Study of Mandatory 24-Hour Vehicle Lighting

January 2011

Minnesota Department of Transportation

Office of Traffic, Safety and Technology

Office of Policy Analysis, Research and Innovation

Minnesota Department of Public Safety

Office of Traffic Safety

Commissioners' Letter

January 15, 2011

Legislative Committee Members:

The 2009 Legislature directed the Minnesota Departments of Transportation and Public Safety to study the effects of 24-hour use of vehicle lighting on public highways and report the findings regarding traffic safety impact by January 15, 2011.

The attached report compiles research results, including studies from the U.S., Canada and Europe, and is submitted to the chairs and ranking minority members of the legislative committees with jurisdiction over transportation policy, pursuant to Laws of Minnesota 2009, Chapter 168, section 13.

Overall, the research demonstrates that daytime use of headlights or factory-equipped daytime running lights has a positive and measurable impact on reducing roadway crashes, injuries and fatalities; furthering Minnesota's Toward Zero Deaths) initiative and its goal of fewer than 350 traffic fatalities by 2015.

For any questions regarding this report, please do not hesitate to contact us or our department personnel.

Sincerely,

Michael Campion
Commissioner
Minnesota Department of Public Safety
Governor's Representative for Highway Safety

Thomas Sorel
Commissioner
Minnesota Department of Transportation
Toward Zero Deaths Steering Committee Chairman

Legislative directives

Report costs

As required in Minnesota Statute 3.197, this document must contain the cost of preparing the report, including any costs incurred by another agency or another level of government.

The Minnesota Department of Transportation contracted with CTC & Associates LLC to prepare a synthesis of transportation research on 24-hour headlight use for a fee of $6,200. This Transportation Research Synthesis can be accessed at *http://www.dot.state.mn.us/research/TRS/2010/TRS1009.pdf.*

Mn/DOT and DPS staff costs are estimated at approximately $7,000.

Legislation

This report is mandated and submitted pursuant to the Laws of Minnesota 2009, Chapter 168, Section 13. It reports on the findings of state, national and international studies and provides conclusions from the commissioners of the Minnesota Departments of Public Safety and Transportation on mandating drivers to turn on their vehicle lights at all times of day and night.

Chapter 168 Section 13 of the session laws of 2009 (H.F. 878) required the commissioners of the Departments of Public Safety and Transportation to perform this study and report the findings to the chairs and ranking minority members of the legislative committees with jurisdiction over transportation policy by January 15, 2011.

The study was to include discussions of:

- Environmental consequences
- Crash prevention
- Motorcycle, bicycle, and pedestrian safety
- Cost to drivers and
- Application to motorcycles

The complete legislation is included as Appendix A.

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Acknowledgments

The development of this document involved a series of meetings, research, and correspondence among the project team, Departments of Public Safety and Transportation Managers and Mn/DOT Office of Government Affairs. Their involvement and insight provided key input in the development and oversight of this document.

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Appendix A: Chapter 186 Section 13, Session Laws of 2009

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Executive summary

This report to the legislature summarizes the most recent studies regarding daytime running lights and 24-hour use of low-beam headlights. The impact of DRL has been studied extensively around the world. As an alternative to requiring an equipment modification to all new or existing vehicles, some jurisdictions have explored the “behavioral option” of requiring motorists to turn on their headlights 24 hours a day. The effect of 24-hour use of regular low-beam headlights has been studied less frequently than DRL. The expectation is that all drivers turning on their lights at all times would confer the same safety benefits as having DRL installed and used in all vehicles at all times.

Current implementation in various countries and jurisdictions

Canada, Denmark, Finland, Hungary, Iceland, Norway, and Sweden currently require vehicle lights to be used during daytime hours.

Following extensive research on the effectiveness of DRL, the European Union implemented DRL as mandatory on passenger vehicles sold in member nations beginning in 2011.

This synthesis found no current state laws requiring 24-hour headlight use. However, two bills were introduced in the Illinois Legislature; one in 2009 and another in 2010. Neither was passed into law.

Effectiveness at reducing multiple vehicle crashes

The issue of differing research methodologies is a critical factor in demonstrating DRL effectiveness, and makes it difficult to aggregate the results of the different studies. Most studies found that the presence of DRL reduces daytime multiple-vehicle crashes, especially head-on and front-corner collisions where vehicle conspicuity is a concern. The magnitude of the reduction varies depending on the study and the type of crash; five of the eight key studies in this report found a crash reduction rate of 5 to 10 percent. The three remaining key studies found crash reduction rates of 3.9 percent, 3.2 percent and no statistically significant effect.

Some of the findings from the eight Key Studies reviewed include:

- Research using the Mn/DOT Crash Database (Krajicek, Shears) found the overall crash rate among vehicles without DRL was 1.73 times higher than the rate for vehicles with standard DRL.
- A 2008 NHTSA study found that DRL had no statistically significant effects on the types of crashes studied, except for a 5.7 percent reduction in the involvement of light trucks/vans in two-vehicle crashes.
- A 2004 NHTSA study that used a different statistical methodology found that DRL reduced opposite-direction fatal crashes and non-fatal opposite-direction and angle crashes by 5 percent each. The study also found a 12 percent reduction in crashes involving pedestrians and bicyclists, and a 23 percent reduction in opposite-direction crashes involving motorcyclists.
- A key European study (Elvik et al., 2003) evaluated 25 studies on the safety effects of DRL for cars and 16 studies for motorcycles found that DRL use produced a 5 to 10 percent reduction in multiparty daytime crashes for both vehicle types.

Effect of automobile DRL on motorcycle safety

The findings of the 2008 NHTSA study regarding motorcycles were not statistically significant, and the 2004 NHTSA study found that DRL reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

Effect of DRL use by motorcycles

Since Minnesota law currently requires motorcyclists to use their headlights at all times, a 24-hour headlight use law would not represent a new requirement for motorcyclists. Elvik et al. (2003) conducted a meta-analysis of 16 studies on DRL use on motorcycles. The study found that the use of DRL on motorcycles reduced the number of multiparty daytime crashes by about 32 percent.

Effect on crashes involving pedestrians and bicyclists

Studies on this topic found the following:

- The Elvik et al. (2003) meta-analysis summary estimate of DRL effects indicated a 19 percent reduction in pedestrian crashes.
- The Elvik et al. (2003) meta-analysis summary estimate of DRL effects indicated a 6 percent reduction in bicycle crashes.
- The 2008 NHTSA study found no statistically significant results for crashes involving pedestrians or bicyclists. The 2004 NHTSA study found that DRL reduced daytime fatal crashes involving pedestrians and cyclists by 12 percent.

Environmental and cost issues

Studies on this topic tend to agree that the environmental impact of DRL use or of 24-hour headlight use is small, as are the overall annual vehicle costs. The studies found the following:

- Elvik et al. (2003) estimated a benefit-cost ratio of 1.96 (for every $1.00 spent, the benefit would be $1.96) for 24-hour headlight use; this was the highest ratio across all options evaluated. The lowest estimated benefit-cost ratio for 24-hour headlight use across all options evaluated was calculated at 1.18.
- A 2008 study by the California Energy Commission recommended that the state not direct motorists to turn DRL off (which is an option on certain vehicles) as a method to reduce fuel consumption because their studies concluded that the fuel savings from this measure would not exceed 1 percent.

Conclusions

Research suggests a potential reduction in crashes involving daytime multiple-vehicle crashes -- especially head-on and front-corner collisions -- with the 24-hour use of low-beam headlights. Additionally, the research suggests potential crash reduction benefits involving bicycles, pedestrians and motorcycles. The research doesn't demonstrate increases in crashes of any type. Studies tend to agree that the environmental impact of DRL use or of 24-hour headlight use is relatively small, and is a relatively small portion of overall annual vehicle costs. Overall the major studies show that requiring daytime headlight use in vehicles not equipped with automatic DRL would likely

have a positive benefit-cost ratio and a measurable impact on reducing crashes, injuries and deaths on Minnesota roadways.

Mn/DOT Talk is a community of 600 Minnesota residents who participate in online discussions on transportation issues. In early November of 2010, Mn/DOT surveyed their thoughts and opinions on headlight use during the day. Many respondents currently limit their daytime headlight use to poor and deteriorating weather conditions, but most do believe use at all times may lead to safer roads. Supporters of such a law cite daytime headlight use as increasing visibility of all parties, and making any transitions from bright to dark driving conditions safer. Those in opposition believe that too many lights may be so bright they obscure vision and that there would be increased wear on car hardware. Just over half of respondents support legislation to require headlights to be on at all times, with around a quarter opposed, and another quarter stating they were unsure. The full Mn/DOT Talk report is included as an Appendix.

Introduction

DRL —generally low-wattage headlights that turn on automatically when a vehicle's ignition is started—are a safety feature intended to reduce multiple-vehicle crashes during daylight hours by making vehicles more conspicuous. In some countries, such as Canada, DRL are required standard equipment on all vehicles manufactured; in the United States they are permitted but not required, and were standard equipment on about 27 percent of new vehicles manufactured in 2005 (NHTSA, 2008).

DRL would require an equipment modification to many new or existing vehicles. Rather than requiring vehicle manufacturers to re-tool, some jurisdictions have explored the "behavioral option" of requiring motorists to turn on their vehicle's existing headlights 24 hours a day. The expectation is that this requirement would achieve the same safety benefits as having DRL installed in all vehicles.

The impact of DRL has been studied extensively by agencies around the world. The effect of 24-hour use of regular low-beam headlights (as opposed to DRL) has been studied less frequently, usually as part of a larger study on DRL. Because of this, most of the research in the Transportation Research Synthesis prepared by CTC & Associates LLC for this report (Appendix B) concerns the use of DRL; however, many studies reference several types of DRL implementations, including both the low-wattage DRL that are common in newer vehicles and older DRL that are brighter, more similar to the wattage of standard low-beam headlights. This research should be applicable to Minnesota's exploration of 24-hour use of low-beam headlights.

Current implementation in various countries and jurisdictions

International

Canada, Denmark, Finland, Hungary, Iceland, Norway, and Sweden currently require DRL.

The European Union commissioned an extensive four-part research project to gather information on the effectiveness of DRL and the most successful implementation scenarios. This project analyzed benefit-cost ratios and projected public acceptance, and recommended implementing DRL in new vehicles and requiring 24-hour use of low-beam headlights in existing vehicles. The authors suggested that the EU consider requiring 24-hour headlight use prior to the changes in the vehicle fleet in order to receive the expected benefits of DRL use more immediately.

Following this research, the European Union decided to require DRL as mandatory equipment on passenger vehicles sold in member nations beginning in 2011.

United States

There are no current state laws requiring 24-hour headlight use, however bills were introduced in the Illinois State Legislature in 2009 and 2010. A synopsis of the 2010 bill as introduced can be found at: *625 ILCS 5/12-201.*

The legislation sought to amend the Illinois Vehicle Code by requiring the use of head lamps or DRL at all times when a motor vehicle is operated on any highway in the State, rather than just requiring the use of headlamps when certain atmospheric or daylight conditions are present. Law enforcement agencies acting in their official capacity were exempted.

Potential for crash prevention

In the considerable body of research on this topic, most studies have found that the presence of DRL reduces daytime multiple-vehicle crashes, especially head-on and front-corner collisions. The magnitude of the reduction varies depending on the study and the type of crash, but many studies have found a reduction of 5 to 10 percent.

