

MOTOR-VEHICLE LIGHTING DURING DAYTIME

A report of the International Steering Committee on the justification of new experiments in European countries. Review and evaluation of existing evidence on the effectiveness of motor-vehicle lighting during daytime.

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FOREWORD

The Dutch initiative to make the use of low-beam headlights during daytime obligatory in November 1990 has caused a lot of interest internationally. At several meetings of the CEMT, EC and ECE commissions dealing with traffic safety issues, the subject has been discussed. At the same time, Denmark decided to introduce a "DRL"-regulation. The general conclusion is that the introduction of motor-vehicle lighting during daytime in Denmark and the Netherlands is of great interest to other European countries and can be considered a test case for Europe. Therefore, as part of European harmonisation, an International Steering Committee has been set up to guide new experiments on motor-vehicle lighting during daytime in Europe. The Directorate-General of Transport of the European Community in Brussels has provided financial support to install this Committee and also provide meeting facilities in Brussels.

In August 1990, SWOV Institute of Road Safety Research invited other European research institutes on road safety or scientific representatives from European countries (Austria, Belgium, Denmark, Germany, Italy, the Netherlands, the Nordic countries, Spain and the United Kingdom) to join an International Steering Committee on motor-vehicle lighting during daytime. Researchers from the United States of America, Canada and Australia have been asked to act as corresponding member or consultant and the European Cyclists' Federation has been asked to act as observer. A full list of participants is given as Appendix I. The Secretariat of the Committee is carried out by SWOV.

The first meeting was held on October 10th, 1990, in Brussels. As part of the Terms of Reference (see Appendix II), the first task of the Committee was to review and evaluate existing evidence on the effectiveness of DRL and to review and evaluate the design and results of new research on DRL, especially in the Netherlands, Denmark, Canada and Austria.

After giving a short review of the problems related to motor-vehicle lighting during daytime, this report describes the considerations of the members of the Committee on the above mentioned tasks, followed by the overall conclusion of the Committee.

This report is drafted by ms. J.E. Lindeijer (SWOV, Netherlands).

1. INTRODUCTION

1.1. Visual perception problems

Incorrect seeing and incorrect selection of information by road users in traffic has been shown to be a causal factor in road accidents (Nagayama, 1978; Otte, 1982). In other words, incorrect visual perception can be fatal in traffic. Therefore, decision makers in the field of traffic safety are constantly searching for new countermeasures in order to facilitate the visual search task of road users. For instance, to decrease the involvement of cyclists in traffic accidents, countermeasures to increase visibility of cyclists in the Netherlands and in Belgium, such as rear reflectors, reflectors on pedals, retroreflecting material in wheels etc, have become mandatory; the same aids to visibility have been recommended in Denmark. In most West European countries, motorcyclists are obliged to use their headlight during daytime; in the other countries, use is recommended.

1.2. A brief summary of the legally recognised practice of motor-vehicle lighting during daytime

In this report, motor-vehicle lighting during daytime will be referred to as DRL. DRL stands for: daytime running lights, with reference to the following equipment (in accordance with the GRE draft for amendment of ECE Regulation 48;

- main-beam headlamps (reduced in intensity);
- dipped-beam headlamps;
- front fog lamps and/or daytime running lamps.

From 1970 until 1972 the use of DRL was recommended in Finland during the winter period outside built-up areas and was evaluated afterwards. After 1972, DRL was made obligatory during winter as well as summer.

Based on the results of the evaluation study in Finland, use of DRL was made obligatory in Sweden in 1976 on a nation-wide scale. In the beginning of the eighties, DRL was adopted in Norway, too. An evaluation study was carried out, both in Sweden and in Norway.

In October 1990, the DRL-regulation was adopted in Denmark.

In Canada, new vehicles sold after the first of December 1989 are required by the Minister of Transport to be fitted with an automatic on/off light switching system.

In most countries of the world, drivers are either obliged or advised to use low-beam headlights or in some instances special daytime running lamps in bad weather conditions during daytime.

Even at a latitude of 26°, the use of DRL is recommended on some highways in Florida (United States).

In November 1989, a nation-wide campaign was carried out in Israel to advise motorised traffic to use low-beam headlights during the winter period outside built-up areas.

