HOW TO EVALUATE THE SAFETY ASPECTS OF DAYTIME RUNNING LIGHTS

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1. INTRODUCTION

It's nearly 10 years ago that the Austrian Road Safety Board started with studying the safety effects of DRL and began to promote that measure in the public. Daytime running light (DRL) means at the moment to drive with dipped (head) lights (50 W) but in the future there should be a special light connected with the ignition System with 20 W lights. At the moment runs a campaign of the federal ministry for science and traffic in the Austrian radio and television under the title „Drivers with light are more bright“ (Lichtfahrer sind sichtbarer).

Original the Austrian government - a coalition of socialists (SPÖ) and Christian conservatives (ÖVP) - intended to carry out a two years experiment to evaluate the safety effects of DRL in Austria, because one main counter argument was that it works in the surroundings and conditions in Sweden but never in Austria. The political discussion in the media and in circles does not accept the relevance of foreign experiments with DRL. Therefore arises the question if it is possible to prove the relevance of earlier evaluation studies for Austria. So it is an important question to determine exactly the effects of DRL in Austria. Meanwhile the political discussion does not get ahead and the Christian conservative party (ÖVP) refuses the implementation even of a great experiment to prove the effects of DRL.

The original plan was that in the first year of experiment DRL will only be advertised. This part was in fact carried out by the mentioned advertising campaign „drivers with light are more bright“. There will be no surveillance and no punishment of drivers not having the lights on during daytime. Only in the second year of the experiment drivers of „dark“ cars have to pay a fine of 200 ATS (it is approx. 17 US$) if they are stopped for a routine control or for a check caused by other violations. No car should be checked only due to the fact that the car has no lights on at daytime. By that control of DRL will be minimalized. So you can not assume a high rate of participation. To my mind in the first year the participation rate will not exceed 30 % in general and in the second year of experiment it will be at about 50% at the maximum. The safety effects therefore will not be identical to the target Situation with 100% showing DRL! There will be in traffic a mixture of cars with the lights on and of cars without lights. That gives on the one hand the risk to overlook a car but on the other hand by applying of Humphry's Paradox there could be also the best safety effect due to the conscious risk to miss a „dark" car. The tension of expectation achieves its maximum.
2. THE DESIGN OF FORMER EXPERIMENTS

Hansen Lars Klit (1994) described the experience with compulsory use of the DRL in Denmark. DRL (dipped lights or special running lights) got compulsory for all motor vehicles during daytime by October 1st, 1990. When DRL were introduced, the rules for carrying headlights at night were adjusted that the minimum lights at night time were dipped lights.

To evaluate the impact of DRL on accidents the development of accidents with personal damage has been studied 15 three-months periods before the introduction (i.e. since 1987) and 11 three-months periods after (until 1993). During that period there were only few law amendments which might have affected daytime accidents except of an increased enforcement of drunk driving. Therefore accidents with drunk drivers where excluded from the evaluation study. For the remaining groups of accidents a statistical analysis has been made in order to calculate an „expected” number of accidents. A log-linear model has been used.

Accidents between two cars and single vehicle accidents were divided into nine main accident situations. Accidents at daylight and during darkness were separately calculated and compared. In the first evaluation it was concluded that the effect was concentrated only on the accident Situation left turn in front of an oncoming vehicle. The accident reduction was estimated to 37 %o. In fact the change was about 34%! During darkness left-turn accidents raised by 6%o!

As a control group the single car accidents were used: for single vehicle accidents an increase of 9% was found for daylight accidents and a decrease of 13% in darkness. So the effect could be ensured by two different measures: the same type of accident in two different conditions (day vs. night) and two different types of accidents (left-turn vs. single car) whereby one type (single car) could not really be influenced by DRL.

Elvik Rune (1993) reported on the effects on accidents of compulsory use of daytime running lights for cars in Norway. The use of DRL were made mandatory for all cars from April 1st, 1988. From January 1st, 1985 DRL switched on by the ignition were required for all new cars.

