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Traffic safety in Cambodia: enforcement of drink-driving, helmet wearing and speeding

A summary review of Dutch and English literature

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Contents

1. Introduction

The Annual Report 2009 of the Cambodia Road Crash and Victim Information System (RCVIS) shows that the number of traffic fatalities in Cambodia has almost doubled in the last five years. In 2009 an estimated 1717 people were killed and 7000 severely injured.
At the same time the number of registered motorized vehicles has increased from 575,000 to 1,392,000 (142%).
According to the police registration, speed was the leading cause of 52 % of the fatalities while another 17% were caused by drink driving. Around 80% of the fatalities were motorbike riders (1218), ¾ of them suffering from head injuries. Surveys of helmet wearing in 2009 showed wearing rates of 65-85% among drivers and around 10% among passengers (Annual Report, 2009).

A strong program of traffic safety measures is required and foreseen to prevent a renewed doubling of these fatality figures in the coming years up to 2020. The National Road Safety Committee (NRSC) has proposed targets in the National Road Safety Action Plan, not only on the number of fatalities but also on safety performance indicators (helmet wearing, speeding and drink driving) aiming at 30% improved observance of the traffic rules. Important measures are about police enforcement and public information.
In order to realize these targets the NRSC wants to learn from the experiences with police enforcement abroad, notably in the Netherlands.
This document therefore presents a summary review of Dutch and English literature on the subject of police enforcement of traffic rules. Most information has been taken from several SWOV factsheets (SWOV 2007;2008a;2008b;2009a; 2009b) and the publications cited in these factsheets.
The safety effects of enforcement depend of the behavioural requirements that are imposed by the traffic laws. Therefore a short review of the relevant Cambodian traffic rules will be presented firstly.

2. Traffic rules

2.1. Drink driving

Article 9 section 10 of the Cambodian Traffic Law sets a limit for the blood alcohol concentration (BAC) of 0.5 g/l (or 0.5 mg/ml). This is according international standards. Most countries have set a limit of 0.5 mg/ml; sometimes (for example in the Netherlands) this is complemented by a lower limit for novice drivers of 0.2 mg/ml.

2.2 Wearing helmets

Article 9 section 4 imposes the obligation to wear a helmet on drivers of motorcycles, tricycles and motorcycles with trailers/ remorque. This is less strict than the international standard because the obligation is not imposed on passengers. On the other hand the rule is more strict than in some countries because no exception is made for drivers of slow speed motorcycles; for example in the Netherlands drivers and passengers of light mopeds (with a maximum speed of 25 km/hr) are not obliged to wear a helmet.
This means that apart from enforcement of the actual law also the introduction of an obligation for passengers to wear a helmet (eventually with exceptions for slow speed motorcycles) could improve safety.

2.3. Speeding

Here only the speed limits for (person)cars and motorcycles are discussed.
Article 17 sets the following limits:

In towns:	on motorways 60 km/hr
	on all other roads 30 km/hr for motorcycles and 40 km/hr for cars
Outside towns:	on motorways 100 km/hr
	on all other roads 90 km/hr

A comparison with international standards is not feasible. Safe limits should be related to the structure of the road network and the lay out of the roads. These vary a lot between countries. In the Appendix a Preliminary proposal is made for road categorization and general speed limits based on the principles of Sustainable safety. Compared with this proposal the most striking difference is the Cambodian general speed limit of 90 km/hr on all roads (except motorways) outside towns. The proposal sets limits of 50 or 70 km/hr on these roads, depending of the road lay out.
This means that apart from enforcement of the actual limits also the introduction of stricter speed limits on some categories of roads outside towns (preferably in combination with adaptation of the road lay out) could improve safety.

3. General effects of police enforcement

Police enforcement determines the probability of being caught. The roadside checks represent the objective probability, also known as the enforcement pressure. Using the enforcement pressure, what they read in the newspapers, and what they hear from friends and acquaintances, road users estimate the probability of themselves being caught committing an offence; this is known as the subjective probability. This estimated probability of being caught acts as a stimulus to avoid committing offences. Psychologists call this extrinsic motivation because behaviour is steered by external stimuli such as rewards or, in this case, punishment (SWOV, 2009b).

