

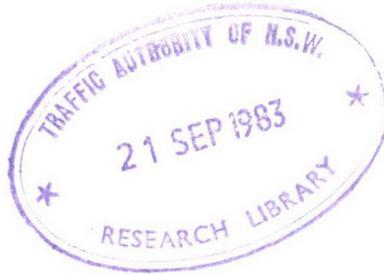


ADDITIONAL HIGH MOUNTED REAR BRAKE LIGHTS
AS A POSSIBLE COUNTERMEASURE TO REAR-END
TRAFFIC COLLISIONS.

BY

Dawn R. Linklater Ph.D.,
Principal Research Scientist,
Behaviour Section.

H. Papatheodorou,
Technical Assistant,
Behaviour Section.



L083237

ADDITIONAL HIGH MOUNTED REAR BRAKE LIGHTS
AS A POSSIBLE COUNTERMEASURE TO REAR-END
TRAFFIC COLLISIONS.

BY

Dawn R. Linklater Ph.D.,
Principal Research Scientist,
Behaviour Section.

H. Papatheodorou,
Technical Assistant,
Behaviour Section.

TRAFFIC ACCIDENT RESEARCH UNIT,
TRAFFIC AUTHORITY OF NEW SOUTH WALES

ISSN 0314-9846
ISBN 0-7240-4304-7

RESEARCH NOTE: RN 1/82
JANUARY, 1982.

JRSRR

ABSTRACT

A brief examination is made of the likely mechanism of action for the reduction in rear-end collisions arising from the installation of a central high mounted rear brake light. It is argued that the extra light would provide an alerting stimulus to increase the likelihood that the following driver or rider respond at all, rather than to decrease their reaction time. The cost effectiveness of the introduction of such an additional brake light is estimated in an attempt to show that the light is a cost-effective countermeasure to collisions into the rear of cars and car derivatives.

CONTENTS

Abstract	i
1. A Field Test of Two, Single Centre High Mounted Brake Light Systems.	1
2. Flashing Rear Brake Lights.	2
3. Possible Mechanisms of Action.	2
4. The Cost Effectiveness of an Additional Centre High Mounted brake Light.	4
5. Conclusions.	5
6. References.	5

Additional High Mounted Rear Brake Lights as a Possible Countermeasure to Rear-End Traffic Collisions.

Various studies have suggested that additional rear brake lights might be an effective countermeasure to rear-end collisions.

1. A Field Test of Two, Single Centre, High Mounted Brake Light Systems (Rausch et al 1981).

Rausch et al (1981) reported a 10 month study of 900 taxis in New York city. The taxis were divided into three equal groups: one control group with a standard tail light configuration and two experimental groups with an additional, single brake light mounted just below the centre of the rear window. In one of these groups the extra light had one bulb (Stimsonite light); in the other group the extra light had two bulbs and "improved optical qualities" (Stanley light).

All taxis reported all collisions. The collision rate was calculated per 1000 days of vehicle operation for each of the experimental units and then expressed as a percentage reduction relative to the control group.

The rear-end collision rate for taxis fitted with the single bulb unit was 44 percent lower than that of the control group (statistically significant, $p = 0.002$). The taxis fitted with the double bulb unit had a rear-end collision rate reduction of 58 percent from that of the control group ($p = 0.0003$), although there was no statistical significance in the difference between the two experimental groups ($p = 0.19$).

However, there are some features of this study which may mean that its results cannot be generalised to all motor cars:

a. the results may, in part, have arisen from the novelty of the extra light (if most cars had the extra light this novelty effect would wear off),

b. there was some confounding of the difference obtained between the two experimental groups and time of year effects (the single-bulb units were installed between December 1979 and February 1980, while the double-bulb units were installed between February 1980 and March 1980,

c. the taxi drivers' apparent awareness of the experimental procedure may have influenced their driving behaviour.

None-the-less, the reduction in rear-end collisions resulting from the addition of an extra, high-mounted rear brake light was considerable and merits further consideration.

2. Flashing Brake Lights

In 1974, Voevodsky reported a large scale taxicab study in San Francisco showing a reduction of rear end collision rate of 60.6% when a centrally mounted amber light was fitted. This light, at the same height as existing stop lights, flashed when the brake pedal was applied. The rate of light pulses emitted from the light varied exponentially with deceleration, increasing as the vehicle decelerated.

Voevodsky's study would appear to have been well executed. The effect of the flashing light was statistically significant such that a 60% reduction in rear-end collisions would appear reasonable.

3. Possible Mechanisms of Action

Moving or flashing visual stimuli are well-known to be efficient attention or alerting devices. Peripheral vision is very sensitive to such stimuli which serve to redirect the eyes so that the stimuli then fall on central visual areas which are efficient at seeing detail, but less efficient at detecting movement. It is therefore possible that it was the flashing quality of the light, rather than the information about rate of deceleration conveyed, that was instrumental in reducing the collision rate in San Francisco.

A driver's eyes are usually directed so that central vision falls on the roadway or traffic some distance ahead. Thus where a vehicle is being closely followed, central vision may not be directed at the rear brake lights which are low in the field of vision. Flashing of such lights would be an efficient means of alerting attention, when a single low set light coming on may have been missed.