His study design is a non-experimental before and after study and covers the years from 1980 to 1990. The year 1980 was chosen due to three reasons; it is the first year for which estimate of the use of DRL are available. Second, summertime was introduced in Norway this year. Third, there have been no major changes in legislation concerning accident reporting after 1980. The years 1980 to 1984 constitute the before period and the years 1985 to 1990 constitute the after period divided in due sub-periods due to the fact the DRL have got mandatory after April 1st, 1988.

Only multiparty accidents in daylight are assumed to be influenced by DRL. The other types of accidents are assumed not to be influenced by the use of DRL and constitute the comparison group. All motorcycle accidents were excluded because DRL have got compulsory for motorcycles already 1978. Accidents with personal damage were used only and broken down by light condition in daylight, twilight and darkness. Daylight multiparty car accidents are further broken down into by time of year (summer, winter) road environment (town, countryside) and type of accident (pedestrian, rear end, head on, turning, right angle and others).

Now a criterion of effectiveness was calculated relating the quotients of multiparty to single car accidents under daylight conditions to the quotient of these accidents at night. The validity of using changes in the odds ratio as criteria of effectiveness rests on the validity of the ceteris paribus clause it relies on. Generally the odds ratio does not take account of
changes that effect one of the four types of accidents that enter into its calculation selectively. If other effects are present in the data the effect of DRL can be falsely reinforced or hidden. An increasing number of single car accidents my generate a false impression of an effect of DRL or falsely reinforce a true effect. By that it seems to me this evaluation criterion is problematic.

We saw in the study of Lars Klit Hansen (1994) that not all types of multiparty accidents are influenced in the same amount by DRL. If you do not regard these effects DRL effects might be masked.

But Elvik Rune (1993) emphasizes correctly the importance of study design (Company fleet experiment versus nationwide because in the first case you might have a DRL rate of 5% in the whole traffic and in the other case 90%) Stresses the weakness of accident data (only one of three injury accidents is actually reported to the police and so included in official statistics) and formulates clear hypothesis (e.g. that the use of DRL has no effect on the number of daylight rear-end collisions). He discusses finally confounding factors like changes in vehicle speed, extension of road lightning, changes in DWI driving and so on.

Arora H., Collard D., Robbins G., Welbourne E.R. and White J.G. (1994) studied the effectiveness of DRL in Canada. Canada Motor Vehicle Safety Standard 108 requires that DRL be installed on all new cars, trucks, busses etc. after December 1st, 1989. Collisions of all severities corresponding to four accident types were extracted from the national Traffic Accident Information Data base (TRAID) for calendar years 1984 to 1991. The target group was defined as two-vehicle different direction daytime collision compared with single vehicle daytime collisions. Additional comparisons were made with two vehicle different direction night time collisions and single vehicle night time collisions like in the study of Hansen Lars Klit (1994). An odds ratio of target group collisions to the comparison groups collisions was calculated like in the study of Elvik Rune (1993) but not for all multiparty accidents together. The odds ratio was calculated for each of five late model vehicle collisions totals in each calendar year because equipment with DRL has got mandatory only for new cars. The odds ratio for a given model year was then compared with the odds ratio for the previous model year and tested with chi-squared test of significance. Lindeijer J.E. (1991) designed a masterplan for an evaluation study into the effect of DRL on road safety in the Benelux-countries. He criticizes that national evaluation studies gave little attention to exposure or to development in driving performance and mobility in traffic. He calls for an exact estimation of the use of DRL and to control all other conditions influencing accident occurrence at the same time. He demands that the difference in the use of DRL when comparing the before and after period must be sufficient. But it is not correct to assume that the effect of DRL rises linearly from 0 to 100%. In the contrary it might be possible that the accident preventing effect is on top at 50% usage of DRL.

