SOME FURTHER DATA RELATING
TO THE DIPPED HEADLIGHTS CAMPAIGNS
IN BIRMINGHAM AND OTHER TOWNS

by
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SOME FURTHER DATA RELATING TO THE DIPPED HEADLIGHTS CAMPAIGNS IN BIRMINGHAM AND OTHER TOWNS

ABSTRACT

The analyses of the results of dipped headlights campaigns have been extended to include later years than those already investigated. Casualty records for Birmingham and a group of four other large towns holding dipped headlights campaigns have been compared with those for a control group of six large towns not holding campaigns.

The data for Birmingham suggest that the increased usage of dipped headlights had

(i) a beneficial effect on the number of pedestrian casualties during dark hours,

(ii) a smaller adverse effect on the more numerous non-pedestrian casualties during dark hours, and, taking these two effects together,

(iii) a negligible effect on total casualties during dark hours.

In the other campaign towns, where the response appears, on the whole, to have been less than in Birmingham, there was some evidence of an adverse effect on total casualties during dark hours.

It is concluded that the evidence is still insufficient to establish whether the use in all lighted streets of dipped headlights (of the types currently used and with the present standard of aiming) would reduce or increase total casualties during dark hours: the indications are that with a 50 per cent usage (as achieved in Birmingham) the change would be small. However, the effect of 100 per cent usage combined with better aiming and/or a more sharply cut-off beam might well be different.

I. INTRODUCTION

After a two-weeks trial in March 1962, Birmingham City Corporation ran a campaign in Birmingham during the winter of 1962-3 to persuade drivers to use dipped headlights in lighted streets instead of sidelights only. In addition to extensive publicity through the Press, radio, television, local
cinemas, competitions etc.; the campaign received much support from the Birmingham City Police, who carried out checks of headlight aim and of speeds (by radar meter). During the winter 1963–64 there was a further campaign in Birmingham and campaigns were held in many other areas.

Only limited data are available on the effect of these campaigns on drivers’ usage of dipped headlights. As far as can be established the maximum and probably the most consistent response was obtained in Birmingham, where it was reported that during the campaigns about 47 per cent of drivers on well-lit roads and 61 per cent of drivers on poorly-lit roads used dipped headlights in the dark. In the other towns with campaigns the use of dipped headlights was estimated to vary between 3 and 50 per cent on well-lit roads and between 60 and 90 per cent on poorly-lit roads. Furthermore, there would be a considerable percentage of badly adjusted headlights, (see 5).

The effects of the campaigns in Birmingham during the winter of 1962–63 and in 26 towns (including Birmingham and Bristol) during the winter of 1963–64 were assessed in Road Research Technical Papers Nos. 691 and 732 respectively, the summaries of which are reproduced verbatim in Appendices 1 and 2. For convenience a summary is given below of the evidence from these reports relating to the effects of the increased usage of dipped headlights on

(i) safety in poorly-lit and well-lit streets separately (data for all classes of road user being combined),

(ii) safety during dark* hours of pedestrians and others separately (data from poorly-lit and well-lit streets being combined),

and (iii) overall safety during dark hours.

The general term ‘safety’ is used because the same type of data is not available throughout: most of the evidence is based on injury accident statistics but some on statistics for fatal and serious injury accidents or on casualty statistics. Only for Birmingham and Bristol could the data be classified according to standard of street lighting and class of road user. Following the usual convention results which could have occurred by chance with a probability of 5% or less are accepted as statistically significant; those with a probability of over 5% but not over 10% are regarded as providing some evidence of a real effect. Where the level of probability exceeds 10%, indications are not accepted as evidence.

(i) Effect of safety in poorly-lit and well-lit streets

The Birmingham campaign of 1962–63 provided a statistically significant indication that the increased usage of dipped headlights had a beneficial effect on safety in poorly-lit streets but no acceptable evidence of any effect in well-lit streets. There was however a significant indication that the effect in well-lit streets was less beneficial than in poorly-lit streets (and possibly harmful) when tested directly against one another.

* Throughout this Report ‘dark’ is used to mean half an hour after sunset to half an hour before sunrise.
There was no acceptable evidence on this point from the Birmingham and Bristol campaigns of 1963–64.

(ii) **Effect on the safety during dark hours of pedestrians and others**

The data from the Birmingham campaign of 1962–63 provided some indications of a beneficial effect of the increased usage of dipped headlights on the safety of pedestrians but no acceptable evidence of an effect on the safety of other road users. There was no acceptable evidence of different effects on the safety of pedestrians and others when tested directly one against the other. The data from the Birmingham and Bristol campaigns of 1963–64 yielded no acceptable evidence on these points.