The most recent large-scale study on this topic conducted in the United States is the 2008 NHTSA study that found that DRL had no statistically significant effects on most of the types of crashes studied, except for a 5.7 percent reduction in the involvement of light trucks/vans in two-vehicle crashes.

A 2004 NHTSA study that used different analysis methodology found that DRL reduced opposite-direction fatal crashes by 5 percent and opposite-direction/angle non-fatal crashes by 5 percent. That study also found a 12 percent reduction in crashes involving pedestrians and bicyclists, and a 23 percent reduction in opposite-direction crashes involving motorcyclists.

In general, the issue of research methodology seems to be a critical factor in the debate over demonstrating DRL effectiveness, and can make it more difficult to aggregate the results of different studies. A key European study (Elvik et al., 2003) that used statistical meta-analysis to aggregate 41 DRL studies (25 studies that evaluated the safety effects of DRL for cars, and 16 for motorcycles) found that DRL use produced a 5 to 10 percent reduction in multiparty daytime crashes for cars. In this study, all 25 of the passenger car studies evaluated in the meta-analysis found that DRL use yielded a crash reduction of some magnitude—no studies demonstrated an increase in crashes. In another example, the 2004 and 2008 NHTSA studies used different statistical analysis methodologies and yielded different results.

Finally, recent research using the Mn/DOT crash database also identified reductions in the rates of various crash types when DRL were present. The magnitudes of the reductions were greater than in other DRL studies, again likely due to differing research methodology. (In this study, the overall crash rate among vehicles without standard DRL was 1.73 times higher than the rate for vehicles with standard DRL.)

To aid in understanding the findings, it is necessary to discuss the methodology used in the key studies.

Krajicek, Michele E, and Raquel M. Schears.

Daytime Running Lights in the USA: What Is the Impact on Vehicle Crashes in Minnesota? International Journal of Emergency Medicine, 2010, Vol. 3. No. 1, pages 39-43.

Researchers used the Minnesota DOT Crash Database from 1995 to 2002 to compare the crash rates of vehicles with and without DRL as standard equipment. They evaluated crashes involving 185,000 vehicles, 38,000 of which had standard DRL. The crashes studied occurred during daylight, with optimal visibility, on a dry road surface.

The study concluded that vehicles equipped with DRL had a statistically significant lower crash rate than vehicles without DRL. Specific findings on the effect of vehicles without DRL included:

- The overall crash rate among vehicles was 1.73 times higher than the rate for vehicles with standard DRL (832 crashes vs. 481 crashes per 10,000 vehicles).
- For fatal vehicle crashes, the crash rate ratio was 1.48 times higher (3.0 fatal crashes vs. 2.0 fatal crashes per 10,000 vehicles).

- For crashes involving pedestrians, the crash rate ratio was 1.77 times higher (5.2 crashes vs. 2.9 crashes per 10,000 vehicles).
- For crashes involving bicycles, the crash rate ratio was 1.72 times higher (7.8 crashes vs. 4.5 crashes per 10,000 vehicles).

The authors point out that these crash rate reductions are notably higher than those seen in previous studies. They hypothesize that this may be because their study was a retrospective study of all vehicle crashes in Minnesota during the time period, whereas previous studies employed a case-control methodology to compare subsets of vehicles with and without DRL.

Exponent Inc. (prepared for General Motors).

Matched Pair Study of the Effectiveness of Daytime Running Lights, February 2008.

This study sought to update the authors' previous research for General Motors using revised methodology, similar to the methods used by the 2008 NHTSA study). This study found a reduction in rates of selected two-vehicle daytime collisions of about 8 to 12 percent for vehicles equipped with DRL. These results were based on Poisson regression analysis; a second analysis using the ratio of odds ratios approach found a reduction of 5 to 8 percent.

Like the NHTSA study, this study used a matched pairs approach in analyzing the crash data; investigators used model year pairs of GM, Saab, Toyota, Subaru, Volkswagen and Volvo vehicles. Whereas the NHTSA study included crash data from Fatality Analysis Reporting System, this study used state data as its primary source. The authors noted that FARS contains data on fatal crashes only, which is a small subset of all crashes that occur.

Their analysis of FARS data concluded:

> *Analyses of fatal crashes reported in FARS showed little difference in crash rates or odds ratios for DRL and non-DRL vehicles. The lack of statistically significant results largely reflects the relatively small numbers of fatal crashes involving these particular vehicle models and years under the specified conditions of interest.*

National Highway Traffic Safety Administration.

The Effectiveness of Daytime Running Lights for Passenger Vehicles, September 2008, Report DOT HS 811 209.

This study is U.S. DOT's most recent research on the effectiveness of DRL. Its findings—that the presence of DRL had no statistically significant effect on the three types of crashes studied—differ from most of the rest of the international body of research on DRL. However, this appears to be more an issue of analysis methodology than of insufficient differences among crash rates.

In this study, NHTSA examined data from the FARS from 2000 to 2005, and from nine states (Florida, Illinois, Maryland, Michigan, Missouri, Nebraska, Pennsylvania, Utah and Wisconsin) during the same time period or portions of it. Specific findings included:

- The presence of DRL had no statistically significant effects on three types of daytime crashes: (1) two-vehicle crashes, excluding rear-end crashes; (2) single-vehicle crashes with pedestrians or cyclists; (3) single-vehicle crashes with motorcyclists.
- When passenger cars and light trucks/vans (LTV) were examined separately, DRL reduced LTV involvement in the two-vehicle crashes studied by 5.7 percent, a statistically significant reduction.

Knight, I.; B. Sexton; R. Bartlett; T. Barlow; S. Latham; and I. McCrae.

Daytime Running Lights (DRL): A Review of the Reports from the European Commission, October 2006, sponsored by the UK Department for Transport.

This report can be found at: *http://ec.europa.eu/transport/road_safety/vehicles/doc/consultations/drl_trl.pdf.*

Commissioned by the UK Department for Transport, this review of the European Commission reports agreed with the reports' conclusion that DRL use would reduce crashes, but questioned the stated magnitude of DRL effect. The reviewers also agreed that the reports' estimates of fuel and emissions increases were calculated in a reasonable and conservative manner.

NHTSA.

An Assessment of the Crash-Reducing Effectiveness of Passenger Vehicle Daytime Running Lamps (DRL), September 2004, Report DOT HS 809 760

This study estimated the effectiveness of passenger vehicle DRL in reducing two-vehicle opposite direction crashes, pedestrian/bicycle crashes, and motorcycle crashes. The authors chose the generalized simple odds, a conventional statistical technique, to analyze the data. This study found that from 1995 to 2001:

- DRL reduced opposite direction daytime fatal crashes by 5 percent.
- DRL reduced opposite direction/angle daytime non-fatal crashes by 5 percent.
- DRL reduced daytime single-vehicle fatal crashes involving non-motorists, pedestrians and cyclists by 12 percent.
- DRL reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

The study notes that, "The reviewers of this paper required the inclusion of an analysis based on odds ratio." None of the results of this analysis were statistically significant. The author further explains the difference between the two methodologies:

> *Unfortunately, when using the odds ratio, the estimated effectiveness of DRL is extremely sensitive to small changes encountered in real world crash data and none of the results were statistically significant. This does not mean that DRL do not reduce target crashes during the daytime. It just means that the odds ratio technique does not detect these changes over the inherent background noise of the data system.*

Elvik, Rune; Peter Christensen; and Svenn Fjeld Olsen.

Daytime Running Lights—A Systematic Review of Effects on Road Safety, 2003.

This study is the most comprehensive analysis of the existing literature on DRL. The authors analyzed 25 studies that evaluated the safety effects of DRL for cars and 16 studies that evaluated the safety effects of DRL for motorcycles. Their review was a statistical meta-analysis that sought to combine the estimates of effect from each study into one summary estimate.

In their analysis, the authors distinguished between the intrinsic effect on safety for an individual vehicle using DRL and the aggregate effect of laws or public campaigns that lead to an increased use of DRL on the total number of accidents in a country.

The results of the meta-analysis included:

- The use of DRL reduces the number of multiparty daytime accidents for cars by about 5 to 10 percent (intrinsic effect). All of the analyzed studies estimated a reduction in the number of accidents, but the size of the reduction varied from study to study.
- Laws or campaigns designed to encourage the use of DRL for cars were associated with a 3 to 12 percent reduction in multiparty daytime accidents.
- Laws or campaigns designed to encourage the use of DRL for motorcycles are associated with a 5 to 10 percent reduction in multiparty daytime accidents.

The robustness of these summary estimates of effect was tested for potential sources of error in the meta-analysis, including publication bias, varying quality of the studies included, the statistical weights assigned to each estimate of effect; and the contribution of a single study to the overall estimate of effect. The authors found that in general, the summary estimates of effect were very robust.

Other conclusions from the meta-analysis included:

- The effects of DRL varied according to accident severity, with DRL having the greatest effects on the most severe accidents. However, evidence concerning the effects on fatal accidents was inconsistent. In the report's benefit-cost analysis, the authors assumed that DRL would reduce fatal multiparty daytime accidents by 15 percent, serious injury multiparty daytime accidents by 10 percent, and slight injury multiparty daytime accidents by 5 percent.
- There was a weak relationship between geographical latitude and the effects of DRL, with the effects of DRL increasing at latitudes further from the equator.
- Evidence concerning a seasonal variation in the effects of DRL was sparse and inconclusive.
- Further study is needed regarding whether the effects of laws mandating the use of DRL tend to diminish over time.
- The authors concluded that DRL are unlikely to have any adverse effect on accidents involving pedestrians, bicyclists or motorcyclists. Some estimates indicated that DRL laws had an adverse effect on pedestrian accidents, but the summary estimate of effect indicated a reduction in pedestrian accidents.

- The authors concluded that it was likely that using low-beam headlights as DRL could have an adverse effect on rear-end collisions, because turning on a vehicle's headlights illuminates its tail lights as well, which could make it more difficult to detect brake lights. However, the presence of a third brake light may counteract this effect, as would the use of dedicated DRL with tail lights that are switched off.

Farmer, C.M., and A.F. Williams (Insurance Institute for Highway Safety).

"Effects of Daytime Running Lights on Multiple-Vehicle Daylight Crashes in the United States," Accident Analysis and Prevention, March 2002, Vol. 34, No. 2, pages 197-203.

Abstract: Involvements in multiple-vehicle daylight crashes in nine states over four years were analyzed for a group of passenger cars and light trucks equipped with automatic DRL. On average, these vehicles were involved in 3.2 percent fewer multiple-vehicle crashes than vehicles without DRL.

Insurance Institute for Highway Safety.

"Q&As: Daytime Running Lights," October 2009.

http://www.iihs.org/research/qanda/drl.html.

