[19] L. Montoro, J. Diaz, "Plan Integral de Seguridad Vial 2008". Diputación de Valencia. Valencia, 2008.

[20] C. G. Hoyos, B. M. Zimolong, "Occupational Safety and Accident Prevention: Behavioral Strategies and Methods". Elsevier. North Holland, 1998.

[21] C. C. Wright, C. R. Abbess, D. F. Jarrett, "Estimating the regression-to-mean effect associated with road accident black spot treatment: towards a more realistic approach". Accident Analysis and Prevention, 1988, 20(3), 199-214.

[22] K. Geurts, G. Wets, "Black Spot Analysis Methods: Literature Review". Steunpunt Verkeersveiligheid bij Stijgende Mobiliteit. Diepenbeek, 2003.

[23] F. Alonso, C. Esteban, J. Sanmartin, S. A. Useche, "Consistency Between the Subjective Perception of Feeling Indisposed, the Decision to Drive and Driving Performance". Science Journal of Public Health, 2016, 4(6), pp. 482-488. doi: 10.11648/j.sjph.20160406.21

[24] S. G. Charlton, P. H. Baas "Fatigue, Work-Rest Cycles, and Psychomotor Performance of New Zealand Truck Drivers". New Zealand Journal of Psychology, 2001, 30(1), pp. 32-39.

[25] F. Alonso, C. Esteban, S. A. Useche & E. López de Cózar, "Prevalence of Physical and Mental Fatigue Symptoms on Spanish Drivers and Its Incidence on Driving Safety". Advances in Psychology and Neuroscience, 2016, 1(2), pp. 10-18. doi: 10.11648/j.apn.20160102.12

[26] E. Hauer, B. N. Persaud, "Problem of identifying hazardous locations using accident data". Journal of the Transportation Research Board. Transportation Research Record, 1984, 1114, pp. 113-140.

[27] Thomas, "Spatial data aggregation: exploratory analysis of road accidents". Accident Analysis and Prevention, 1996, 28, 251-264.

[28] F. Alonso, C. Esteban, S. A. Useche, V. Manso, "Analysis of the State and Development of Road Safety Education in Spanish Higher Education Institutions". Higher Education Research, 2016, 1(1), pp. 10-18. doi: 10.11648/j.her.20160101.12

[29] S. Nassar, F. Saccomanno, J. Shortreed, "Road accident analysis: A micro- level approach". Canadian Journal for Civil Engineers, 1994, 21 (5), pp. 847-855.

[30] S. A. Useche, A. Serge, F. Alonso, "Risky Behaviors and Stress Indicators between Novice and Experienced Drivers". American Journal of Applied Psychology, 2015, 3(1), pp. 11-14. doi: 10.12691/ajap-3-1-3.

[31] WHO, "Global status report on Road Safety: Time for Action". World Health Organization. Geneva 2009.

[32] WHO, "Global status report on road safety 2013: supporting a decade of action". World Health Organization. Geneva, 2014.