(iii) **Overall effect on safety during dark hours**

No acceptable evidence was obtained from the Birmingham campaign of 1962–63 or from the campaigns in Birmingham, Bristol and 24 other towns in 1963–64 that the increased usage of dipped headlights had either a beneficial or harmful overall effect on safety during dark hours.

It will be seen that no clear-cut case either for or against a general rule requiring the use of dipped headlights in dark hours in all lighted streets emerged from these investigations in which only partial use of headlights was obtained and the adjustment of headlights was not controlled.

More data are now available because the efforts to promote the use of dipped headlights in all lighted streets at night have been continued with different degrees of emphasis in different campaign towns. Sample counts indicate that in Birmingham the proportion of drivers using dipped headlights on well-lit roads is still of the order of 50%; no counts are available for other campaign towns. It might therefore be hoped that with these results and with longer experience of the use of dipped headlights the evidence for or against their general use might now be more conclusive. In this report the road casualty records for Birmingham and a group of four other large towns in which dipped headlights campaigns were held in 1963 and later years, (Coventry, Liverpool, Newcastle and Stoke) are tabulated for the six calendar years 1960–65 and compared with these for a control area. These four towns were selected as being the largest in the list of campaign towns in Road Research Technical Paper No. 73.

The use of casualties instead of accidents in this analysis calls for some comment. Casualties are not independent events (because more than one may result from the same accident) and therefore, strictly speaking, are not ideally suited to statistical treatment. However, it is thought that this lack of independence is not sufficiently serious to invalidate the tests of significance which are used. Moreover, if there has been a real change in the number of casualties per accident the use of casualties will provide a slightly more complete estimate of the overall effect of the measure.

2. **THE NECESSITY FOR AND CHOICE OF A CONTROL AREA**

In order to interpret the changes that occurred in the numbers of casualties in the towns which had
dipped headlights campaigns it is necessary to estimate what trends there might have been, if the campaigns had not been held, due to changes in traffic volume, improvements in street lighting and road layout, and the introduction of traffic engineering measures. This can be done, at least in part, by assuming that the trend would have been the same as those recorded in a control group of similar towns. The extent to which this assumption is likely to be justified in the present investigation is discussed at the end of this section.

For the control area the six largest towns listed in Road Research Technical Paper No. 73 as having no dipped headlights campaign were chosen:

Bradford, Edinburgh, Glasgow, Ipswich, Nottingham, and Sheffield.

With the exception of Ipswich these are large industrial towns similar in character to Birmingham. Recent sample counts indicate that the proportion of drivers using dipped headlights in well-lit streets in three of these 'non-campaign' towns, (Glasgow, Nottingham and Sheffield) is still low, about 1%, 15%, and 5% respectively.

Unfortunately it cannot be claimed that the six 'non-campaign' towns provide an ideal control group though it is probably the best available. There is evidence to show that measures to control parking are likely to affect accidents during daylight and dark hours differently and changes to street lighting certainly do so. The programmes for the improvement of street lighting and the control of parking in the 'non-campaign' towns are unlikely to have been exactly the same as those carried out in Birmingham.

It may be seen from the description of the method of analysis used (see section 3) that the effects of such measures cannot be distinguished from those of the extra usage of dipped headlights. However, these measures would only affect the results for a proportion of the streets, unlike the extra usage of dipped headlights which would affect the results for all streets. Any large differences between the trends in the campaign and non-campaign towns (found by the method described in the next section) can probably be ascribed mainly to the extra usage of dipped headlights; the cause of small changes, however, must remain in doubt.

3. METHOD OF ANALYSIS

The method of analysis used in this report is basically the same as that used in Road Research Technical Reports Nos. 691 and 732. Changes in casualty frequencies between periods before and after the commencement of dipped headlights campaigns in the areas holding campaigns are compared with the corresponding changes in a control area not holding a campaign. In explaining the basis of the method the following symbols are used:

<table>
<thead>
<tr>
<th>Numbers of casualties</th>
<th>Dark hours</th>
<th>Daylight hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental area (campaign)</td>
<td>Control area (no campaign)</td>
</tr>
<tr>
<td>Before commencement of campaign</td>
<td>b</td>
<td>B</td>
</tr>
<tr>
<td>After commencement of campaign</td>
<td>a</td>
<td>A</td>
</tr>
</tbody>
</table>
A simple method of estimating the effect of a dipped headlights campaign would be to consider the after/before ratio for the casualty frequency during dark hours for the experimental area i.e. to base the analysis on the ratio
\[ \frac{a}{b} \]

However, for reasons given in the last section, a better estimate is obtained by comparing the change in the experimental area with that in a control area by using the ratio
\[ r = \frac{\frac{a}{b}}{\frac{A}{B}} \]

A value of \( r \) less than (or greater than) unity would then mean that the casualty frequency during dark hours in the experimental area fell (or increased) relative to that in the control area. This difference can be ascribed to the dipped headlights campaign provided that it can be assumed that there were no other factors involved which could affect the casualty frequencies during dark hours in the experimental and control areas differently.