In general, the preventive effects of police enforcement are stronger with increasing subjective probability and certainty of punishment, and with punishment quickly following the offence (Goldenbeld, 2005). Each of these elements is a link in the chain of enforcement and - to continue this metaphor - the chain is no stronger than its weakest link. If for example, the subjective probability is small, the penalty, certainty of being punished, and time between punishment and offence will not make much difference in the preventive effect. The subjective probability can be increased by 1) publicity about the enforcement activities, 2) the checks being highly visible, 3) unpredictable sequence and locations of random checks, 4) selecting checks at times and places with a high probability of offenders being actually caught, and 5) making police checks difficult to avoid.

Every country has a certain basic level of regular police traffic enforcement, often expressed in the annual hours of traffic enforcement or an annual number of traffic police checks. A stable enforcement level is, in the long run, insufficient to further reduce the number of offences. Bjørnskau & Elvik (1992) point to the fact that the regular enforcement level must be increased with a factor of two, three, or even four in order to have effect on behaviour and thus road safety. Based on eleven international studies of speeding enforcement, Elvik (2001) assessed that an ever higher level of speeding enforcement leads to ever less extra safety benefit, expressed in prevented injury crashes. The 'law of diminishing returns' seems to apply here. This effect can partly be prevented by alternating periods of high enforcement levels in an inconspicious way by periods of lower levels.
Unfortunately the actual enforcement pressure in Cambodia is not known quantitatively. Therefore only the effects of a relative increase of the level of enforcement can be estimated.

4. Drink driving

4.1. Development of drink driving since 1973

The actual Dutch Road Traffic Act makes it an offence to drive a motorvehicle under such influence of alcohol and drugs that one must be considered unfit to drive. For alcohol the legal limit for the driver´s blood alcohol concentration (BAC) has been set at 0.5 g/l and for novice drivers at 0.2 g/l. The 0.5 g/l BAC limit has been introduced in 1974 accompanied by a large-scale publicity campaign; at the same time legal power was given to the police for random breath testing to detect offenders in traffic, in those days still with chemical breathalyser tubes. In court a blood test was required for conviction of offenders.

Since 1973 road side surveys during weekend nights have been performed in the Netherlands in order to monitor the development of drink driving. These surveys were executed first by SWOV and since 1999 by the research centre of the Ministry of Transport (AVV, later DVS). The main results over this whole period 1973-2007 have been summarized in figure 1 (SWOV, 2009a).
During the first period following the introduction of the 0.5 g/l limit the percentage of offenders in weekend nights decreased drastically. After a while, when it became clear that the probability of being detected was not as high as it was estimated initially, the number of offenders rose again. But the percentage remained lower than before the introduction of the BAC limit.
Some years later, in 1984, the police was equipped with electronic breath testing devices for detection of offenders in traffic; in 1987 the blood test was replaced by breath analysis for purposes of evidence in court. These legal and operational changes improved the efficiency of police enforcement and thus increased the level of enforcement. The percentage of offenders in weekend nights decreased considerably in the period between 1983 and 1991. In 1999 regional traffic enforcement teams were introduced, resulting in an increased level of enforcement. Drivers were informed about these changes by publicity campaigns. A specially designed public information campaign (the so called ´Bob´campaign, developed in Belgium) was launched in 2001. Lastly, the legal alcohol limit for novice drivers was lowered to 0.2 g/l in 2006. Since 1991 the percentage of offenders in weekend nights first showed a slight increase, then decreased gradually since 2000 and remained stable in recent years.