1.3. Skepticism with regard to the positive benefits of a DRL-regulation in Europe

Nevertheless, DRL is widely disputed as a promising countermeasure to increase visibility of motorised traffic for a number of reasons. First, the available statistical evidence, so far, is inconclusive. Second, there is still no conclusive theoretical explanation for the working of DRL. And thus, the use of headlights on a bright sunny day may provoke ambivalent feelings. Therefore, even although most people will accept on a rational basis that DRL might contribute to traffic safety, some emotionally based resistance can be expected.

The fact that a complete theoretical explanation for the working of DRL cannot be given at present, a number of questions still need to be addressed:

- The unknown risks of non-DRL users among a majority of DRL-users.
- The degree to which benefits of a regulation in one country can be transferred to other countries.
- The need for more proof concerning the road safety of unprotected road users.
- The need to specify the influence on road safety for motorcyclists when all motor-vehicles use DRL.
- The influence of heterogeneous light systems in Europe, the development of various types and the growing intensities of low-beam headlights on the DRL-sensitivity of certain types of collisions.
- The relationship between costs (environmental and economical) and benefits in terms of a reduction in traffic accidents is not known.

2. INTERNATIONAL STEERING COMMITTEE (ISC)

2.1. General

In meetings of the CEMT, the Minister of Transport of the Netherlands brought the DRL-regulation under discussion. The Minister argued that the easiest way to introduce the DRL-regulation on a nationwide scale would be to introduce it as a technical rule. For instance, through a structural vehicle requirement. This would prevent enforcement problems as well as technical problems such as empty batteries.

On the other hand, the Minister was convinced that there was no reason to postpone the introduction until international agreement had been reached on the subject. Therefore, the Minister announced the introduction of DRL as a law in November 1990. At the same time, Denmark decided to introduce their DRL-regulation.

Although the member countries of the European Community were interested, they decided that more objective and convincing evidence was needed before a decision could be made as part of the European harmonisation. They agreed upon the introduction of DRL as a national rule of conduct in a member country. Such an experiment would offer an opportunity to evaluate the effectiveness according to a scientifically acceptable method.

To this end, an International Steering Committee was set up in the autumn of 1990 to follow and guide the progress of the evaluation studies in the Netherlands.

Financial support towards the realisation of this Committee has been provided by the Directorate-General of Transport of the European Community in Brussels. The first meeting of the Committee was held on October 10th, 1990, in Brussels.

2.2. The postponed Dutch experiment

Since January 1990, criticism increased in the Netherlands with regard to the design and execution of available studies and the uncertainties about possible negative influences on safety for unprotected road users and for drivers not complying with DRL. This criticism has caused the Dutch Minister of Transport to postpone the planned introduction of DRL in 1990. The Minister has informed Parliament of the intended studies before renewing discussion on the subject. The objective is as follows:

- To obtain an objective assessment of the current evidence on the effectiveness of DRL by the ISC.
- To study the possibilities of a large-scale experiment in a part of the Netherlands.

Denmark did not meet such a strong opposition and implemented the DRL-regulation on October 1st, 1990.

2.3. Questions

In accordance with the first task of the Committee (see Terms of Reference, Appendix II) and at the request of the Dutch Minister of Transport, the Committee has been asked to answer the following questions:

- Is it justifiable to start a new experiment on DRL in the Netherlands on the basis of existing evidence, bearing in mind the sort of criticism which has been voiced up till now?
- If the Committee concludes that a new experiment is justified, does the Dutch design of a study into the effect of DRL on accident rates reach a scientifically acceptable level?

3. INDIVIDUAL ANSWERS TO THE POSED QUESTIONS

A summary (in alphabetical order) is given of the received individual considerations of members of the ISC (based on written and verbal information).

- Austria, Mr. Mehl:

Since 1986, Austria has been very interested in further experiments on the accident-reducing effect of DRL. Based on well-known international literature, the "Kuratorium für Verkehrssicherheit KfV" in Austria has tried to increase public acceptance through fleet-studies and campaigns. Until now it has been impossible to put into practice a large-scale-experiment in Austria, comparable with the Dutch planned experiment. The institute is convinced that DRL can contribute to traffic safety, but the actual accident-reducing effect should be proven in a more scientifically accepted manner. For instance, more objective knowledge is needed on the accident risks of non-DRL-users and unprotected road users (e.g. pedestrians), as well as the background mechanisms of social and psychological public resistance. The institute is convinced that this can be executed as suggested by the Dutch masterplan.

However, its own study (Mehl, 1990) led the institute to question the reliability of police record accident data as well as the damage-only-accident data mentioned in the Dutch stationary analysis model. Austrian accident data shows that damage-only-accidents of special user groups (e.g. the Austrian Post Office fleet study) are not comparable to the general accident data. Besides, to achieve widespread public acceptance, it will be necessary to define technical standards of DRL at the very beginning of new experiments.