3. THE PROPOSED EXPERIMENTAL DESIGN OF THE AUSTRIAN DRL EVALUATION STUDY

To measure the effects of DRL the accident figures in the two years before Start of the experiment and during the experiment endurance (2 years) should be compared and analyzed. Basis for the analysis of accident occurrence are the accident data reported by the Austrian board on statistic, a federal office. By that only accidents with personal damage will be reported. The federal ministry for science and transport will invite tenders for the performance of the accident research and the accident analysis through an official or private Institute.

The aim of the investigation will be the exact representation of accident occurrence - e.g. the accidents with personal damage - in the period two years before the introduction of DRL and
during the two years of implementation of DRL. The results of the first year of experiment
have to be presented six months after the end of the first year of performance of DRL as an
intermediate report and the final report has to be presented six months after the second
year of experiment. The reports should show the trend of accident figures during the
experiment in comparison with the accidents in the two years before. The Statements to the
analysis of accident figures have to refer to the determined rates of application of DRL that
means the percentage of cars having the lights on during daytime. These rates will be
determined not only for the whole state but also for regions. The accident figures therefore
have to refer also to these regional data.

To determine the effects of DRL only those accidents should be taken for evaluation where
both partners used DRL. All other accidents should count for the control group.

Accidents assumed referring to DRL are:

Superior group 1: accidents with traffic in the same direction
    sub group 12: collision during change of lanes
    sub group 13: rear-end collisions to driving vehicle
    sub group 14: rear-end collisions to standing vehicles
    sub group 15: rear-end collisions at crossings to driving vehicle
    sub group 16: rear-end collisions at crossings to standing vehicle

Superior group 2: accidents with oncoming traffic

Superior group 4: accidents during branch off- opposite direction
    sub groups 41,42,43: collisions during branch off on crossings

Superior group 5: right angle collisions on crossings
    right angle collisions while turning in

sub group 8: pedestrian accidents
sub group 9: accidents in entrances or doorways
sub group 94: collisions at entrances or doorways

But the cited studies show that DRL influence rear-end collisions in an other way them
accidents during branch off. By that effects of DRL could be masked. Better the analyzis
should be carried out for each type of accident separately.

The control group beyond it will be constituted by the following types of accidents:

- single car accidents
- night time accidents in general
- all other accidents not related to DRL

Nevertheless the police have to know whether or not a car involved in an accident had the
lights on or not in the accidental Situation. By that it would be possible to compare accidents
s follows:

- dark to dark
- light to light
- light to dark
By political decision the design has been restricted to a pre-after design of comparison of accident data. Conflict studies and driver Interviews were excluded. This restriction in connection with the expected low application rate of DRL hinders the evaluation of DRL in Austria.

The following aspects should be studied:

- evaluation separated for the different types of roads e.g. freeway, federal highway, regional roads, community roads, traffic in towns and outside towns
- evaluation separated for the different parts of the control group e.g. accidents with more than two partners involved at night, single car accidents during night and at daylight accidents with no relevance to DRL during daytime and accidents in principle relevant for DRL but not all partners showing DRL
- evaluation according to the light Situation that means: blinding sun, daylight in comparison with dawn, twilight and artificial lightning.

Due to the fact that all these variables are not clearly separated but in some way interfered multivariate analysis will be needed.

4. Special hypothesis and remarks

Masking effects could emerge by changements in the general development of traffic safety in Austria and in Europe and there are such changes by the introduction of probatory license, the introduction of a point demerate system, less young drivers because their percentage in the population is continuously decreasing with increasing motorization. Other effects depend from changements in licensing like moped riding with 15, C-I license, changes in driver education and driver testing. Further problems arise from changes in the value System of the entire society - e.g. if you compare the 68-generation with today's students. And there are changes in the population by continuing immigration from Asia, Africa and Eastern European countries. Nevertheless the percentage of female drivers rises quickly....
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