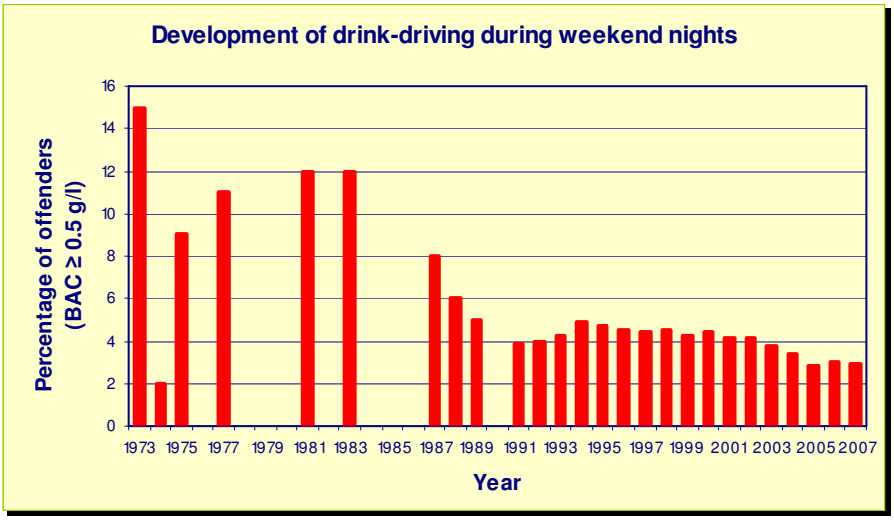

Figure 1. Development of drink driving during weekend nights, 1973-2007(sources: SWOV (through 1998); DVS (AVV) (starting in 1999).

4.2. Effectiveness of measures

Enforcement
Enforcing legal measures is a major factor in the duration of the effects as well as in their degree of success (Fell & Voas, 2004; Geary & Preusser, 2004). Various studies (e.g. Mathijssen, 2001; Erke et al., 2008) showed that enforcement is more effective when supported by publicity. Publicity about intensified enforcement results in a higher subjective probability of being caught and to a more rapid decrease in the number of offenders. The establishment of regional traffic enforcement teams in the Netherlands in 1999 resulted in an increase in the enforcement of drink driving. This was accompanied by a slight decrease in drink driving (AVV, 2003).

Public information and education
Campaigns are nearly always carried out in combination with other measures. This is why their direct effect on behaviour associated with drink driving cannot be proven. However,

campaigns can contribute to maintaining desired behaviour which has more or less been forced on people (Schults et al., 2004). Indications of this in the Netherlands were found particularly during the early 1990s. Despite a significant decrease in the enforcement of drink driving that resulted from a reorganisation of the police, driving under the influence increased very slightly at that time (Mathijssen, 1999).

Increasing penalties
In comparison with many other European countries, the penalties for alcohol-impaired driving in the Netherlands are relatively light. Research into the opinions, preferences and behaviour of Dutch motorists indicates that they are against drink driving and would like to see it punished more severely (SARTRE, 2004). However, whether increased penalties would lead to a substantial reduction in drink driving is doubtful. In any case, a considerable increase in the penalties issued in 1992 did not result in a decrease in drink driving in following years. It even increased slightly, probably partly because of a sharp drop in the enforcement level (Mathijssen, 1994). This indicates that the severity of penalties has less impact than the probability of detection.

5. Wearing helmets

5.1. Development of wearing rates since 1972

The Dutch Traffic Law defines three categories of motorized two-wheelers: motorcycles (cubic cylinder capacity over 50 cc), mopeds (up to 49 cc, maximum speed of 45 km/hr) and light mopeds (up to 49 cc, maximum speed of 25 km/hr). In 2007 about 800.000 mopeds and light mopeds were registered in the Netherlands and over 500.000 motorcycles.
Presently light moped riders are not obliged to wear a helmet; motorcyclists, moped riders and their passengers do have to wear a helmet. Newly bought helmets have to meet legal standards, layed down in international regulation ECE R22-05, in order to offer good protection. This regulation sets minimum requirements for shock absorbance, penetration resistance, stiffness, protruding parts, surface friction, chin strap and falling off (SWOV, 2007).