Results from new experiments, evaluated on the basis of a scientifically acceptable method (the Dutch masterplan meets this aim), could influence political opinion in Austria. Therefore, new experiments are not only justified but also necessary as part of the European harmonisation. Compulsory use of low-beam headlights for motorcycles and mopeds was established in Austria in 1977.

In fact one important aim was fulfilled successfully: the rate of drivers using low-beam headlights during rain, fog, snow or twilight has increased a lot, this had not been possible without the discussion about DRL.

- Belgium, Mr. De Brabander:

There are indications that better conspicuity of motor-vehicles during daytime will have an overall positive safety effect. Although this is possible at no extra cost by avoiding unsuitable colours for motor-vehicles, several years will be necessary to set up regulations relating to minimum paint reflectance. In the short term, the only possibility is to use the low-beam headlights.

Nevertheless, expert opinion in Belgium is divergent on this question. A more accurate assessment is necessary in order to establish more exactly the benefits of motor-vehicle lighting during daytime. Among other things, more objective information is needed on the DRL-sensitivity of various types of collisions, according to the diversity of light systems already in use (different characteristics of the lamps). Also, more information is needed on the social and psychological acceptance of such a measure. To answer these questions, an experimental design according to a scientifically acceptable method is needed. SWOV's masterplan offers an excellent basis for discussion of the method to be followed.

Although the introduction of the DRL-regulation in Denmark on October 1st 1990 has been well prepared, the data on the use of motor-vehicle lighting during the summer of 1990 indicate a relatively high frequency of use before the introduction. This obviously represents a weakness in the evaluation study in Denmark. Therefore, a new experiment besides the Danish experiment is advisable. The Belgian Administration of Transport already proposed such an experiment to the Benelux countries in December 1990. To enable such an experiment in the short term, it is advisable to use dipped-beam headlamps. The political objective is:

- to increase visibility of dark vehicles;
- to introduce optimum real DRL on a European level.

- Denmark, Mr. Christensen:

This summary is based partly on written and partly on verbal information. From a methodological point of view, the Danish evaluation study will meet a lot of problems, such as:

- DRL was proposed in Parliament as one among several safety measures.

Therefore, to prove the benefit of this single measure may be difficult.

- Use of DRL was measured in April through October 1990 according to the measurement programme described in the Dutch masterplan (Lindeijer, 1989). The results show a very high and increasing percentage. This demonstrates

the difficulties in obtaining reliable estimates for the use of DRL in the period before introduction; this will therefore weaken the interpretation of results of the before and after study.

- The expected number of available accidents is quite low. Therefore, it is expected that an analysis on special effects (suggested in the Dutch design) cannot be carried out in Denmark.
- For the same reason, providing more precise data on DRL-sensitivity towards specific types of collisions remain uncertain.
- The analysis according to the proposed 'static-model' in the Dutch design cannot be carried out in Denmark. Unlike the Dutch police departments, the Danish police has not recorded the use of DRL of vehicles involved in accidents in the preceding period. It is no longer possible at this stage, as since October 1990 the use of DRL is almost 100% already. This means that results of the Danish experiment cannot provide evidence, if indeed present, concerning accident risks of non-DRL-users.
- In March 1990, a nation-wide campaign was successfully carried out in Denmark, emphasising the use of bicycle helmets, particularly for children. Sales figures of helmets for children as well as for grown-ups are very promising. This could perhaps also influence the evaluation study on DRL.

Considerations on the proposed Dutch experiment and answers to the questions of the ISC:

- In consideration of the above mentioned problems in evaluating DRL-effects on the basis of the Danish experience it is desirable from a scientific point of view to conduct a complementary experiment. It is a requirement, of course, that such an experiment overcomes the problems specific to the Danish situation. Taken together, the results and interpretations from both experience and experiment will provide important guidance for a possible European harmonisation.
- The principle of the proposed Dutch experiment (an experiment based on voluntary but different usage of DRL in different areas) has been discussed in Denmark on previous occasions, but has never gained political acceptance: if researchers are convinced of an overall positive effect, such an experiment has an ethical problem: why should some citizens in the country enjoy the benefits of this measure and others not?
- Besides, an experiment based on voluntary use of DRL will create many other problems, such as:

- Compliance under these conditions will never be 100%, and the results are therefore unable to provide the full answer to the question about the effect of DRL.
- The non-users may include a disproportionate share of high risk drivers, e.g. drivers who also have less regard for other safe driving habits, such as speed limit compliance.
- Extra efforts (campaigns, publicity and research) are necessary to stabilise and monitor DRL-use at a high level in the test area during the entire experimental period.
- Local campaigns to promote DRL use in control areas might influence the experiment and may even officially be considered undesirable! To keep such a development under control also increases research costs.