Likewise, raising the level of the brake light to the lower centre of the rear window (Rausch et al 1981) would be likely to bring the light into central vision and alert the following driver to brake application in the vehicle being followed. Thus, the reduction in collisions noted in both studies may be attributed to drivers being made aware that brakes are being applied by a lead vehicle.

A recent study by Sivak et al (1981) would appear to support this conclusion. The authors examined the responses of following vehicle drivers to high mounted brake lights of lead vehicles. Control vehicles had conventional brake light systems. One experimental group had single, central high mounted brake lights; the other experimental group had dual high mounted brake lights. Subjects were unaware of the ongoing experiment, their responses being monitored by equipment in the lead vehicle and in a monitoring vehicle that followed the subject's vehicle.

The subject's responses were videotaped by a hidden camera in the monitoring vehicle. A second camera viewed a digital clock. The cameras were activated, by means of telemetry, when the driver of the lead vehicle applied his brakes. The frequency and reaction time of the subject's responses were then timed according to videotape records. Unfortunately, trials were only conducted during daylight and the distances between the lead and monitoring vehicles and the subject's vehicles were not clearly defined. However, the study is important in that subjects were not obviously being monitored.

When subjects were following experimental vehicles, their frequency of responding to brake lights was increased by approximately 72 percent compared to when subjects were following control vehicles. There was no significant difference in the reaction times of the braking responses between the groups of subjects, nor did the addition of dual lights show significant advantage over the addition of a single light.

This study supports the hypothesis that reduction in crashes arising from either a high mounted light or a flashing lower light is due (at least in part) to the properties such lights have in alerting following drivers to brake applications in the lead vehicles. It seems unlikely that the effect arises from a reduction in reaction time.

The addition of a single centre high mounted brake light may be of particular importance at night, since the standard tail light configuration has brake lights and rear lights of the same colour and height. Providing a light at a different location that comes on only when the brakes are applied will provide an additional and distinctive cue to highlight brake application for following drivers.

4. The Cost Effectiveness of an Additional Centre High Mounted Brake Light

In 1977, the flashing light (Cyberlite) was estimated to cost \$135.00 per unit. It was doubtful that fitment of such an expensive unit on every vehicle would be a cost-effective countermeasure to rear-end collisions. However, the single (non-flashing) centre high mounted brake light is considerably cheaper. Mr. Cantali, Engineer, Traffic Accident Research Unit, has estimated that such a unit and bulb replacements would cost approximately \$25.00 per ten years if installed at the manufacturing stage.

At 30 June, 1980, there were 2,275,000 cars and car derivatives registered in New South Wales. It would cost \$56,875,000 to fit the single light to all these vehicles, or approximately \$5,687,500 per year to fit such lights to all vehicles in New South Wales.

During 1980, there were 10,255 collisions into the rear of cars and car derivatives, giving rise to 28 fatalities. If a high mounted brake light on every car were to reduce such fatalities by 40 percent, it would be expected to save around 11 lives per year based on 1980 figures. Thus the cost of saving each life could be estimated at \$517,045.

This figure is based on the conservative estimate of a 40 percent reduction, Rausch et al (1981) having reported a 44 percent reduction when a single bulb high mounted light was installed. While the 44 percent reduction reported was over all collisions, the assumption has been made in this report that the reduction would occur for fatal collisions to the same extent as for non-fatal collisions.

This assumption is based on evidence suggesting that the mechanism of action is that of alerting following vehicle controllers rather than improving their reaction time. It would seem feasible that in many rear-end collisions the driver or rider of the following vehicle fails to react at all. Thus the severity of the collision would arise from characteristics of the following

vehicle in relation to the lead vehicle such as speed, size or momentum.

Furthermore, the estimate of \$517,045 for each life saved once all vehicles had the central rear light fitted has allocated all the costs to saving lives and none to preventing either property damage or injuries. The introduction of the high mounted, additional brake light should substantially reduce the painful neck injuries that are a common result of rear-end collisions, and a source of many insurance claims. Were costs to be allocated to preventing property damage and non-fatal injuries, the estimate of \$517,045 to save a life would appear to be a gross over estimate.

5. Conclusions

It would appear that a high, centrally-mounted rear brake light is a viable countermeasure to collisions with the rear of cars and car derivatives.

The initial effect of such installations may be slightly higher than the long term effect. However, this report has suggested that the logical reason for the effect lies, not in the novelty of the extra lights, but in the raising of them to bring them more into the centre of the following driver's field of view than are the standard brake light configurations.

6. References

- RAUSCH, A., WONG, J. and KIRKPATRICK, M. (1981). A Field Test of Two Single Center, High Mounted Brake Light Systems, (Insurance Institute for Highway Safety, Washington, D.C.).
- SIVAK, M. POST, D.U., OLSON, P.L., and DONOHUE, R.J. (1981). Driver responses to high-mounted brake lights in actual traffic, Human Factors 23(2), 231-235.
- VOEVODSKY, J. (1974). Rear-End Collisions Reduced: A Large-Scale Experiment Under Natural Conditions, Society of Automotive Engineers, New York.