This online Q&A page notes that "nearly all published reports indicate DRL reduce multiple-vehicle daytime crashes," and summarizes key results from several studies conducted in Scandinavia, Canada and the United States, including:

- A 2002 study by the Insurance Institute for Highway Safety reported a 3 percent decline in daytime multiple-vehicle crash risk in nine US states concurrent with the introduction of DRL.
- A study examining the effect of Norway's DRL law from 1980 to 1990 found a 10 percent decline in daytime multiple-vehicle crashes.
- A Danish study reported a 7 percent reduction in DRL-relevant crashes in the first 15 months after DRL use was required and a 37 percent decline in left-turn crashes.
- In a second study covering 2 years and 9 months of Denmark's law, there was a 6 percent reduction in daytime multiple-vehicle crashes and a 34 percent reduction in left-turn crashes.
- A 1994 Transport Canada study comparing 1990 model year vehicles with DRL to 1989 vehicles without them found that DRL reduced relevant daytime multiple-vehicle crashes by 11 percent.

Impacts to motorcycle, bicycle, and pedestrian safety

DRL have the potential to effect pedestrian and bicyclist safety in at least two ways. It is possible that pedestrians and bicyclists would become relatively less visible when motor vehicles have their headlights on. However, the enhanced conspicuity of motor vehicles may make them easier for pedestrians and bicyclists to observe (Elvik et al., 2003). Studies on this topic found the following:

- The Elvik et al. (2003) meta-analysis found that DRL reduced crashes involving pedestrians, though some of the individual studies reviewed showed an increase in crashes. The report reviewed three studies that estimated DRL effect on crashes involving bicyclists, and all showed a reduction.
- The 2008 NHTSA study found no statistically significant results for crashes involving pedestrians or bicyclists. The 2004 NHTSA study found that DRL reduced daytime fatal crashes involving non-motorists, pedestrians and cyclists by 12 percent.

- An experimental 2004 European study (Brouwer et al.) found no evidence of a reduced conspicuity of road users in the vicinity of a DRL-equipped vehicle.

Cost to drivers and environmental consequences

The issues of cost and environmental impact are closely related, because factors that affect the environment, such as increased fuel use and increased use and disposal of headlight bulbs, tend to increase costs as well. Studies on this topic tend to agree that the environmental impact of DRL use or of 24-hour headlight use is relatively small, and is a relatively small portion of overall annual vehicle costs.

Several studies have conducted benefit-cost analyses, often comparing the benefit-cost ratios of dedicated DRL vs. 24-hour headlight use. The range of benefit-cost ratios across all options varied considerably from study to study, although the ratios for 24-hour headlight use varied less:

- Elvik et al. (2003) estimated a benefit-cost ratio of 1.96 for 24-hour headlight use; this was the highest ratio across all options evaluated.
- An October 2003 study conducted in Australia calculated a 1.18 benefit-cost ratio for 24-hour headlight use; this was the lowest ratio across all options evaluated.
- A 1997 Australian study calculated a 1.27 benefit-cost ratio of requiring motorists to turn on their headlights 24 hours a day, compared with 1.76 for automatic in-vehicle DRL with low-wattage lights.
- A 2008 study by the California Energy Commission recommended that the state not limit DRL use as a method of reducing petroleum fuel use. The study concluded that the fuel savings from this measure would not exceed 1 percent.

Study effect of DRL use by motorcycles

Minnesota law requires motorcyclists to use their headlights during daylight hours, and opponents of DRL have argued that requiring headlight use for all vehicles could make motorcycles less conspicuous. An additional NHTSA study on this topic, *Motorcycle Conspicuity and the Effect of Fleet Daytime Running Lights,* is nearing completion as of late 2010 but is not yet available for review.

The findings of the 2008 NHTSA study regarding motorcycles were not statistically significant, and the 2004 NHTSA study found that DRL reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

Since Minnesota law currently requires motorcyclists to use their headlights at all times, a 24-hour headlight use law would not represent a new requirement for motorcyclists. Elvik et al. (2003) conducted a meta-analysis of 16 studies on DRL use in motorcycles, and found that:

- Laws or public campaigns designed to encourage the use of DRL for motorcycles were associated with a 5 to 10 percent reduction in multiparty daytime crashes.

Conclusion

Research suggests a potential reduction in crashes involving daytime multiple-vehicle crashes -- especially head-on and front-corner collisions -- with the 24-hour use of low-beam headlights. Additionally, the research suggests potential crash reduction benefits involving bicycles, pedestrians and motorcycles. The research doesn't demonstrate increases in crashes of any type. Studies tend to agree that the environmental impact of DRL use or of 24-hour headlight use is relatively small, and is a relatively small portion of overall annual vehicle costs. Overall, the major studies show that requiring daytime headlight use in vehicles not equipped with automatic daytime running lights would likely have a positive benefit-cost ratio and a measurable impact on reducing crashes, injuries and deaths on Minnesota roadways.

Appendix A. Legislative Request

Minnesota Session Laws

Key: (1) ~~language to be deleted~~ (2) new language

2009, Regular Session

CHAPTER 168--H.F.No. 878

Sec. 13. STUDY OF MANDATORY 24-HOUR VEHICLE LIGHTING.

(a) The commissioner of public safety, in cooperation with the commissioner of transportation, shall study the mandatory 24-hour use of vehicle lighting by vehicles on public highways. The study must examine the experience of jurisdictions in this country, Canada, and the European Union, that require 24-hour display of vehicle lighting, including but not limited to:

(1) environmental consequences;
(2) crash prevention;
(3) motorcycle, bicycle, and pedestrian safety;
(4) cost to drivers; and
(5) application to motorcycles.

(b) By January 15, 2011, the commissioners of transportation and public safety shall report their findings and recommendations to the chairs and ranking minority members of the legislative committees with jurisdiction over transportation policy. The report must be made electronically and available in print only upon request.

(c) The commissioners of public safety and transportation shall study and report under this section within current appropriations.

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TRANSPORTATION RESEARCH SYNTHESIS

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Appendix B. Effects of 24-Hour Headlight Use on Traffic Safety

The purpose of this TRS is to serve as a synthesis of pertinent completed research to be used for further study and evaluation by Mn/DOT. This TRS does not represent the conclusions of either CTC & Associates or Mn/DOT. Note: Appendices to this appendix can be found in the full source document:

http://www.dot.state.mn.us/research/TRS/2010/TRS1009.pdf)

Introduction

Daytime running lights—generally low-wattage headlights that turn on automatically when a vehicle's ignition is started—are a safety feature intended to reduce multiple-vehicle crashes during daylight hours by making vehicles more conspicuous to other drivers. In some countries, such as Canada, DRL are required standard equipment on all vehicles manufactured; in the United States they are permitted but not required, and were standard equipment on about 27 percent of new vehicles manufactured in 2005 (NHTSA, 2008).

Rather than requiring an equipment modification to new or existing vehicles, some jurisdictions have explored the "behavioral option" of requiring motorists to turn on their vehicle's existing headlights 24 hours a day. The expectation is that this requirement would confer the same safety benefits as having DRLs installed in all vehicles.

The Minnesota Legislature recently directed the Minnesota Department of Public Safety to work with Mn/ DOT to study the impact of 24-hour vehicle lighting. The report is required to address the following issues:

- Potential for crash prevention
- Motorcycle, bicycle and pedestrian safety
- Application to motorcycles
- Experiences of other jurisdictions and countries
- Environmental consequences
- Cost to drivers

In support of this effort, CTC & Associates prepared this Transportation Research Synthesis to analyze the existing literature on 24-hour headlight use, especially as it applies to the issues listed above.

Summary

The impact of DRL has been studied extensively by agencies around the world. The effect of 24-hour use of regular low-beam headlights (as opposed to DRLs) has been studied less frequently, usually as part of a larger study on DRLs. Because of this, most of the research in this Transportation Research Synthesis concerns the use of DRLs; however, many studies reference several types of DRL implementations, including both the low-wattage DRLs common in newer vehicles and older DRLs that are brighter and similar to the wattage of standard low-beam headlights. This research should be applicable to Minnesota's exploration of 24-hour use of low-beam headlights.

We identified research related to the following key topic areas:

- Effectiveness at reducing crash rates
- Effect of automobile DRLs on motorcycle safety
- Effect of DRL use by motorcycles
- Effect on crashes involving pedestrians and bicyclists
- Environmental and cost issues
- Related legislation
- Implementation

Effectiveness at reducing crash rates

In the considerable body of research on this topic, most studies have found that the presence of DRLs reduces daytime multiple-vehicle crashes, especially head-on and front-corner collisions where vehicle conspicuity is a concern. The magnitude of the reduction varies depending on the study and the type of crash, but many studies have found a reduction of 5 to 10 percent.

The most recent large-scale study on this topic was conducted in 2008 in the United States by NHTSA, which found that DRLs had no statistically significant effects on the types of crashes studied, except for a 5.7 percent reduction in the involvement of light trucks/vans in two-vehicle crashes. A 2004 NHTSA study that used different analysis methodology, found that DRLs reduced opposite-direction fatal crashes by 5 percent and opposite-direction/angle non-fatal crashes by 5 percent. That study also found a 12 percent reduction in crashes involving pedestrians and bicyclists, and a 23 percent reduction in opposite-direction crashes involving motorcyclists.

In general, the issue of research methodology seems to be a critical factor in the debate over demonstrating DRLs' effectiveness, and can make it more difficult to aggregate the results of different studies. A key European study (Elvik et al., 2003) that used statistical meta-analysis to aggregate 41 DRL studies (25 studies that evaluated the safety effects of DRL for cars, and 16 for motorcycles) found that DRL use produced a 5 to 10 percent reduction in multiparty daytime crashes for cars. In this study, all 25 of the passenger car studies evaluated in the meta-analysis found that DRL use yielded a crash reduction of some magnitude—no studies demonstrated an increase in crashes.

Finally, recent research using the Minnesota DOT Crash Database also identified reductions in the rates of various crash types when DRLs were present. The magnitudes of the reductions were greater than in other DRL studies, again likely due to differing research methodology. (In this study, the overall crash rate among vehicles without standard DRLs was 1.73 times higher than the rate for vehicles with standard DRLs [832 crashes vs. 481 crashes per 10,000 vehicles].)

Effect of automobile DRLs on motorcycle safety

Minnesota law requires motorcyclists to use their headlights during daylight hours, and opponents of DRLs have argued that requiring headlight use for all vehicles could make motorcycles less conspicuous. A NHTSA study on this topic, *Motorcycle Conspicuity and the Effect of Fleet Daytime Running Lights,* is expected to be complete by the end of 2010.

The findings of the 2008 NHTSA study regarding motorcycles were not statistically significant, and the 2004 NHTSA study found that DRLs reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

Effect of DRL use by motorcycles

Since Minnesota law currently requires motorcyclists to use their headlights at all times, a 24-hour headlight use law would not represent a new requirement for motorcyclists. Elvik et al. (2003) conducted a meta-analysis of 16 studies on DRL use in motorcycles, and found that:

- The use of DRLs on motorcycles reduced the number of multiparty daytime accidents by about 32 percent. However, this estimate was highly uncertain and was based on a single study only.
- Laws or campaigns designed to encourage the use of DRL for motorcycles were associated with a 5 to 10 percent reduction in multiparty daytime accidents.