The obligation for *motorcyclists* was introduced in 1972. Before that date voluntary use was already increasing since the 1960´s. Nowadays virtually 100% of motorcyclists is wearing helmets. It is not known whether these helmets meet the international (ECE R22-05) requirements.
The same helmet requirements apply to *moped riders* and passengers who are obliged to wear a helmet since 1975. Initially this obligation was generally accepted. In 1984 about 100% wore a helmet but in 1996 this had dropped to 98,5 % for riders and 86% for passengers. This decline has continued since then; in 2002 the numbers were 90.6% for riders and 74% for passengers. Since 2001 the police has increased the enforcement of helmet wearing by moped riders and has commissioned road side surveys in order to monitor wearing rates. In 2004/2005 wearing increased to 93% and 85% respectively because of stricter police enforcement. After a slight decline in 2006 and 2007 the wearing rate for riders improved again to 96% (Henkens & Hijkoop, 2008). (table 1)

	2002	2004	2006	2007	2008
Wearing percentage					
Helmet wearing riders	91%	93%	91%	92%	96%
Manner of wearing					
Chin strap shut (riders)	86%	89%	88%	87%	90%
No slack chin strap (riders)	51%	74%	74%	73%	60%
Helmet fits forehead (riders)	91%	91%	89%	89%	87%
Helmet quality					
Approval label present	86%	89%	89%	93%	93%
No change in helmet surface	79%	87%	89%	88%	88%
No damage to helmet surface	49%	64%	62%	54%	53%
No mechanical contact (crash/dropped)	81%	81%	72%	56%	59%

Table 1. *Use of moped helmet, manner of wearing and helmet quality (Henkens & Hijkoop, 2008, commissioned by the BVOM).*

5.2. Effectiveness of measures

There are several indications that increased police enforcement has stopped the decline in helmet use from 2000 onwards. Firstly it is indicated by the development of wearing rates in table 1. This enforcement was supported by public information on the benefit of helmets and on the intensified enforcement. Secondly additional evidence is provided by the experiences with enforcement of seatbelt wearing. During the 1995-2002 period enforcement of seatbelt wearing was intensified in a number of police regions in the Netherlands. An evaluation study has estimated that this did result in an increase by 23% of seatbelt use in these regions (Mathijssen & De Craen, 2004).
The effectiveness of protection in a crash depends not only of wearing a helmet but also of the manner of wearing and of the helmet quality (SWOV, 2009b).
When a helmet is worn without a fastened chin strap, the effectiveness of protection in a crash is limited. Therefore it is important to keep the chin strap well fastened, allowing no slack. In 2005 , 90% of moped riders in the Netherlands had their chin strap fastened, 70 % of which had no slack. These percentages were improved since 2001-2002 thanks to intensified enforcement.
The helmet quality varies a lot over the years. The most important requirement (to pass the type approval test at the introduction on the market, proven by the approval label) is being met by a vast majority of the helmets, increasing the last years to 93% (table 1).

6. Speeding

6.1. Instruments for speed management

Apart from (credible) speed limits, driving speeds can be managed with the following instruments (SWOV, 2008b):
- good information about the local speed limit
- infrastructural measures
- police surveillance and enforcement
- education and information
- intelligent speed assistance (ISA)

In practice the speed limit is not always clear at any place and any time. Information about the local limit is often indicated by a road sign. However, general limits are not communicated by road signs. The road user is supposed to know them and this knowledge can be advanced by education and training. In addition it is possible to consistently use road markings as well to indicate the applicable general limit.

Next, the road design and the infrastructure must support the speed limit. At places where a low speed is very important, e.g. in the vicinity of schools, pedestrian crossings and cyclists crossings, but also at intersections, physical speed limiters can be used. In the Netherlands this has resulted in a considerable increase in the number of urban 30 km/h zones and the introduction of rural 60 km/h zones where motorized traffic is mixed with non-motorized traffic. On urban access roads speed humps, raised junctions and roundabouts are constructed to reduce speeds. Raised junctions are also being used in rural areas, in 60 km/h zones and on 80 km/h roads. Evaluation studies of all these infrastructural measures have shown large reductions of injury crashes (20 –70 %) (Beenker et al., 2004; Dijkstra, 2005; Fortuijn et al., 2005).

Even when motorists are aware of the local speed limit, a group will always remain that regularly exceeds the limit deliberately. Police surveillance and control remains of the utmost importance to reach this group. The less infrastructural speed limiters are constructed the more police surveillance will be needed. Various methods of speed enforcement will be discussed below.