A further elaboration of the method is desirable because dipped headlights campaigns are sometimes either accompanied by other road safety measures which might affect casualty frequencies during both daylight and dark hours, or are conducted in such a manner as to direct road users' attention to road safety at all times and so reduce accident frequency by both night and day. For instance, in the 1962-63 campaign in Birmingham, accidents were reduced by about the same percentage in daylight and dark hours. Such effects should be welcomed as a bonus from campaigns. Since, however, the interest here is in the effect of increased usage of dipped headlights (which can only affect the casualty frequency during dark hours), it is desirable to take steps to correct for other effects of the campaigns which can affect casualty frequencies during both daylight and dark hours. This can be done by using dark/daylight ratios of casualty frequencies instead of the casualty frequencies themselves i.e. by substituting \( \frac{a}{a'} \), \( \frac{b}{b'} \), \( \frac{A}{A'} \), and \( \frac{B}{B'} \) for \( a, b, A \) and \( B \) respectively in \( r \) to obtain the new ratio \( R \)
\[ R = \frac{\frac{a}{a'}}{\frac{b}{b'}} \times \frac{\frac{A}{A'}}{\frac{B}{B'}} = \frac{a \cdot b' \cdot A 
\times \frac{b \cdot A'}{a' \cdot b' \cdot A'}{B}}{a' \cdot b' \cdot A'} \]

The statistic \( R \) is used in this report as the measure of the effect on safety of the increased use of dipped headlights in the campaign areas, a value of less than unity being an indication of a beneficial effect and a value of greater than unity being an indication of an adverse effect. The test of significance which must be carried out to decide whether \( R \) differs significantly from unity (i.e. to estimate the probability of the observed changes, beneficial or adverse, occurring by chance) is described in Appendix 3. As before results with a probability of 5% or less are accepted as statistically significant and those with a probability over 5% but not over 10% as providing some evidence of a real effect.

4. RESULTS OF THE ANALYSIS

For the reasons already given changes in the dark/daylight ratio of casualty frequencies for Birmingham and the group of four other ‘campaign’ towns will now be compared with the corresponding changes in the control group of six ‘non-campaign’ towns using the statistic \( R \). For analysis
casualties have been grouped according to the type of road user injured —

(a) pedestrian casualties
(b) non-pedestrian casualties
and (c) all categories of road user together

and also according to the severity of the injuries sustained —

(i) fatal and serious casualties
and (ii) casualties of all severities

The trends in the casualty frequencies in Birmingham and the group of other 'campaign' towns are shown in Figs. 1 and 2 for daylight and dark hours respectively. The frequencies for all areas discussed are listed (grouped as above) in Appendix 4. Table 1 shows the values of $R$ together with their statistical significance, (i.e. the probabilities that values of $R$ differing from unity by the observed amounts could have arisen by chance). If the probability is greater than (10%) this is indicated by (−).

The analysis has been carried out with casualty totals for complete calendar years. The years in which the campaigns started have been classified as campaign years — 1962 in the case of Birmingham and 1963 in the case of the other campaign towns.

TABLE 1

<table>
<thead>
<tr>
<th>Campaign area (Before &amp; after periods)</th>
<th>Type of road user</th>
<th>Severity of injury</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fatal and serious</td>
<td>All severities</td>
</tr>
<tr>
<td>Birmingham (1960–1/1962–5)</td>
<td>Pedestrian</td>
<td>0.77 (0.1%)</td>
<td>0.82 (0.1%)</td>
</tr>
<tr>
<td></td>
<td>Non-pedestrian</td>
<td>1.13 (10%)</td>
<td>1.04 (−)</td>
</tr>
<tr>
<td></td>
<td>All types</td>
<td>0.96 (−)</td>
<td>0.98 (−)</td>
</tr>
<tr>
<td>Four other campaign towns (1960–2/1963–5)</td>
<td>Pedestrian</td>
<td>1.07 (−)</td>
<td>1.03 (−)</td>
</tr>
<tr>
<td></td>
<td>Non-pedestrian</td>
<td>1.07 (−)</td>
<td>1.02 (−)</td>
</tr>
<tr>
<td></td>
<td>All types</td>
<td>1.08 (10%)</td>
<td>1.03 (−)</td>
</tr>
</tbody>
</table>

* A value of $R$ less than 1.0 is an indication of increased safety during dark hours.