Effect on crashes involving pedestrians and bicyclists

DRLs have the potential to effect pedestrian and bicyclist safety in at least two ways. It is possible that pedestrians and bicyclists would become relatively less visible when motor vehicles have their headlights on. However, the enhanced conspicuity of motor vehicles may make them easier for pedestrians and bicyclists to observe (Elvik et al., 2003). Studies on this topic found the following:

- The Elvik et al. (2003) meta-analysis found that DRLs reduced crashes involving pedestrians, though some of the individual studies reviewed showed an increase in crashes. The report reviewed three studies that estimated DRLs' effect on crashes involving bicyclists, and all showed a reduction.
- The 2008 NHTSA study found no statistically significant results for crashes involving pedestrians or bicyclists. The 2004 NHTSA study found that DRLs reduced daytime fatal crashes involving non-motorists, pedestrians and cyclists by 12 percent.
- An experimental 2004 European study (Brouwer et al.) found no evidence of a reduced conspicuity of road users in the vicinity of a DRL-equipped vehicle.

Environmental and cost issues

The issues of cost and environmental impact are closely related, because factors that affect the environment, such as increased fuel use and increased use and disposal of headlight bulbs, tend to increase costs as well. Studies on this topic tend to agree that the environmental impact of DRL use or of 24-hour headlight use is relatively small, and is a relatively small portion of overall annual vehicle costs.

Several studies have conducted benefit-cost analyses, often comparing the benefit-cost ratios of dedicated DRLs vs. 24-hour headlight use. The range of benefit-cost ratios across all options varied considerably from study to study, although the ratios for 24-hour headlight use varied less:

- Elvik et al. (2003) estimated a benefit-cost ratio of 1.96 for 24-hour headlight use; this was the highest ratio across all options evaluated.
- An October 2003 study conducted in Australia calculated a 1.18 benefit-cost ratio for 24-hour headlight use; this was the lowest ratio across all options evaluated.

- A 1997 Australian study calculated a 1.27 benefit-cost ratio of requiring motorists to turn on their headlights at all times.

A 2008 study by the California Energy Commission recommended that the state not limit DRL use as a method of reducing petroleum fuel use. The study concluded that the fuel savings from this measure would not exceed 1 percent.

Related legislation
No current state laws requiring 24-hour headlight use were identified, but two bills requiring it have been introduced to the Illinois State Legislature in recent years. In addition, some states have made headlight use mandatory on certain corridors; a 2005 Connecticut bill is an example of this type of proposal.

Implementation
The European Union commissioned an extensive four-part research project to gather information on the effectiveness of DRLs and the most successful implementation scenarios. This project analyzed cost-benefit ratios and projected public acceptance, and recommended implementing DRLs in new vehicles and requiring 24-hour use of low-beam headlights in existing vehicles. The authors suggested that the EU consider requiring 24-hour headlight use prior to the changes in the vehicle fleet in order to receive the expected benefits of DRL use more immediately.

Following this research, the European Union decided to implement DRLs as mandatory on passenger vehicles sold in member nations beginning in 2011.

Effectiveness at reducing crash rates

As countries around the world have weighed whether to mandate the installation of DRLs or the use of headlights during daytime, a considerable amount of research has been performed into the effectiveness of DRLs at preventing crashes. In the last decade, several studies have been performed that analyze and synthesize the large body of existing research. A 2003 meta-analysis study (Elvik et al., 2003) performed for the European Commission is the most extensive of recent syntheses in this area, and is widely cited by subsequent studies.

In the United States, two NHTSA studies (2004 and 2008) are the most recent large-scale research in this area sponsored by the federal government. In addition, a 2010 paper gives a more localized perspective on how the use of DRLs have affected crash rates in Minnesota, but the crash rate reductions are much higher than have been reported in much of the rest of the literature. The authors suggest that this may be due to methodological differences.

Most studies have found that the presence of DRLs reduces daytime multiple-vehicle crashes, especially head-on and front-corner collisions where vehicle conspicuity is a concern. The magnitude of the reduction varies depending on the study and the type of crash, but many studies have found a reduction of 5 to 10 percent. The Elvik et al. meta-analysis (2003) examined 25 studies of passenger cars, and found that DRL use yielded a crash reduction of some magnitude in all 25 studies.

In general, the issue of research methodology seems to be a critical factor in the debate over demonstrating DRLs' effectiveness; for example, the 2004 and 2008 NHTSA studies used different statistical analysis methodologies and yielded different results. For this reason, this Transportation Research Synthesis highlights the methodology used in key studies summarized below.

Minnesota research

Krajicek, Michele E., and Raquel M. Schears. "Daytime Running Lights in the USA: What Is the Impact on Vehicle Crashes in Minnesota?" *International Journal of Emergency Medicine*, 2010, Vol. 3., No. 1, pages 39-43.

http://www.springerlink.com/content/l7650hx33t56n144/fulltext.pdf

Researchers used the Mn/ DOT Crash Database from 1995 to 2002 to compare the crash rates of vehicles with and without DRLs as standard equipment. They evaluated crashes involving 185,000 vehicles, 38,000 of which had standard DRLs. The crashes occurred during daylight, with optimal visibility, on a dry road surface.

The study concluded that vehicles equipped with DRLs had a statistically significant lower crash rate than vehicles without DRLs. Specific findings included:

- The overall crash rate among vehicles without standard DRLs was 1.73 times higher than the rate for vehicles with standard DRLs (832 crashes vs. 481 crashes per 10,000 vehicles).
- For fatal vehicle crashes, the crash rate ratio was 1.48 times higher (3.0 fatal crashes vs. 2.0 fatal crashes per 10,000 vehicles).
- For crashes involving pedestrians, the crash rate ratio was 1.77 times higher (5.2 crashes vs. 2.9 crashes per 10,000 vehicles).
- For crashes involving bicycles, the crash rate ratio was 1.72 times higher (7.8 crashes vs. 4.5 crashes per 10,000 vehicles).

The authors pointed out that these crash rate reductions are notably higher than those seen in previous studies. They hypothesized that this may be because their study was a retrospective study of all vehicle crashes in Minnesota during the time period, whereas previous studies employed a case-control methodology to compare subsets of vehicles with and without DRLs.

National and international research: key studies

National Highway Traffic Safety Administration. ***The Effectiveness of Daytime Running Lights for Passenger Vehicles,*** September 2008, Report DOT HS 811 209.

http://www.regulations.gov/search/Regs/contentStreamer?objectId=090000648070b5b6&disposition=attachment&contentType=pdf

This study is U.S. DOT's most recent research on the effectiveness of DRLs. Its findings—that the presence of DRLs had no statistically significant effect on the three types of crashes studied—differ from most of the rest of the international body of research on DRLs. See page 6 of the PDF for a summary of results.

In this study, NHTSA examined data from the Fatality Analysis Reporting System from 2000 to 2005, and from nine states (Florida, Illinois, Maryland, Michigan, Missouri, Nebraska, Pennsylvania, Utah and Wisconsin) during the same time period or portions of it. Specific findings included:

- The presence of DRLs had no statistically significant effects on three types of daytime crashes: (1) two-vehicle crashes, excluding rear-end crashes; (2) single-vehicle crashes with pedestrians or cyclists;
  (3) single-vehicle crashes with motorcyclists.
- When passenger cars and light trucks/vans were examined separately, DRLs reduced LTVs' involvement in the two-vehicle crashes studied by 5.7 percent, a statistically significant reduction.
- Although this finding was not statistically significant, DRLs appeared to have a negative impact on LTV crashes involving pedestrians and cyclists.

Methodology
This was a control-comparison study that compared specific models of cars and LTVs that had DRLs with earlier versions of identical models without DRLs, as opposed to aggregating all vehicles with DRLs and all vehicles without. Using matched vehicle models was intended to control for vehicle-specific factors so that the presence or absence of DRLs would be the only difference between DRL and non-DRL vehicles. In addition, this study used ratio of odds ratios, rather than simple odds, as the primary statistic to estimate the magnitude of DRLs' effects. The investigators stated that the ratio of odds ratios method produces more conservative estimates, is more sensitive to sample size, and has a greater ability to control for confounding factors.

Contact: Principal investigator Jing-Shiarn Wang, NHTSA, *Jing.Wang@dot.gov*.

In a study performed concurrently with the NHTSA study, researchers for General Motors Corp. sought to use the same matched-pairs methodology, analyzed with two statistical methods, in examining data from slightly different sources:

> **Exponent Inc. (prepared for General Motors).** ***Matched Pair Study of the Effectiveness of Daytime Running Lights****,* February 2008. See *Appendix A*. (Note: Appendices to this appendix can be found in the full source document: *http://www.dot.state.mn.us/research/TRS/2010/TRS1009.pdf)*
>
> This study sought to update the authors' previous research for General Motors using revised methodology, similar to the methods used by the 2008 NHTSA study). This study found a reduction in rates of selected two-vehicle daytime collisions of about 8 to 12 percent for vehicles equipped with DRLs. These results were based on Poisson regression analysis; a second analysis using the ratio of odds ratios approach found a reduction of 5 to 8 percent.
>
> Like the NHTSA study, this study used a matched pairs approach in analyzing the crash data; investigators used model year pairs of GM, Saab, Toyota, Subaru, Volkswagen and Volvo vehicles. Whereas the NHTSA study included crash data from FARS, this study used state data as its primary source. The authors noted that FARS contains data on fatal crashes only, which is a small subset of all crashes that occur. Their analysis of FARS data concluded:
>
> > *"Analyses of fatal crashes reported in FARS showed little difference in crash rates or odds ratios for DRL and non-DRL vehicles. The lack of statistically significant results largely reflects the relatively small numbers of fatal crashes involving these particular vehicle models and years under the specified conditions of interest."*

NHTSA. ***An Assessment of the Crash-Reducing Effectiveness of Passenger Vehicle Daytime Running Lamps (DRLs),*** September 2004, Report DOT HS 809 760.

http://www-nrd.nhtsa.dot.gov/Pubs/809760.pdf

This study estimated the effectiveness of passenger vehicle DRLs in reducing two-vehicle opposite direction crashes, pedestrian/bicycle crashes, and motorcycle crashes. The authors used generalized simple odds, a conventional statistical technique, to analyze the data. This study found that from 1995 to 2001:

- DRLs reduced opposite direction daytime fatal crashes by 5 percent.
- DRLs reduced opposite direction/angle daytime non-fatal crashes by 5 percent.

- DRLs reduced daytime single-vehicle fatal crashes involving non-motorists, pedestrians and cyclists by 12 percent.
- DRLs reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

The study notes that the report's reviewers required the inclusion of an analysis based on odds ratio, which is provided in Appendix B of the report. None of the results of this analysis were statistically significant. The author further discusses the difference between the two methodologies on page 27 of the PDF.

Elvik, Rune; Peter Christensen; and Svenn Fjeld Olsen. ***Daytime Running Lights—A Systematic Review of Effects on Road Safety,*** 2003.

This study was Part 2 of a four-part research project into the effects of daytime running light use sponsored by the European Commission. See *Appendix B* for a summary of all four parts, and see *page 15* for a description of Part 4 (Commandeur et al., 2003). (Note: Appendices to this appendix can be found in the full source document: *http://www.dot.state.mn.us/research/TRS/2010/TRS1009.pdf)*

http://ec.europa.eu/transport/roadsafety_library/publications/IR2_report3_ver_oct_2004.pdf

This study is the most comprehensive analysis of the existing literature on DRLs. The authors analyzed 25 studies that evaluated the safety effects of DRL for cars and 16 studies that evaluated the safety effects of DRL for motorcycles. Their review was a statistical meta-analysis that sought to combine the estimates of effect from each study into one summary estimate.