Therefore, to answer questions still open on this subject and to minimise later critique on the results from the international research community, it is very advisable that any new experiment be conducted on the basis of compulsory DRL-use.

- European Cyclists' Federation, Mr. Godefrooij:

The Federation is not in favour of new experiments on DRL. Apart from their doubts about the safety effects of DRL, they fear a further marginalising of cyclists. After the implementation of DRL, drivers will probably pay less attention to cyclists as other cars will attract more attention. Any positive effect of DRL for cyclists and pedestrians can only be explained by assuming that cyclists and pedestrians more frequently will give way to motorised traffic. This change in behaviour can be explained by the fact that DRL makes cyclists feel more unsafe and will cause delay in bicycle trips and make the use of bicycles less attractive. Furthermore, this behavioural change will affect the behaviour of motorists: they will be less motivated to pay attention to cyclists and pedestrians. This problem is still not taken into account seriously. For any new experiment, this should be the major condition.

At this moment the Federation does not see any need for further experiments. Recently, Denmark implemented DRL, this provides a good opportunity for further research on the subject.

In this study the Federation asks for special attention for the position of cyclists. As stated before, they fear that the use of DRL will change the behaviour of motorists towards cyclists. Therefore, in addition to research relating to the reduction of accidents, they require an answer to the following questions:

- Does the implementation of DRL influence the 'perception priorities' of road users in general and of car drivers specifically? And if so, to what extent?
- Does the implementation of DRL have an effect on the actual speed of motorists?

DRL offers a solution to a problem. But the problem itself is rarely discussed. It would be good to do some research into the problem itself:

- To what extent is inappropriate perception a principal cause of accidents during daytime?
 - What are the causes of this inappropriate perception? (Aspects of perception are: visibility, conspicuity, recognisability and detectability).
- They have pointed out that positive effects of DRL may only be a novelty effect. It is plausible that the negative effects they fear are only then in the long term. Any research project on this subject should therefore span a period of several years in order to be conclusive.

- France, Mr. Petica:

From the psycho-ergonomic point of view, it is known that stimuli are sooner noted in the absence of uniformity if all vehicles use lights (assuming that this practice is universally followed), there will no longer be any distinction between vehicles except in relation to the environment. But under normal conditions (reasonable visibility, good weather, full daylight), people perceive particularly the 'movement' (in relation to a static environment) and 'volume' (on a road with no fixed obstructions and in the normal line of vision).

Added to this, if the average reduction in accidents has already been assessed as only 5%, the interpretation of the results is a very delicate matter with respect to the analysis of the true cause.

The evaluation of the proposed Dutch experiment in the northern part of The Netherlands on a voluntary basis will meet a lot of problems with interpretation of the results.

The strategy of the Dutch method is generally correct and specific to a certain type of approach to accident studies. But, if the probability factor remains scientifically operative as described, it is questionable whether this is really the appropriate method if one wishes to be certain of a genuine reduction in accident rates and to what degree.

One would certainly expect a reduction in accidents in the experimental

area, but the potential impact of increased vigilance on the part of users as a result of the bias of preparation and sensitisation through the mass media has not been taken into account.

If rear-collisions are likely to increase, this implies a greater number of accidents in situations which are normally safer (motorways) and one might wonder about the advisability and responsibility of diversions. Furthermore, the design does not specify the duration of future experiments.

Among other things, the design does not take into account behaviour in the medium and long term with regard to:

- habituation;
- lack of interest in the case of an experiment conducted on a voluntary basis;
- an increase in speed in practice;
- a decrease in psychological alertness (vigilance) due to the feeling that risk is diminished.

According to the theory of risk compensation mechanisms, the duration of an experiment should be at least two years, using unique instruments. It must be ascertained that other variables have not changed in relation to the period involved, for example:

- media campaigns;
- improvement of vehicles;
- new regulations;
- changes in the collective perception of risk;
- infrastructural changes;
- improved driving.