Education and information (training at schools, driver training, rehabilitation courses for convicted offenders, public campaigns) are a support and a prerequisite for each of the measures discussed above. Road users must understand that speeding is a serious problem; they must understand why measures are taken; and they must understand how the speed limit system works. Important is to realize that education and information as stand alone measures have very little direct effect on speed behaviour. An international study has shown that especially the combination of public campaigns with enforcement is effective (Delhomme et al., 1999).

Intelligent Speed Assistance (ISA) is a collective term for various systems (SWOV, 2010). In all cases the vehicle receives information from the surroundings about the desirable or mandatory speed limit and reacts to it. The reaction can be a warning to the driver who has to decide himself whether or not to slow down. Others systems react by exercising counter pressure on the accelarator pedal or even by limiting the speed automatically. All these systems are technically available. Mainly legal and political considerations are delaying the application of the more intervening systems that constrain the free choice of the driver.

6.2 Effectiveness of speed enforcement

Police enforcement determines the probability of being caught. But enforcement alone it is not sufficient to increase the subjective probability of being caught and also the preventive effect depends on more elements than only the subjective probability of being caught.

Prevention of speeding can be improved by increasing the (subjective) probability of being caught, the probability of being punished, the severity of the punishment and the rapidity of the punishment. Each of these elements is a necessary link in the chain of prevention and one weak link (e.g. a low probability of being caught) cannnot be compensated by strengthening another link (e.g. by more severe punishment) (SWOV, 2008a).
In the Netherlands a reform of penal law in 1992 has changed the settlement of frequent, small violations of traffic law, e.g. exceeding a speed limit by less than 30 km/h. Now these cases are settled in a overwhelming majority out of court. The burden of proof of innocence was put with the holder of the registration number of a motorvehicle and the power to fine offenders was granted to an administrative body in stead of a criminal court. This reform made the settlement of these offences a lot quicker, more efficient and more complete, with less work for the police and the courts. As a consequence it became feasible to control speeding on a large scale with camera´s (proof being based on pictures of number plates) and thus to increase the objective probability of being caught.

The subjective probability of being caught depends on the objective probability and on what drivers see alongside the road, on what they perceive through newspapers, tv, internet and on what they hear from friends or relatives. To increase the subjective chance it is important that

controls are accompanied by the necessary publicity, take place regularly, are unpredictable, clearly visible and difficult to avoid. During the 1999-2003 period, more intensive enforcement projects were started by the police all over the Netherlands which increased the number of speed controls. By accompanying information and communication the subjective chances of being caught increased as well as the public support for rules and limits (SWOV, 2008a).

Four main speed suveillance methods are used in the Netherlands:
- “fixed camera´s”: automatic speed controls at permanent locations with fixed speed camera´s
- “changing locations”: speed controls at varying locations using radar cars, laser guns, or hidden camera´s, with or without stopping offenders
- “mobile surveillance”: mobile surveillance and stopping speed offenders
- “section controls”: speed controls along a particular road section in which the average speed of all passing vehicles is determined.

Different studies have been made of the effectiveness of the various methods, looking at the effects on speeding and on crashes.
In Great Britain large effects of fixed camera´s and on changing locations have been found on speeding and injury crashes (Gains et al., 2005). Dutch studies however found only effects on speeds on specific roads but not on crashes in a larger region (Mathijssen& De Craen, 2004). More positive results were found in the Netherlands of controls by radar cars (changing locations) on many particular dangerous road sections in a larger region. The number of offenders decreased as well as the injury crashes on those roads (Goldenbeld et al., 2004). From literature studies it follows that mobile surveillance has little effect on the driving speed of the average road user because very few offenders can be caught and the moving car is only noticed by the surrounding drivers.
Section control is fully automated now and results in practically none offenders on the controled sections. Because of the great length of these sections, the behavioural effects of these controls will be more sustainable than spot checks (Goldenbeld, 2005).

7. Conclusions and recommendations

Police enforcement is an effective instrument to reduce drink-driving and speeding and to increase helmet wearing. To reach a significant change in behaviour the number of controlled drivers should be doubled or tripled compared with the actual level of enforcement in Cambodia.