In their analysis, the authors distinguished between the **intrinsic effect** on safety for an individual vehicle using DRLs and the **aggregate effect** on the total number of accidents in a country of laws or campaigns that lead to an increased use of DRLs.

The results of the meta-analysis included:

- The use of DRL reduces the number of multiparty daytime accidents for cars by about 5 to 10 percent (intrinsic effect). All of the analyzed studies estimated a reduction in the number of accidents, but the size of the reduction varied from study to study.
- Laws or campaigns designed to encourage the use of DRL for cars were associated with a 3 to 12 percent reduction in multiparty daytime accidents (aggregate effect)
- The use of DRL on motorcycles reduces the number of multiparty daytime accidents by about 32 percent (intrinsic effect). However, this estimate is highly uncertain and is based on a single study only.
- Laws or campaigns designed to encourage the use of DRL for motorcycles are associated with a 5 to 10 percent reduction in multiparty daytime accidents (aggregate effect).

The robustness of these summary estimates of effect was tested for potential sources of error in the meta-analysis, including publication bias, varying quality of the studies included, the statistical weights assigned to each estimate of effect; and the contribution of a single study to the overall estimate of effect. The authors found that in general, the summary estimates of effect were very robust.

Other conclusions from the meta-analysis included:

- The effects of DRL varied according to accident severity, with DRL having the greatest effects on the most severe accidents. However, evidence concerning the effects on fatal accidents was inconsistent. In the report's cost-benefit analysis, the authors assumed that DRL would reduce fatal multiparty daytime accidents by 15%, serious injury multiparty daytime accidents by 10%, and slight injury multiparty daytime accidents by 5%.
- There was a weak relationship between geographical latitude and the effects of DRL, with the effects of DRL increasing at latitudes further from the equator.
- Evidence concerning a seasonal variation in the effects of DRL was sparse and inconclusive.
- Further study is needed regarding whether the effects of laws mandating the use of DRL tend to diminish over time.
- The authors concluded that DRL is unlikely to have any adverse effect on accidents involving pedestrians, bicyclists or motorcyclists. Some estimates indicated that DRL laws had an adverse effect on pedestrian accidents, but the summary estimate of effect indicated a reduction in pedestrian accidents.
- The authors concluded that it was likely that using low-beam headlights as DRLs could have an adverse effect on rear-end collisions, because turning on a vehicle's headlights illuminates its tail lights as well, which could make it more difficult to detect brake lights. However, the presence of a third brake light may counteract this effect, as would the use of dedicated DRLs with tail lights that are switched off.
- The authors evaluated the presence of a dose-response relationship regarding the use of DRL (that is, the greater the increase in DRL usage, the greater the effect on safety), and did not find evidence of this type of relationship. Therefore, they predicted that making DRL use mandatory in the European Union would have an effect on accidents similar to the average effect observed in previous evaluation studies.

Methodology

The authors present more detail on the methodology of their statistical meta-analysis on page 7 of the PDF (see "Concerns about meta-analysis"). In addition, in 2005 one of the study's authors published a paper in *Transportation Research Record* on the topic ("Can We Trust the Results of Meta-Analyses?: A Systematic Approach to Sensitivity Analysis in Meta-Analyses," *Transportation Research Record* vol. 1908, pages 221-229, 2005).

The UK Department for Transport sponsored a study that reviewed the results of the European Commission research:

> **Knight, I.; B. Sexton; R. Bartlett; T. Barlow; S. Latham; and I. McCrae. *Daytime Running Lights (DRL): A Review of the Reports from the European Commission*,** October 2006, sponsored by the UK Department for Transport.
>
> *http://ec.europa.eu/transport/road_safety/vehicles/doc/consultations/drl_trl.pdf*
>
> Commissioned by the UK Department for Transport, this review of the European Commission reports agreed with the reports' conclusion that DRL use would reduce crashes, but questioned the stated magnitude of DRLs' effect. The reviewers also agreed that the reports' estimates of fuel and emissions increases were reasonable (and possibly slightly conservative, or high). See page 42 of the PDF for additional conclusions from this review.

National and International Research: Additional Studies

United States

Farmer, C.M., and A.F. Williams (Insurance Institute for Highway Safety). "Effects of Daytime Running Lights on Multiple-Vehicle Daylight Crashes in the United States," *Accident Analysis and Prevention*, March 2002, Vol. 34, No. 2, pages 197-203.

Abstract: Involvements in multiple-vehicle daylight crashes in nine states over 4 years were analyzed for a group of passenger cars and light trucks equipped with automatic DRLs. On average, these vehicles were involved in 3.2% fewer multiple-vehicle crashes than vehicles without DRLs (P = 0.0074).

Insurance Institute for Highway Safety. "Q&As: Daytime Running Lights," October 2009.

http://www.iihs.org/research/qanda/drl.html

This online Q&A page notes that "nearly all published reports indicate DRLs reduce multiple-vehicle daytime crashes," and summarizes key results from several studies conducted in Scandinavia, Canada and the United States, including:

- A 2002 study by the Insurance Institute for Highway Safety reported a 3 percent decline in daytime multiple-vehicle crash risk in nine U.S. states concurrent with the introduction of DRLs.
- A study examining the effect of Norway's DRL law from 1980 to 1990 found a 10 percent decline in daytime multiple-vehicle crashes.
- A Danish study reported a 7 percent reduction in DRL-relevant crashes in the first 15 months after DRL use was required and a 37 percent decline in left-turn crashes.
- In a second study covering 2 years and 9 months of Denmark's law, there was a 6 percent reduction in daytime multiple-vehicle crashes and a 34 percent reduction in left-turn crashes.
- A 1994 Transport Canada study comparing 1990 model year vehicles with DRLs to 1989 vehicles without them found that DRLs reduced relevant daytime multiple-vehicle crashes by 11 percent.

Canada

All vehicles produced for sale in Canada after December 1, 1989, are required to be equipped with DRLs. (See the text of the legislation at *http://www.tc.gc.ca/eng/acts-regulations/regulations-crc-c1038-sch-iv-108.htm*.) Transport Canada examined the effect of the law a few years after it was introduced, in the 1994 study by Arora et al., and evaluated costs and benefits of DRLs in 1995.

We contacted Transport Canada to identify whether additional research on DRLs had been initiated or completed. Senior Crash Avoidance & Research Engineer Vittoria Battista confirmed that there had been no additional studies undertaken beyond those listed below.

Contact: Vittoria Battista, Senior Crash Avoidance & Research Engineer, Transport Canada, (613) 998-1950, *vittoria.battista@tc.gc.ca*.

Arora, H.; D. Collard; G. Robbins; E.R. Welbourne; and J.G. White (Transport Canada). *Effectiveness of Daytime Running Lights in Canada.* December 1994, Report No. TP-12298.

Lawrence, E. (Transport Canada). *Preliminary Economic Evaluation of the Costs and Benefits of the Daytime Running Lights Regulation,* 1995, Report No. TP 12517.

From the abstract: This paper presents a cost-benefit analysis of the use of DRL in preventing collisions, taking into account the original equipment costs of fitting vehicles with DRL and with the fuel consumption penalties associated with fitting and use of DRL. High and low cost estimates are given, reflecting factors such as the difference between integrating DRL into existing systems or into new vehicle designs. Benefits are calculated from the collision reduction rate due to DRL as determined in a 1995 Transport Canada study, combined with previously developed estimates of the standard cost of the avoided collisions.

White, J. *Information on Daytime Running Lights*, May 1998, Transport Canada Technical Memorandum TMSR 9801 (unpublished).

Key findings of this report are summarized in a 2003 literature review conducted by Australia's National Roads and Motorists Association, *A Review of Daytime Running Lights* (see *http://members.optusnet.com.au/carsafety/paine_drl_nrma_racv.pdf*, beginning on page 16 of the PDF).

The following two papers present additional perspectives on DRL use in Canada:

Tofflemire, Troy C., and Paul C. Whitehead. "An Evaluation of the Impact of Daytime Running Lights on Traffic Safety in Canada," *Journal of Safety Research,* Volume 28, Issue 4, Winter 1997, pages 257-272.

Abstract: Since December 1, 1989 all new cars sold in Canada were required to be equipped with DRLs. This policy was expected to reduce angle and opposing collision involvement by 10% to 20% by making cars more conspicuous, thereby increasing the window of opportunity within which drivers can react. A quasi-experimental comparative posttest design is used in this study to evaluate the impact of DRL legislation on the incidence of angle and opposing collisions for 1989 cars and 1990 cars in the 1991 calendar year. The results show that the combined incidence of the two types of collisions is reduced by 5.3% ($p < .05$), mainly due to a reduction in the incidence of opposing collisions (−15%; $p < .05$), rather than angle collisions (−2.5%; NS). An examination of each province reveals that only two small provinces display a statistically significant reduction in the incidence of opposing collisions and one province displays a statistically significant reduction in the incidence of angle collisions. The implications of these results are discussed in terms of their relevance for DRL policy theory, traffic safety, future research, and cost.

Sparks, Gordon A.; Russell D. Neudore, Anne E. Smith, Kenneth R. Wapman, and Paul L. Zador. "The Effects of Daytime Running Lights on Crashes Between Two Vehicles in Saskatchewan: A Study of a Government Fleet," *Accident Analysis and Prevention,* 1991, Vol. 25, pages 619-625.

From the abstract: Crashes of vehicles with and without DRLs owned by the Central Vehicle Agency of the Province of Saskatchewan were compared to a random selection of crashes drawn from provincial crash files involving vehicles without DRLs for the years 1982 through 1989. Daytime two-vehicle crashes involving vehicles approaching from the front or side were reduced by about 28% for the daytime running-light equipped vehicles. A 28% reduction in daytime running-light relevant daytime two-vehicle crashes corresponds to a 15% reduction in all daytime two-vehicle crashes.

Other countries

Holló, P. "Changes in the Legislation on the Use of Daytime Running Lights by Motor Vehicles and Their Effect on Road Safety in Hungary," *Accident Analysis and Prevention*, March 1998; Vol. 30, No. 2, pages 183-199.

This paper analyzed the effects of DRL use laws implemented in Hungary in 1993 and 1994 and found a 13 percent reduction in daytime frontal and "crossing" vehicle collisions where DRL use was required.

Koornstra, M.J.; F. Bijleveld; and M. Hagenzieker. *The Safety Effects of Daytime Running Lights,*
Report R-97-36. Leidschendam, The Netherlands, SWOV Institute for Road Safety Research, 1997.

http://www.landesverkehrswacht.de/fileadmin/downloads/Tagfahrlicht/Studie_Niederlande_Tagfahrlicht.pdf

This report analyzed 24 previous studies, with a focus on issues of perception of vehicles with DRLs. The authors found that DRLs generally had a positive effect on visual perception of vehicles, "particularly peripheral perception as well as perception under low levels of (daytime) ambient illumination and when not too high intensity lamps are used (to avoid glare effects)."

In addition, researchers calculated a benefit-cost ratio of 1.27 for mandatory daytime use of headlights ("behavioral obligation"). See page 10 of the PDF.

Note on study methodology:

Stone, M. "Questions of Probability in Daytime-Running-Light Argument," Accident Analysis and Prevention, September 1999, Vol. 31, No. 5, pages 479-483.