Taking into account the fact that several experiments have already taken place and that no scientific consensus has yet been reached, additional experiments could be effectively justified if they were to supply more precise data and provide answers to questions about a possible novelty effect (depending on the duration of the experiment) and the relationship between the possible benefits and the costs (cost of research, the actors implicated, energy consumption, potential additional accidents, technical problems, psycho-social acceptance).

On the other hand, there are various ways to increase the visibility of road users, of which DRL is only one possibility. Therefore, an investiga

tion into 'colour' and 'colour contrast' would be preferable when one considers the uncertainties of possible positive and/or possible side effects of DRL.

However, if the overall conclusion of the International Steering Committee concludes that, given all the considerations, a new experiment is justified, INRETS is interested and willing to cooperate in following and guiding the investigation.

- Germany, Mr. Klöckner:

On the basis of the available literature concerning evaluation studies in countries outside Germany, there are indications of a positive safety effect of DRL. However, it is uncertain whether these results can be expected in Western, Central and Southern parts of Europe as well. Besides, the literature does not give a clear account of whether negative effects can be expected for special groups of road users like motorcyclists (compulsory use of low-beam headlight during daytime since October 1st, 1988). Therefore, the results of such an experiment can contribute an answer to the many questions still open taking into account that:

- there is a possibility of starting a new experiment in a European country more comparable to the European countries;
- the experiment will be carried out by a scientifically acceptable method;
- the guidance of the ISC will follow an unprejudiced method.

Based on above mentioned conditions a new experiment can be justified. The proposed method described in the Dutch design is an acceptable basis for discussion of the method to be followed. Based on wider knowledge, an expert opinion can then be drafted for the German Minister of Transport which - depending on the results available - may be positive or negative.

- Italy, Mr. Mengoly:

(Based on a translation of the considerations written in Italian):

- In general: even if there are serious indications that a new measure could have a positive benefit on traffic safety it is still necessary to prove that this is so. Every action which could improve road safety is not only worthwhile, but in fact necessary, firstly to save lives and secondly to spare our society high costs.

During the experiment it is advisable to recommend the use of low-beam headlights as well as rear lights.

- It would be interesting to conduct the experiment in countries with daylight conditions and environmental contrasts which differ from those of the Nordic countries.
- The experiments should be conducted on busy roads with high accident rates, as well as on quiet roads which nevertheless have a high level of serious accidents.
- It would be useful to come to an arrangement with the police that members of the DRL working group should collaborate in initial investigations of serious and DRL-significant vehicle collisions, which are likely to be attributable to the fact that the vehicles were not sufficiently visible.
- Experiments aimed at establishing the contribution to road safety of good lighting on roads and motorways would also be appropriate in this context.
- It is recommended that a cost-benefit analysis should be carried out with regard to the increase in fuel consumption as well as the cost of electrical systems and equipment to overcome battery problems.

- The Netherlands, Mr. Koornstra:

The road safety policy in The Netherlands is to reduce the number of fatalities and severely injuries by 25% in the year 2000. To reach that goal, promising new measures are developed. SWOV is convinced that one of these measures could be the use of motor-vehicle lighting during daytime. The positive benefit of DRL in the Nordic countries with regard to the reduction in accidents involving unprotected road users is promising. However, it is true to say that the statistical evidence, so far, can be criticised. Therefore, new evidence should be gathered, based on a scientifically acceptable method. Furthermore, as part of the European harmonisation, it is also necessary to increase knowledge about the working human mechanisms underlying the use of vehicle lighting during daytime, in order to avoid discussion regarding possible alternative explanations.

As mentioned previously, the decision to introduce DRL on a nationwide scale in The Netherlands in November 1990 has been postponed by the Minister of Transport due to increased criticism after January 1990. The expert opinions in The Netherlands are divergent, both with regard to the anticipated overall positive effect and with regard to the anticipated DRL-sensitivity for different types of collisions (Koornstra, 1989; Theeuwes & Riemersma, 1990).

The state of affairs concerning the feasibility of starting an experiment

in the Netherlands is presently that at a provincial level. The Northern provinces in The Netherlands are requested on behalf of the Dutch Minister of Transport to cooperate in an experiment on DRL on a voluntary basis. In anticipation of the advice of the ISC the decision to cooperate with such an experiment at provincial level has been postponed.