To continue the behavioural adaptations following from the intensified enforcement, the enforcement should be kept at this level permanently. For further behavioural changes, the controls should be increased again.

Controls should be accompanied by public information on the enforcement activities and the reasons for the rules. Publicity about intensified enforcement results in a higher subjective probability of being caught and to a more rapid decrease in the number of offenders.

Controls should take place regularly, unpredictable and clearly visible. It must be difficult for drivers to avoid the controls. All drivers passing the control unit, or a random sample of them, should be controled.

Speeding on a road network can best be controled by a mixture of fixed camera´s and patrol cars with camera´s on changing locations.

Effective enforcement should be facilitated by simple procedures for collecting legal evidence and settling cases:
- drink driving can best be controled by random breath testing at road sides so the police should have power to require a breath test from every driver, without a reason for suspicion.
- also it should be possible to provide evidence of drink driving in court with (high quality) breath tests of suspected drivers.
- speeding can best be controled if pictures of number plates are accepted as evidence of the holders´guilt.
- mass offences can best be settled initially out of courts with a possibility to appeal in court.

Some common ideas about enforcement should be left behind:
- a low level of enforcement can not be compensated by more severe punishments
- one should not try to fine as many offenders as possible by hidden controls; the ultimate goal should be that everybody is keeping to the rules and thus nobody can be fined
- driving behaviour can not be changed by public information alone
- moving patrol cars and stopping offenders is not effective to reduce speeding.

And last one could consider to introduce some changes of the actual Cambodian Traffic law:
- an obligation for passengers of motorcycles to wear a helmet
- stricter speed limits on some categories of roads outside towns (preferably in combination with adaptation of the road lay out).

References

Annual report 2009 (2010). Cambodia Road Crash and Victim Information System RCVIS. Handicap International Belgium, Phnom Penh.

AVV (2003). Rijden onder invloed in Nederland, onderzoek 2002: Ontwikkeling van het alcoholgebruik van automobilisten in weekeindnachten. Adviesdienst Verkeer en Vervoor AVV, Heerlen.

Beenker, N., Mook, H. van, Dijkstra, A. & Ruijter, M. de (2004). Watrschap gaat door met 60 km-gebieden: eerste evaluatiegegevens 60 km-maatregel tonen significant verkeersveiligheidseffect. Verkeerskunde, vol. 55, nr. 2, 26-31.

Bjørnskau, T. & Elvik, R. (1992). Can road traffic law enforcement permanently reduce the number of accidents? In: Accident Analysis and Prevention, vol. 24, p.507-520.

Delhomme, P., Vaa, T., Meyer, T., Goldenbeld, C., Jarmark, S., Christie, N. Harland, G. & Vlasta, R. (1999). Evaluated road safety campaigns: an overview of 265 campaigns and some meta-analysis on accidents. In; Guiding Automobilists Through Technology & Education. EC- DG VII. Deliverable 4. Contract R0-97-SC 2235. European Commission, Brussels.

Dijkstra, A. (2005). Are roundabouts with separate cycle tracks also safe for cyclists ? (In Dutch). R-2004-14. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam

Erke, A., Goldenbeld, C. & Vaa, T.(2008). Good practice in the selected key areas: speeding, drink driving and seat belt wearing: Results from meta-analysis. Deliverable 9 of the European Research Programme PEPPER. European Commission, Brussels.

Elvik, R. (2001). Cost-benefit analysis of police enforcement. The ESCAPE project. Working Paper 1, Technical Research Centre of Finland VTT, Espoo.

Fell, J.C. & Voas, R.B. (2004). The effectiveness of reducing illegal BAC limits for driving: Evidence for lowering the limit to .05 BAC in Canada. In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

Fortuijn, L.G.H., Carton, P.J. & Feddes, B.J. (2005). Veiligheidseffect van kruispuntplateaus in gebiedsontsluitingswegen. In: Verkeerskundige Werkdagen 2005, 1 en 2 juni 2005. CROW kenniscentrum voor verkeer, vervoer en infrastructuur, Ede.