Abstract: The paper presents a revision of the formulae of Koornstra for converting "raw" daytime-running-light effects into "intrinsic" effects, based on a reworking of the underlying probability calculus.

Hansen, L.K. *Daytime Running Lights in Denmark—Evaluation of the Safety Effect.* Danish Council of Road Safety Research, Copenhagen, 1993.

Early Studies of Effectiveness

Andersson, K.; G. Nilsson; and M. Salusjarvi. *The Effect of Recommended and Compulsory Use of Vehicle Lights on Road Accidents in Finland,* 1976, Report 102A, National Road and Traffic Research Institute, Linkoping, Sweden.

Andersson, K., and G. Nilsson. *The Effect on Accidents of Compulsory Use of Running Lights During Daylight Hours in Sweden,* 1981, Report 208A, National Road and Traffic Research Institute, Linkoping, Sweden.

The following study re-examines the data in Andersson and Nilsson (1981):

Theeuwes, J., and J. Riemersma. "Daytime Running Lights as a Vehicle Collision Countermeasure: The Swedish Evidence Reconsidered," *Accident Analysis and Prevention,* October 1995, Vol. 27, No. 5, pages 633-542. TNO Human Factors Research Institute, Soesterberg, The Netherlands. *http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.77.8738&rep=rep1&type=pdf*

Abstract: In Sweden the use of DRLs was made mandatory on 1 October 1977 for all motor vehicles at once, during all seasons and for all areas. According to a study conducted by Andersson and Nilsson (1981) [Andersson and Nilsson. VTI Swedish Road and Transport Research Institute, Report No. 208A; 1981] the introduction of DRL resulted in a reduction of 11% of multiple accidents during daytime. In many discussions on the effectiveness of DRL, these findings have been considered as the strongest evidence that the use of DRL is an effective vehicle collision countermeasure. The present study reexamines this evidence and shows that the reported 11% effect of DRL in the Swedish study is spurious. The effect is mainly the result of the application of a model that shows selective effects of DRL through modeling of unexplained changes in the number of single accidents. It is concluded that the Swedish data fail to show a clear effect of DRL.

Industry research

Bergkvist, P. (General Motors). "Daytime Running Lights—A North American Success Story," *Proceedings of 17th Conference on the Enhanced Safety of Vehicles,* Windsor, Canada, 1998.

From the abstract: This paper begins with a brief regulatory history of DRLs in the U.S. and how General Motors Corporation (GM) introduced DRL-equipped vehicles. It also describes a DRL effectiveness study conducted by Exponent Failure Analysis Associates of San Francisco for General Motors Corporation. The study compared the collision rates of specific General Motors Corporation, Saab, Volvo and Volkswagen vehicles before and immediately after the introduction of DRLs. Information from police accident reports and registration data shows that General Motors Corporation customers have avoided more than 25,000 vehicle collisions since General Motors Corporation began equipping vehicles with DRLs in 1995.

Other General Motors studies discussed elsewhere in this report include:

> **Exponent Inc. (prepared for General Motors).** ***Matched Pair Study of the Effectiveness of Daytime Running Lights****,* February 2008. See *Appendix A*.
>
> This study sought to update the authors' previous research for General Motors using revised methodology, similar to the methods used by the 2008 NHTSA study). This study found a reduction in rates of selected two-vehicle daytime collisions of about 8 to 12 percent for vehicles equipped with DRLs. These results were based on Poisson regression analysis; a second analysis using the ratio of odds ratios approach found a reduction of 5 to 8 percent.
>
> **Thompson, Paul A. (General Motors).** ***Daytime Running Lamps (DRLs) for Pedestrian Protection****,* May 2003.
>
> This study updated a 2000 study that reviewed crash data from 12 states, adding five additional states and more vehicle models. The abstract notes that in the 2000 study, the presence of DRLs yielded the most significant collision reductions in crashes involving pedestrians. The abstract does not give detailed results of the 2003 study.

Effect of automobile DRLs on motorcycle safety

NHTSA. ***Motorcycle Conspicuity and the Effect of Fleet Daytime Running Lights,*** Contract DTNH22-05-D-01002. In progress; expected completion in 2010.

Principal investigator Stephanie Binder indicated via email that NHTSA is currently finalizing this report and expects it to be available for review by the end of the year. An undated paper and a 2005 presentation based on this research are available online; they describe the study but do not give results or conclusions.

> **Binder, Stephanie, Michael Perel, John Pierowicz, Valerie Gawron, and Glenn Wilson. "Motorcycle Conspicuity and the Effects of Motor Vehicle Fleet Daytime Running Lights (DRLs),"** paper presented at International Motorcycle Safety Conference, undated.
>
> *http://www.msf-usa.org/imsc/proceedings/b-Binder-EffectsofMotorVehicleDRLonMotorcycleConspicuity.pdf*
>
> **Binder, Stephanie, and Michael Perel. "The Effects of Motor Vehicle Fleet Daytime Running Lights (DRLs) on Motorcycle Conspicuity,"** presentation, Dec. 6, 2005.
>
> *http://www.nhtsa.gov/DOT/NHTSA/NVS/Public%20Meetings/Presentations/2005%20Meetings/Binder_DRLS.pdf*

Contact: Principal investigator Stephanie Binder, NHTSA, *stephanie.binder@dot.gov*.

NHTSA. ***The Effectiveness of Daytime Running Lights for Passenger Vehicles,*** September 2008.

http://www.regulations.gov/search/Regs/contentStreamer?objectId=090000648070b5b6&disposition=attachment&contentType=pdf

This study found no statistically significant effect of DRL use on crashes involving motorcycles. Although the results were not significant, the authors found that DRLs in cars and light trucks/vans were more likely to increase fatal daytime crashes involving motorcycles, and seemed to increase overall crashes between vehicles and motorcycles. DRLs seemed to reduce crashes causing injury and overall crashes involving passenger cars and motorcycles, but seemed to have adverse effects on crashes involving light trucks/vans and motorcycles (see page 8 of the PDF). These adverse effects were not statistically significant.

NHTSA. *An Assessment of the Crash-Reducing Effectiveness of Passenger Vehicle Daytime Running Lamps (DRLs),* September 2004.

http://www-nrd.nhtsa.dot.gov/Pubs/809760.pdf

This study found that from 1995 to 2001, DRLs reduced daytime opposite direction fatal crashes of a passenger vehicle with a motorcycle by 23 percent.

Effect of DRL use by motorcycles

Minnesota law currently requires motorcyclists to turn on their headlights during daylight hours, so a 24-hour headlight use law would not represent a new requirement for motorcyclists. Several researchers studied the effectiveness of motorcycle headlight use laws during the 1980s, but less research has been performed on the topic in recent years. Elvik et al. (2003) analyzed 16 studies on DRL use in motorcycles; the results of this analysis are presented below.

Elvik, R., et al. *Daytime Running Lights—A Systematic Review of Effects on Road Safety,* 2003.

http://ec.europa.eu/transport/roadsafety_library/publications/IR2_report3_ver_oct_2004.pdf

This meta-analysis study identified two effects of motorcycles using DRLs:

- The use of DRL on motorcycles reduces the number of multiparty daytime accidents by about 32 percent (intrinsic effect). However, this estimate is highly uncertain and is based on a single study only.
- Laws or campaigns designed to encourage the use of DRL for motorcycles are associated with a 5 to 10 percent reduction in multiparty daytime accidents (aggregate effect).

Effect on crashes involving pedestrians and bicyclists

DRLs have the potential to effect pedestrian and bicyclist safety in at least two ways. It has been suggested that pedestrians and bicyclists become relatively less visible when motor vehicles have their headlights on. However, the enhanced conspicuity of motor vehicles may make them easier to observe for pedestrians and bicyclists (Elvik et al., 2003).

Elvik, R., et al. *Daytime Running Lights—A Systematic Review of Effects on Road Safety,* 2003.

http://ec.europa.eu/transport/roadsafety_library/publications/IR2_report3_ver_oct_2004.pdf

This meta-analysis study drew conclusions about the effect of DRLs on pedestrian and bicyclist safety (see page 88 of the PDF):

- This study analyzed five studies that provided estimates of the **intrinsic** effects of DRLs on crashes involving pedestrians. All studies, as well as the meta-analysis summary estimate, indicated a reduction of pedestrian accidents.
- The study analyzed nine studies that provided estimates of **aggregate** effects of DRLs on crashes involving pedestrians. Five showed an increase in the number of accidents, and four showed a reduction. However, the meta-analysis summary estimate showed a reduction in pedestrian accidents, despite the fact that a majority of the individual estimates of effect showed an increase.
- No estimates were found of the intrinsic effects of DRL on crashes involving bicyclists. There were three estimates of the aggregate effects, and all of them showed a reduction in crashes involving bicyclists.

Based on the meta-analysis, it is concluded that the DRL is unlikely to have any adverse effects on accidents involving pedestrians, cyclists or motorcyclists. Some estimates indicate an adverse effect of DRL laws for pedestrian accidents, but the summary estimate of effect, taking all individual estimates into account, indicates a reduction in pedestrian accidents.

NHTSA. *The Effectiveness of Daytime Running Lights for Passenger Vehicles,* September 2008.

http://www.regulations.gov/search/Regs/contentStreamer?objectId=090000648070b5b6&disposition=attachment&contentType=pdf

This study found no statistically significant effect of DRL use on crashes involving pedestrians and cyclists. Although the results were not significant, the authors found that DRLs in cars were more likely to reduce both fatal and injury crashes involving pedestrians and cyclists. For light trucks/vans, they found a large negative effect (see page 7 of the PDF), which was also not statistically significant.

NHTSA. *An Assessment of the Crash-Reducing Effectiveness of Passenger Vehicle Daytime Running Lamps (DRLs),* September 2004.

http://www-nrd.nhtsa.dot.gov/Pubs/809760.pdf

This study found that from 1995 to 2001, DRLs reduced daytime fatal crashes involving non-motorists, pedestrians and cyclists by 12 percent.

Brouwer, R.F.T.; W.H. Janssen; M. Duistermaat; and J. Theeuwes. *Do Other Road Users Suffer from the Presence of Cars That Have Their Daytime Running Lights On? Investigation of Possible Adverse Effects of Daytime Running Lights,* 2004, TNO Report TM-04-C001, TNO Human Factors, Soesterberg.

This study was part of the four-part European Commission project; see a summary at *http://www.swov.nl/rapport/R-2003-29.pdf*, pages 12 to 13 of the PDF.

In this experimental study, subjects viewed color slides depicting natural daylight scenes of traffic intersections. The slides contained a vehicle with or without DRL and possibly other road users such as a bicyclist, pedestrian, or

motorcyclist. Subjects were instructed to determine as fast as possible whether other road users were present or not. The main result of the study is that no evidence was found of a reduced conspicuity of road users in the vicinity of a DRL-equipped vehicle. Other road users actually appeared to benefit from DRL, although the effect was small. A similar

absence of adverse effects was found with respect to driver visual capacities, as measured in elderly drivers by UFOV (useful field of view) and static visual acuity scores.

Thompson, Paul A. (General Motors). ***Daytime Running Lamps (DRLs) for Pedestrian Protection,*** May 2003.