- Nordic countries, Mr. Salusjärvi:

There are four general aspects to be considered when the question of justification of an experiment and an investigation is discussed:

1. Can the results concerning the effects of the suggested countermeasure be 'imported' from other countries where it has been applied?
2. Is more information needed about the quality and quantity of the countermeasure in order to be able to decide, or are the other expected results self evident?
3. What can you gain by carrying out an investigation? (Or what can you lose if you make the wrong decision?).
4. Is the suggested study plan scientifically valid?

When DRL is discussed, our answers to the questions are:

- (1) An experiment and an investigation are justified because the results obtained in the Nordic countries or the results found in the literature cannot be directly applied in other countries of Europe.
- (2) We have reason to believe that DRL will also be effective in other European countries. To ascertain the expected effects, an experiment is justified. Despite the clear reduction in pedestrian accidents in the Nordic studies, there seems to be doubt concerning possible secondary negative effects among pedestrians and cyclists. This further justifies the suggested experiment and investigation, because the investigation will provide answers to such doubt.
- (3) The experiment/investigation is also justified from the point of view of usefulness of possible results. (If we would consider the pros and cons of the countermeasure to be small, there is no reason to use money for an investigation where the pros and cons are quantified). In this case, our conclusion is that it would be wise to use resources in order to ascertain and quantify the effects of DRL in other European countries.
- (4) The proposed Dutch study design is comprehensive and valid. The investigation suggested should be able to provide the information about DRL needed by the decision makers.

Taking into account the above mentioned considerations a new experiment with DRL is necessary in order to estimate the effectiveness of DRL in other European countries. Especially when an international scientific consensus on the methodological questions is reached and the studies are carried out under supervision of the International Steering Committee, the investigation should lead, unlike most earlier studies, to reliable results. Such results will form a solid basis for further decisions in countries of Western, Central and Southern Europe.

We regard the suggested experiment and investigation clearly justified.

- Spain, Mr. Lozano:

- In Spain the use of DRL on motorcycles is obligatory and, according to the Vienna convention, is also compulsory for all motor-vehicles during bad weather conditions.

- Several times the use of motor-vehicle lighting during daytime (DRL) has been brought under discussion in the international bodies of the European Community and the United Nations in Geneva by the Nordic countries, Denmark and the Netherlands. The Spanish standpoint of view on this subject is to study carefully the results of past and future evaluation studies.

- At this moment the General Directorate for Traffic of the Ministry of the Interior does not take the introduction of DRL into consideration for a number of reasons. First, the use of DRL will increase the energy consumption and therefore will be in conflict with the countermeasures already taken to decrease energy consumption. Second, in according to the effectiveness and/or possible side-effects of DRL, still, a lot of questions are left open. Third, a more reliable estimation of the benefit of DRL is needed to facilitate a cost-benefit analysis. Fourth, at this moment it is difficult to say to what extent DRL will be beneficial in Spain taking into account, for instance, the brighter light level in Spain.

- From the point of view of traffic safety, in terms of reducing the high accident risk in Spain the General Directorate for Traffic of the Ministry of the Interior has no objection to start new experiments on DRL. On the contrary, it is necessary to collect new empirical data on the effectiveness of DRL to facilitate a more reliable estimation of the cost-benefit of such a measure in Spain.

- According to the risk-compensation theory, the question: what will be the benefit of DRL on the short, middle and long term, has to be answered.

- If the results of new evaluation studies prove the effectiveness of DRL in terms of reducing numbers of fatal and injured accidents the General Directorate for Traffic of the Ministry of the Interior will make an estimation of the costs, such as the increase of energy, campaigns to introduce DRL etc.

- Switzerland, Mr. Huguenin:

The "Schweizerische Beratungsstelle für Unfallverhütung BfU" concludes that during poor ambient lighting conditions, use of DRL will significantly contribute to traffic safety. On the other hand, the Institute is of the opinion that in broad daylight, DRL will have no effect. In poor ambient lighting conditions recommendations to use vehicle lighting on are already in force and the impression is that the majority of drivers comply with those recommendations. Added to this, in consultation with members of the Ministry of Transport and police authorities, it is still the policy of Switzerland that increased visibility of unprotected road users has a higher priority. So, DRL for motorised traffic is not a topic of interest in Switzerland at this moment. For that reason, the institute withdraws its membership of the International Steering Committee. However, if required, the institute is willing to cooperate by sending accident data to the International Steering Committee.

- United Kingdom, Mr. Cobb:

There are indications that using some form of vehicle front lighting under particular daytime conditions can have a positive effect on road safety. On the other hand, concerning the lighting systems in use, effort would be better spent in finding the intensities required in various directions for various weather conditions, so that a purpose-designed DRL can be developed, complete with a relevant control system. Such a device could then be introduced on new vehicles.