Gains, A., Nordstrom, M., Heydecker, B., Shrewsbury, J., Mountain, L. & Maher, M. (2005). The national safety camera programme: Four year evaluation report. PA Consulting Group, London.

Geary, L.L. & Preusser, D.F. (2004). Suspended drivers. In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

Goldenbeld, C., Bijleveld, F., Craen, S. de & Bos, N.M. (2004). Effectiviteit van snelheidstoezicht en bijbehorende publiciteit in Fryslân: Effecten op sneleheidsovertredingen en ongevallen op 80 en 100 km/uur-wegen in de periode 1998-2002. R-2003-27. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Goldenbeld, C. (2005). Verkeershandhaving in Nederland: Inventarisatie van kennis en kennisbehoeften. R-2004-15. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Henkens, N.C. & Hijkoop, S. (2008). Monitoring Bromfietshelmen 2008. In opdracht van Bureau Verkeershandhaving Openbaar Ministerie. Grontmij Verkeer en Infrastructuur, De Bilt.

Mathijssen, M.P.M. (1994). Rijden onder invloed in Nederland, 1992-1993. Ontwikkeling van het alcoholgebruik van automobilisten in weekeindnachten. R-94-21. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Mathijssen, M.P.M. (1999). Drug-, medicijn- en alcoholgebruik van automobilisten in Nederland, 1997/1998. R-99-11. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Mathijssen, M.P.M. (2001). Rijden onder invloed en het politietoezicht daarop. R-2001-8. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Mathijssen, M.P.M. & Craen, S. de (2004). Evaluatie van de regionale verkeershandhavingsplannen: Effecten van geïntensiveerd politietoezicht op verkeersgedrag en verkeersonveiligheid. R-2004-4. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

SARTRE (2004). European drivers in road risk: Project on Social Attitudes to Road Traffic Risk in Europe SARTRE 3, part 1: Report on principal results. Institut National de Recherche sur les Transport et leur Sécurité INRETS, Arcueil.

Schults, R.A., Elder, R.W., Sleet, D.A., Nichols, J.L. & Thompson, R.S. (2004). Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-related crashes. In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

SWOV (2007). Motorcycle and moped helmets. SWOV Factsheet, August 2007. SWOV Institute for Road Safety Research, Leidschendam.

SWOV (2008a). Police enforcement and driving speed. SWOV Factsheet, June 2008. SWOV Institute for Road Safety Research, Leidschendam.

SWOV (2008b). Measures for speed management. SWOV Factsheet, December 2008. SWOV Institute for Road Safety Research, Leidschendam.

SWOV (2009a). Driving under the influence of alcohol. SWOV Factsheet, July 2009. SWOV Institute for Road Safety Research, Leidschendam.

SWOV (2009b). Effects of police enforcement of safety devices, of moped helmet use, and of red light running. SWOV Factsheet, April 2009. SWOV Institute for Road Safety Research, Leidschendam.

SWOV (2010). Intelligent speed assistance. SWOV Factsheet, February 2010. SWOV Institute for Road Safety Research, Leidschendam.

Appendix: Preliminary proposal of road categorization and general speed limits (km/hr)

Speed limits for motorcycles and cars

- Access roads, residential areas:
  - Within built –up areas:
    - along the road: mix of motorized and non-motorized traffic, max 30
    - crossings: roundabout, raised junction, max 30
  - Outside built-up areas
    - along the road: mix of motorized and non-motorized traffic, max 50
    - crossings: roundabout, raised junction, max 30

- Distributor roads
  - Within built –up areas:
    - along the road: separation of motorized and non-motorized traffic, max 50
    - crossing: roundabout, raised junction, traffic lights, max 30
  - Outside built-up areas
    - along the road: separation of motorized and non-motorized traffic, max 70
    - crossings: roundabout, raised junction, traffic lights, max 50

- Through roads
  - Within built-up areas:
    - along the road: separation of high speed and other traffic, max 70
    - crossing: roundabout, traffic light, split-level, max 70
  - Outside built-up areas:
    - along the road: separation of high speed and other traffic, physical separation of opposite driving direction , max 100
    - crossing: split-level, traffic light, roundabout, at grade crossing max 50