This study updated a 2000 study that reviewed crash data from 12 states, adding five additional states and more vehicle models. The abstract notes that in the 2000 study, the presence of DRLs yielded the most significant collision reductions in crashes involving pedestrians. The abstract does not give detailed results of the 2003 study.

Environmental and cost issues

The issues of cost and environmental impact are closely related, because factors that affect the environment, such as increased fuel use and increased use and disposal of headlight bulbs, tend to increase costs as well. Studies on this topic tend to agree that the environmental impact of DRL use or of 24-hour headlight use is relatively small, and is a relatively small portion of overall annual vehicle costs.

Several studies have conducted benefit-cost analyses, often comparing the benefit-cost ratios of dedicated DRLs vs. 24-hour headlight use. The range of benefit-cost ratios across all options varied considerably from study to study, although the ratios for 24-hour headlight use varied less:

- Elvik et al. (2003) estimated a benefit-cost ratio of 1.96 for 24-hour headlight use; this was the highest ratio across all options evaluated.
- An October 2003 study conducted in Australia calculated a 1.18 benefit-cost ratio for 24-hour headlight use; this was the lowest ratio across all options evaluated.
- A 1997 Australian study calculated a 1.27 benefit-cost ratio of requiring motorists to turn on their headlights 24 hours a day, compared with 1.76 for automatic in-vehicle DRL with low-wattage lights.

A 2008 study by the California Energy Commission recommended that the state not limit DRL use as a method of reducing petroleum fuel use. The study concluded that the fuel savings from this measure would not exceed 1 percent.

Insurance Institute for Highway Safety. "Q&As: Daytime Running Lights," October 2009.

http://www.iihs.org/research/qanda/drl.html

Excerpt: "Running vehicle lights in the daytime does not significantly shorten bulb life. Systems like those on General Motors cars that use high beams are designed to operate at half their normal power during daylight hours, thereby conserving energy and reducing the effect on a vehicle's fuel economy. The National Highway Traffic Safety Administration (NHTSA) estimates that only a fraction of a mile per gallon will be lost, depending on the type of system used. GM estimates the cost to be about $3 per year for the average driver. Transport Canada estimates the extra annual fuel and bulb replacement costs to be $3-15 for systems using reduced-intensity headlights or other low-intensity lights and more than $40 a year for DRL systems using regular low-beam headlights."

California Energy Commission. ***Option 1G: Limiting the Use of Daytime Running Lights and Optional Lamps,*** addendum to the CEC report *Options to Reduce Petroleum Fuel Use,* August 7, 2008.

http://www.energy.ca.gov/2005publications/CEC-600-2005-024/addendum_individual_files/CEC-600-2005-024-AD-1G.pdf

This analysis examines the petroleum reduction that might be achieved by limiting the use of DRLs, fog lamps, and other optional vehicle lights.

> *Summary:* The analysis estimates that the petroleum savings from limiting the use of DRLs would not exceed 1 percent and would defeat the more important societal safety function they provide. Daytime visibility and avoidance of head-on or sideswipe multiple car accidents is the primary function of DRLs. Additionally, a general trend towards low energy/high luminosity lamps is occurring in the automobile market. Lower energy use in these lamps may be hastened by regulatory proceedings underway to correct for unintended glare. A proposed safety regulation will limit the luminosity of DRLs used in the United States in the near future.

Elvik, et al. *Daytime Running Lights—A Systematic Review of Effects on Road Safety,* 2003.

http://ec.europa.eu/transport/roadsafety_library/publications/IR2_report3_ver_oct_2004.pdf

(see pages 98-99 of the PDF)

This study calculated benefit-cost ratios for five implementation options. The ratios ranged from 1.42 to 1.96, with the behavioral-only option (requiring motorists to turn on their headlights manually) yielding the highest benefit-cost ratio. (Although using a vehicle's existing headlights consumes more fuel than using low-wattage DRLs, this option requires no installation of new equipment.)

Cairney, Peter, and Tanya Styles (Australian Transport Safety Bureau). *Review of the Literature on Daytime Running Lights (DRL),* October 2003.

http://www.infrastructure.gov.au/roads/safety/publications/2003/pdf/Cons_Lights.pdf

This study calculated benefit-cost ratios for six implementation scenarios, and found the option that required motorists to turn on their existing headlights 24 hours a day (referred to as the "Model 2" option) had the lowest benefit-cost ratio of the six options evaluated, at 1.18. The highest benefit-cost ratio in this study was 4.59 (see Table 9, page 61 of the PDF).

In preparing the benefit-cost ratios, this study estimated the annual costs of the six options for daytime headlight use (see Table 5, page 57 of the PDF). The "Model 2" option was estimated to cause drivers to need to purchase an additional set of headlight bulbs every two years, and an additional 30 liters (8 gallons) of gasoline per year.

Koornstra, Matthijs; Frits Bijleveld; and Marjan Haganzieker. *The Safety Effects of Daytime Running Lights*, 1997, Report R-97-36, SWOV Institute for Road Safety Research.

http://www.landesverkehrswacht.de/fileadmin/downloads/Tagfahrlicht/Studie_Niederlande_Tagfahrlicht.pdf

(See page 9 of the PDF for an erratum that provides revised benefit-cost ratios.)

This study calculated that the benefit-cost ratio of requiring motorists to turn on their headlights 24 hours a day was 1.27, compared with 1.76 for automatic in-vehicle DRL with low-wattage DRL lamps.

Lawrence, E. (Transport Canada). *Preliminary Economic Evaluation of the Costs and Benefits of the Daytime Running Lights Regulation,* 1995, Report No. TP 12517.

From the abstract: This paper presents a cost-benefit analysis of the use of DRL in preventing collisions, taking into account the original equipment costs of fitting vehicles with DRL and with the fuel consumption penalties associated with

fitting and use of DRL. High and low cost estimates are given, reflecting factors such as the difference between integrating DRL into existing systems or into new vehicle designs. Benefits are calculated from the collision reduction rate due to DRL as determined in a 1995 Transport Canada study, combined with previously developed estimates of the standard cost of the avoided collisions.

National Roads and Motorists' Association [Australia] Motoring & Services and RACV, *A Review of Daytime Running Lights,* June 2003.

http://members.optusnet.com.au/carsafety/paine_drl_nrma_racv.pdf

This report discusses cost-benefit scenarios for Australia on pages 34-35 of the PDF.

Related legislation

No current state laws requiring 24-hour headlight use were identified, but two bills requiring it have been introduced to the Illinois State Legislature in recent years. In addition, some states have made headlight use mandatory on certain corridors; a 2005 Connecticut bill is an example of this type of proposal.

Illinois

House Bill 4701, introduced January 4, 2010, by State Rep. Dan Brady

http://www.ilga.gov/legislation/BillStatus.asp?DocNum=4701&GAID=10&DocTypeID=HB&LegId=48973&SessionID=76&GA=96

This bill would require the use of headlights or DRLs 24 hours a day. Bill sponsor State Rep. Dan Brady was quoted about the bill in a March 2010 article in the *Daily Herald* (see *http://www.dailyherald.com/story/?id=365890&src=109*) as saying he introduced the bill at the request of law enforcement officials from his district as a possible way to reduce accidents.

Contact: Rep. Dan Brady, State Representative, (309) 662-1100, *dan@rep-danbrady.com*

State Rep. Jim Sacia introduced a similar bill in the Illinois House of Representatives last year. He indicated via e-mail that the impetus for the bill came from "an elderly lady who indicated that, in the afternoon sun, it was hard to see gray cars against gray pavement." Sacia said resistance to the bill was significant; although most police agencies were in favor of it, he said many residents thought it was "a government intrusion." He noted that antique car enthusiasts were also resistant to the idea.

Contact: Jim Sacia, State Representative, (815) 232-0774, *jimsacia@aeroinc.net*

Connecticut

Proposed Bill No. 336, introduced January 2005 by State Sen. Prague

ftp://ftp.cga.ct.gov/2005/tob/s/2005SB-00336-R00-SB.htm

This bill would have required a 24-hour "headlight use zone" on a portion of Route 169

Implementation

The European Union commissioned an extensive four-part research project to gather information on the effectiveness of DRLs and the most successful implementation scenarios. The Elvik et al. study (2003) was Part 2 of this project, and Part 4, Commandeur et al. (2003), focused on implementation.

Commandeur et al. (2003) analyzed cost-benefit ratios and projected public acceptance, and recommended implementing DRLs in new vehicles and requiring 24-hour use of low-beam headlights in existing vehicles. The authors suggested that the EU consider requiring 24-hour headlight use prior to the changes in the vehicle fleet in order to receive the expected benefits of DRL use more immediately.

Following this research, the European Union decided to implement DRLs as mandatory on passenger vehicles sold in member nations beginning in 2011 (see a fact sheet at *http://www.swov.nl/rapport/Factsheets/UK/FS_DRL.pdf*).

Commandeur, Jacques; René Mathijssen; Rune Elvik; Wiel Janssen; and Veli-Pekka Kallberg. *Scenarios for the Implementation of Daytime Running Lights in the European Union,* 2003. Part 4 of a four-part project sponsored by the European Commission.

http://www.swov.nl/rapport/R-2003-29.pdf

This study analyzed five policy options for the implementation of DRL in the European Union. The authors recommended an option that yielded the second best benefit-cost ratio, which they believed would be most widely accepted by the public: mandatory use of low-beam headlights as DRL for cars currently on the road, together with the installation of automatic dedicated DRL on new cars, both to be implemented at the same time

from a certain date forward, and preceded by a period of recommended DRL usage combined with a large-scale publicity campaign.

The authors note: “Should the technical part of the implementation take too long, however, the report recommends to start imposing the use of [low-beam] headlights as DRL as soon as possible, thus avoiding an unnecessary delay in the expected road safety benefits of DRL.”

Appendix C. Mn/DOT talk: daytime headlight use

Summary

Many respondents currently limit their daytime headlight use to poor and deteriorating weather conditions, but most do believe use at all times may lead to safer roads. Supporters cite daytime headlight use as increasing visibility of all parties, and making any transitions from bright to dark driving conditions safer. Those in opposition feel that obscured vision and increased wear on car hardware merits drivers avoiding use of headlights at all times of the day/night. Possible legislation requiring daytime headlight use is supported by many, but there is public interest in seeing supporting research. Some of those opposed suspect questionable politics as potential motivating factor.