This would avoid the undesirable situation, where a light designed for one purpose (night-time vision) is forced into use for another purpose (day-time conspicuity). This could result in the beam pattern not being completely suitable for either job.

There is a fundamental conflict involved in using low-beam headlights for conspicuity. A low-beam headlight needs an intensity as low as possible towards oncoming drivers to avoid glare, but this is precisely the direction where light is needed for conspicuity.

Also, it appears that conspicuity is needed at considerable sideways angles (for cross-over accidents), a direction which is not addressed by a low-beams.

The size and duration of the proposed regional experiment is such that the 'voluntary' use of vehicle lighting in daytime will spread into the rest of the country. It would be almost impossible to reverse this and change back to 'no lights' during daytime, even if the experiment proved to have a negative effect. In other words, the act of performing the experiment will effectively introduce the use of vehicle lighting during some daytime conditions, whatever the result of analysis might be.

Besides, the widespread use of low-beam headlights during daytime will make it difficult to introduce a 'proper' DRL with light distribution and intensity NOT based on current headlight or signalling lights at a later stage. In general, I am against 'more light' in response to visibility problems. We should be searching for a solution which does not have a novelty effect; which continues to work.

No comments are offered on the statistics of the proposed study.

- United States of America, Mr. Perel:

What is needed now is not just another comparison of accidents involving DRL-equipped and control vehicles. Instead, on an international level a comprehensive evaluation is needed that can provide conclusive evidence of the potential benefits, if any, of DRL. The Dutch design proposed much of what is needed and is very detailed and comprehensive.

The objective of the International Committee is very worthwhile as there have been many studies of DRL over the years although many questions about their actual safety benefits are still left open.

Therefore, the following comments and suggestions are given for consideration:

- Results of a study based on a voluntary use of DRL will probably be biased, because the safer drivers will be the ones using DRL; biased results will be open to the same criticism as some past studies.

- In some past studies, the level of DRL use in general and especially the use of DRL on the accident vehicles was not clear. Without this information, DRL effectiveness estimates would be uncertain. The design mentioned that some police departments are noting DRL use on the accident records. This will be very important information and anything that can be done to enlist similar cooperation of other police departments would greatly benefit the results of the study.

- Arguments have been raised that DRL will not affect actual accidents because drivers will increase their risk taking to compensate for the perceived safety benefit provided by DRL. For this reason, it is desirable that new experiments can address this issue by making comparisons between DRL and non-DRL vehicles in terms of their observed speed and other relevant actions.

- When conducting time series analysis using a multivariate method with interventions and control groups in order to calculate the extent to which this measure has been effective, it is very important that the accident categories used (type of collision) are stable over a long enough period before the intervention is introduced.

- A general criticism is that the effectiveness of DRL was due to a novelty effect and not because of any improvement in vehicle detectability. Once the novelty ends, effectiveness would drop. This kind of criticism can be avoided by collecting data for a long enough period to determine if any initial accident reduction is maintained over time.

- If there are different types of lighting systems in use and it is possible to compare effectiveness of the different systems, the results of such an experiment would be helpful for setting possible lighting regulations.

4. CONCLUSIONS OF THE INTERNATIONAL STEERING COMMITTEE

4.1. Justification of new experiments

Considering the previously mentioned pros and cons, the International Steering Committee subscribes to the viewpoint that:

1. The totality of empirical evidence (studies in the Nordic countries and fleet-owner studies in Austria, the United States and Canada) leads one to expect a positive overall effect in terms of a reduction in accidents.

2. There is still lack of (statistically) convincing evidence from a single study and of reliable estimates of the magnitude of the effect. Accident studies to determine the relevance of their findings to DRL had inconclusive results because of an improper method, possible novelty effects, or lack of statistical significance. Until now results of laboratory experiments on perceptual and behavioural processes underlying the working of DRL have not provided a clear account of the problem area. Many of the experimental, human factor studies suffered due to problems such as too few subjects, lack of control of ambient light conditions, subjective effectiveness measures, or irrelevance to high ambient light conditions.

3. It is difficult to say to what extent a beneficial measure in one country will also be beneficial in another country with other driving conditions, ambient light conditions, population density, infrastructure, traffic density and composition.

4. If a 'good' evaluation can be performed (see Chapter 2) in one or more of the European countries more representative of Western, Central and Southern Europe, it would help to provide a better knowledge of the conditions under which DRL-use might be beneficial in other European countries.

Therefore:

- Considering the above mentioned evaluation problems, lack of theoretical and empirical knowledge and taking into account that:

- There is no empirical evidence to suppose that DRL will increase the accident risk of unprotected road users or motorcyclists. On the contrary, there are indications that unprotected road users in particular will benefit from this measure.

- An anticipated accident-reducing effect can only be proven by carrying out an experiment.
- A new experiment carried out on the basis of a scientifically acceptable method can provide a more precise estimation of the cost-effectiveness of such a measure.
- The Dutch design has been judged to be a scientifically acceptable basis for the method to be followed.
- Considering the problems of evaluating DRL effects based on the Danish experience, the Dutch proposal for a new experiment is desirable from a scientific point of view to complement the Danish experiences.
- Considering that results and interpretations from different countries can provide answers to the important questions left open, these should provide important guidance for a possible European harmonisation.

The Committee concludes:

A new experiment with DRL is justified and necessary to be able to estimate the effectiveness of DRL in Western Continental Europe. Especially when an international scientific consensus on the methodological questions has been reached and the studies are carried out under supervision of the International Steering Committee, the investigation will lead, unlike most earlier studies, to reliable results. Those results will form a solid basis for further discussions in countries of Western, Central and Southern Europe.

4.2. The Dutch proposal for a new experiment

In accordance with the considerations of the individual members concerning the Dutch proposal for a new experiment, the Committee is of the opinion that:

1. An experiment based on voluntary use of DRL has the following serious drawbacks:

- Compliance with a measure on a voluntary basis will never be 100%, and the results can therefore not provide the full answer to the question about the overall effect of DRL.
- In case of an experiment on a regional basis, the size and duration of the experiment is such that the voluntary use of headlights in daytime will spread into the rest of the country. It would be almost impossible to reverse this.

- Non-DRL-users may include a disproportionate share of high risk drivers e.g. drivers who have less regard for other safe driving habits, such as speed limit compliance.

- Extra efforts (campaigns, publicity and research) are necessary to stabilise and monitor DRL-use at a high level in the test area during the entire experimental period.

- Campaigns to promote DRL use in control areas might influence the experiment and may even officially be considered undesirable! To keep such a development under control also increases research costs.

Most of these problems do not occur when an experiment is conducted on the basis of compulsory DRL-use.

2. To minimise later criticism on the results from the international research community, the experiment should offer the following possibilities:

- The experiment must be carried out for a long enough period (for instance, two years) to be able to determine if any initial accident reduction is maintained over time (novelty effect), bearing in mind that possible negative effects may be long term effects.

- To observe and investigate perceptual and behavioural processes underlying the mechanisms of DRL in practice.

- To observe and investigate social-psychological and social-cultural acceptance/resistance of the use of DRL.

- To observe and investigate driving behaviour of DRL-users and non-DRL-users in practice, as well as to investigate the possible development of risk compensation behaviour, such as changes in speed in general and other behavioural actions in the before and after period .

- To investigate the accident risk of unprotected road users (motorcyclists, pedestrians and cyclists) as well as non-DRL-users.

- To investigate (during the experiment) the influence on actual increase of energy consumption in practice, extra costs from wear and tear of lamps, batteries, alternators and the like.

- To verify in the meantime the optimum light intensity necessary for the working of DRL.

4.3. Alternative suggestions for research

Other suggestions for research in relation to the visibility problem are:

- An investigation on 'colour' and 'colour contrast' (by France).

- The development of a purpose designed DRL (by the United Kingdom) to implement in new cars.

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APPENDIX I

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APPENDIX II

TERMS OF REFERENCE OF THE INTERNATIONAL STEERING COMMITTEE ON VEHICLE
LIGHTING DURING DAYTIME

The International Steering Committee will be seen as an independent group of experts on an European level. The tasks of this Committee will be:

- to review and evaluate existing evidence on the effectiveness of DRL;
- to review and evaluate the design and results of new research on DRL, especially in the Netherlands, Denmark, Canada and Austria;
- to coordinate research on DRL on an international level;
- to exchange information on the technical and political developments on DRL and public opinions about the subject in the member countries;
- to compose a final report on the bases of new scientific findings on the method of assessment and in a later stage on the effectiveness of DRL.

As soon as the national experiences with the introduction of DRL in fore-mentioned countries have been reported to the ISC, the Committee will report the European Commission about the agreed assessment method and on the possible introduction of DRL.