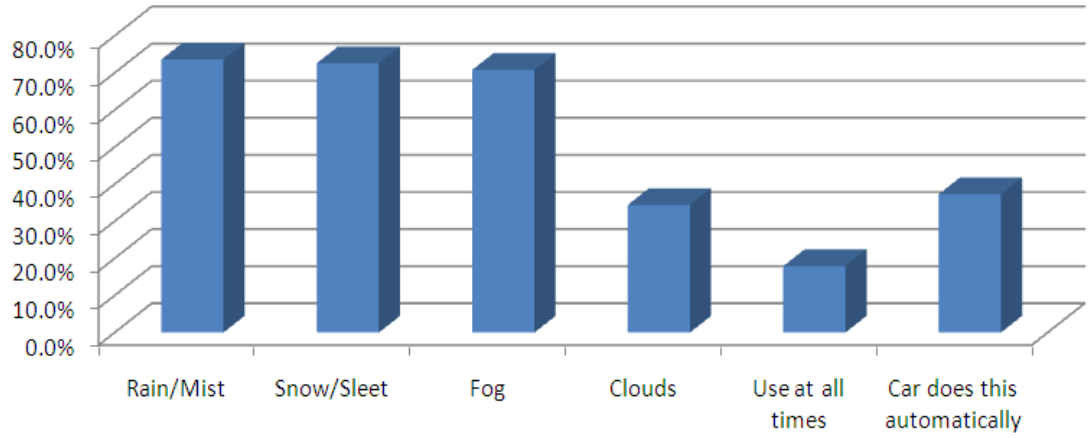
> *"[Daytime headlights make it] Easier to see the oncoming vehicle, and if everyone did it all of the time they wouldn't forget to turn them on when they really need it."*

> *"No need to burn out my headlights by using them in good weather. And again, some of the newer lights tend to blind me if they catch my eyes just right. Is there any data showing that daytime headlights reduce crashes?"*

Current daytime headlight use is primarily the result of weather conditions and car technology

A majority of respondents typically drive with their headlights on during the daytime in the midst of inclement weather like rain, snow/sleet and fog; however when faced with cloudy conditions only, during the day, the number of those likely to use their headlights decreases by about half.

In which of the following situations do you typically drive in the daytime with your headlights on?
(n=212)



November 19, 2010

Mn/DOT Talk is the Minnesota Department of Transportation's online community of 600 Minnesota residents. Customers participate in online discussions, surveys, brainstorming sessions and chats on a multitude of transportation issues.

Project:
Daytime Headlight Use

Project Objectives:
Explore member thoughts on headlight use during the day, in all conditions, as well as legislation that may make it a requirement.

Methodology:
Survey, "Headlight vision" *(n=212)*

For More Information Contact:

Karla Rains
Market Research/PARI
651-366-3172
Karla.Rains@state.mn.us

www.dot.state.mn.us/online/

NOTE: these returned responses are not "balanced" back to the MN state (population) demographics; as such review with caution.

"[I use my headlights] Anytime I feel that the situation calls for my car to be able to be seen more easily by others. Generally speaking I don't think people realize how easy it is to lose a white, silver or gold car in the bright sunlight."

"Anytime that I need to use the wipers I will turn on the headlights."

Support for daytime headlight use points to advantages like increased visibility, and safe transitions between light and dark conditions

A majority of respondents believe there is a benefit to everyone using headlights at all times during the day. As observed in the previous discussion "Losing Daylight", respondents cite an ongoing issue with drivers failing to turn their headlights on as the sun goes down and darkness sets in. That same problem may apply, as some indicate, to anyone that experiences other sudden transitions from light to dark driving conditions, e.g., driving through a tunnel or parking garage. Overall, the use of headlights during the daytime ensures that drivers are clearly visible at all times, regardless of current lighting. As few members hint, cars can even appear to blend in with the scenery. Respondents believe daytime headlight helps to ensures that vehicles stand out from the background, thus they not only help one see, but *be seen.*

"Anytime when it's darker than usual, or anytime I think that I should increase my visibility. For example I do this in underground car parks because mine do not automatically come on. Ever notice it's hard to tell when someone is coming around the corner in a crowded dark car park?"

"It can be very difficult to see oncoming cars if they don't have their headlights on, so I assume that I'm difficult to see if I don't have mine on. I think the main benefit is I'm not going to get hit because I didn't have my lights on."

"It makes cars more visible. There is no guessing as to when to turn them on. People don't seem to realize that they are to make you seen as much as to help you see."

Respondents also point out that this [potential] improved visibility may benefit drivers wearing sunglasses, driving on more rural roads (where other cars are less frequent), and the elderly, whose eyesight may not be as good as their younger counterparts.

"Approaching cars can see you better. It may not be important in the metro areas or on divided roadways but here in the rural areas it makes it FAR easier to see oncoming traffic. I believe it would decrease by at least 35% the number of head-on crashes in rural areas where there is two-way traffic."

"It makes everyone more visible to others. Car colors, background colors and weather conditions can make it harder to see other vehicles so having headlights on gives everyone a better chance of being seen. As part of the aging population, I know that we don't always see as much as we did when we were younger and lights on is a benefit to everyone."

Opposition to daytime headlight use focuses on problems with glare, obscured vision, and increased hardware issues

Less than half (42%) of respondents feel as though there are some drawbacks to requiring the use of headlights during the day, such as:

- **Added glare and blur.** With modern cars relatively higher compared to older models, some express concern over experiencing the rearview shine, head on; while further adding that normal daytime glare may cause greater vision issues.

  "On a sunny day, the glare of the headlights off of chrome on the vehicle in front of you or in your mirrors."

  "A line of cars with all lights on is a blur. Sometimes you can't differentiate between separate vehicles."

  "Since the lights on some vehicles sit higher than on others, it could actually impair the vision of oncoming traffic by blinding them on a clear day. It would also increase the cost of motor vehicle use, because lights would need replacement more often."

- **It may eventually become "the visual equivalent of white noise".**

  "While I believe there are benefits to driving with headlights on when conditions warrant it (i.e. when visibility for yourself and to other drivers is enhanced), if everyone has headlights on at all times, I believe pretty soon it would become the visual equivalent of 'white noise' and would not serve the desired effect."

- **Effect on headlamp wear and tear.** The assumed effect daytime headlight use may have on car hardware also raises some red flags. An increased drain on car batteries, for example, encourages some to envision more stranded motorists, especially drivers of older cars who have to manually turn off headlights when parking (and may forget). In addition, increased headlight use leads many to envision more burnt out bulbs, forcing drivers to foot the bill for new parts.

  "Does it really reduce that many crashes? I agree that they should be legally required to be on during inclement weather and at night but not during the day. That's going to create a burden on those that don't have newer cars as they are going to forget to turn them off in the daytime. If you can't see them, you won't remember."

  "Older cars don't have the headlights-on-always function, and the automatic shut-off of headlights if accidentally left on. I have killed my battery several times just in the last few years because I left the house in semi-dark, arrived in light and forgot to turn them off."

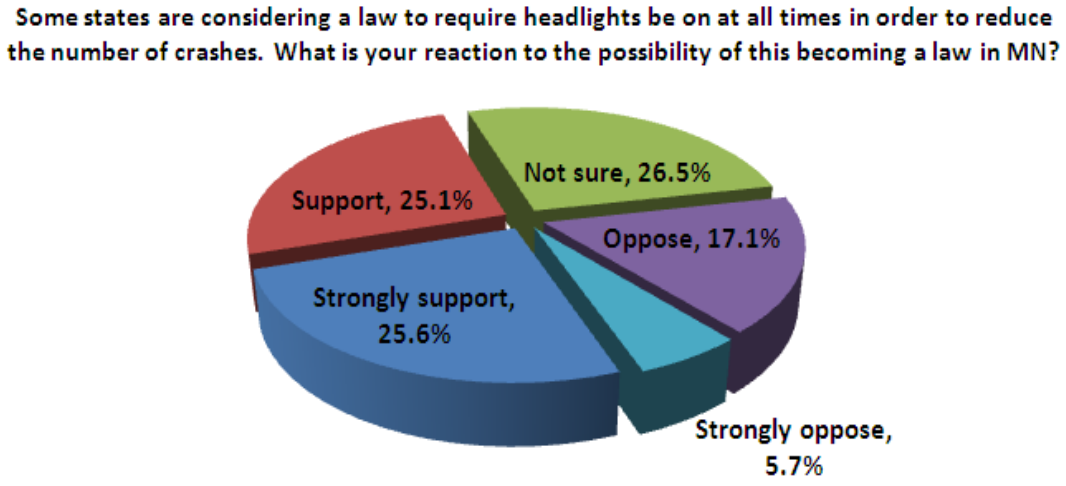
  "I don't think requiring headlights to be on at all times would have any benefits and would cost the car owners more to replace headlights lights that burn out faster. Some headlights these days cost several hundred dollars and that's an unnecessary expense given the doubtful benefits."

- **Effect on funeral processions.**

  - *"The drawbacks are: Funeral processions with the head lights on are always a good indicator that there will be a significant line of traffic. Lights always on would take this identifier away."*

Legislation mandating the use of headlights during the day may be polarizing

Just over half of respondents support legislation to require headlights to be on at all times, with around 24% opposed in some capacity, and 26% stated they were unsure.



Those in support of a law echo the same reasons why they see such use as beneficial – that increased visibility overall leads to generally safer driving conditions; however, given the difference in intensity between daytime running lights and normal headlights, any new legislation may need to make a distinction as to which light intensity is required and when.

> *"Having headlights on during the day would only add an additional level of security and safety. As easy as vehicles are to see, we all know we miss them sometimes and having headlights on could only improve the visibility of vehicles during the day or at other points during the day."*

> *"Most vehicles now have daytime running lights which I believe are adequate for normal daytime driving. Full headlights should be used in foul weather."*

> *"On a longer trip (2 hrs) it's easy to start the trip at daylight and end at dusk and simply forget to turn on the headlights. This is something that should be emphasized and OVER-emphasized by parents and driver's ed instructors first and foremost. I agree that police should continue to pull people over (as I know they do) to remind them of this. I don't think they should immediately get ticketed (unless rain/fog as mentioned). People don't intentionally leave their lights off."*

Those opposed to legislation point out that some current driving laws (including those related to headlights) are hardly enforced as-is, and question the point of adding a law to the list of those that already not being adequately enforced. Opposition also surfaces a degree of suspicion with the motivations behind any sort of daytime headlight mandate, asking what sort of deal politicians may have struck up with light bulb or car battery manufacturers.

> *"I too often see enforcement breaking the very rules they are [there] to enforce. Having your lights on in certain conditions is LAW here, but it's almost never enforced. Enforcement of almost any road law here is spotty at best. I see a lot of very avoidable accident scenarios when I drive the area Interstates, and I believe that education about the rules (laws) of the road, and a reconsideration of a minimum speed that is frighteningly below the average traffic speed and leads to daily incidents that could cost someone a life … requiring headlights to be on for motor vehicles is like mandating reflectors on bicycles, it's a nice concept, but it doesn't address the core problem."*

"Which bulb manufacturers funded the study 'proving' that having headlights on at all times is for 'safety'? Which politicians accepted campaign contributions from said manufacturers to move this through committee?"

"There's enough nanny-State nonsense already. One can only wonder if there's legitimate research behind this or if it's just more payola and bribery. Now anyone who forgets to turn on their lights will be stopped and incur huge fines and increased insurance. This is all about soaking the public for more fees and fines and expenses."

With a [potential] new law requiring the use of daytime headlight use may come the need for statistics to back the push

While respondents point out advantages and disadvantages to driving with headlights on at all times, there is a desire to see research to understand the impact and enable informed decisions.

"In Scandinavian countries one is required to have headlights on at all times. I believe those countries have safety data supporting daytime headlight use."

"If there is research to suggest that having your headlights on at all times reduces the number of crashes state/nation-wide, I would definitely support it becoming law."

"[It's] Just another law to be enforced. I would need the data that would support a significant impact to the level of safety to be able to support it."

"I understand that Greyhound Bus Lines did a study that indicated their buses had far fewer crashes when driving at all times with the headlights on, and consequently made it a company-wide practice."

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