In each case the observed changes for fatal and serious casualties are in the same direction as for casualties of all severities, though the levels of statistical significance are not always the same.

Comparison of the data for Birmingham alone with those for the 'non-campaign' towns shows:

(a) a beneficial effect on the number of pedestrian casualties during dark hours,

(b) some indication of an adverse effect on the number of fatal and serious non-pedestrian casualties during dark hours (though for casualties of all severities
the observed increase could easily have arisen by chance),

and (c) evidence that the effect on the numbers of casualties to all categories of road user during dark hours was small and could easily have arisen by chance.

The comparison of the data for the other 'campaign' towns (excluding Birmingham) with those for the non-campaign towns yielded some indication of an adverse effect of the campaigns on fatal and serious casualties for all categories of road user together during dark hours but the observed increases in all the remaining comparisons studied could easily have arisen by chance.

5. DISCUSSION

It would have been useful to classify the casualties according to the standard of public lighting at the site of the accident, as was done in the earlier studies. Unfortunately, the necessary information about the standard of lighting is not recorded in the national road accident records (Form Stats. 19) from which the data used in this report were derived. However the main point of interest must be the effect of the increased usage of dipped headlights in the campaign towns on the total numbers of casualties in dark hours when the numbers occurring in well-lit and poorly-lit streets are added together.

Any departure of the quantity \( R \) from unity for which the statistical significance is considered adequate can probably be ascribed mainly to the increased usage of dipped headlights though, as discussed in 2, it could be partly due to or offset by other changes such as new parking regulations and improvements to street lighting.

Even if a reliable estimate of the full effect of the increased usage of dipped headlights in the campaign towns (including Birmingham) could be made it would be of limited value in forecasting the effect of the use of dipped headlights in all lighted streets everywhere for the following reasons:

(a) The overall effect on all urban roads would be expected to be somewhat less beneficial (or more harmful) than in the campaign towns where there is a higher than average proportion of pedestrian casualties (see Appendix 4).

(b) Since there is no evidence that the effect increases steadily with greater usage the effect of 100% usage of dipped headlights cannot be predicted from the results of the much lower level of usage obtained in Birmingham and the other 'campaign' towns.

(c) The overall effect would differ from one district to another, depending on the proportions of well-lit and poorly-lit streets as the effects would be different on the two kinds of road (see 1).

Finally, any conclusions drawn, apply only to headlights (a) of the types currently used in Britain and (b) with the poor standard of aiming existing at present in Britain (even during the Birmingham campaign of 1962-63, police checks
showed that only one-third of vehicles had their headlights correctly aimed). Tests have shown that seeing conditions in well-lit streets when dipped headlights are in use can be substantially improved by changing from the present British type of dipped beam to one giving less light above the horizontal (as with an accurately aimed European E beam). Better aiming of existing beams would also help in this respect.

6. CONCLUSIONS

The analysis of the results from dipped headlights campaigns in Birmingham and a group of four other campaign towns have been extended to cover later years than those already investigated.

The effect of the increased usage of dipped headlights on total casualties in dark hours in Birmingham where a usage of about 50% in well-lit streets was achieved cannot be established with certainty but the most likely interpretation is that it had:

(i) a beneficial effect on pedestrian casualties,
(ii) a smaller adverse effect on the more numerous non-pedestrian casualties and, taking these two effects together,
(iii) a negligible effect on total casualties.

In the other 'campaign' towns, where the response appears, on the whole, to have been less than in Birmingham, there was some evidence of an adverse effect on total casualties during dark hours.

It will be seen therefore that the evidence is still insufficient to establish conclusively whether the use in all lighted streets of dipped headlights of the types currently used and with the present standard of aiming would reduce or increase total casualties during dark hours: the indications are that with a 50 per cent usage (as achieved in Birmingham), the effect would probably be small. However, the effect of 100 per cent usage combined with better aiming and/or more sharply cut-off beam might well be different.

7. ACKNOWLEDGEMENTS

This Report was prepared in the Road Layout and Lighting, and Statistics Sections of the Safety Division.

The casualty tabulations were provided by H. C. Hall, D. G. H. Mace and members of the Computer Section. The analyses were carried out by G. R. Taylor, Hilary Green, and A. E. Wheeler.

8. REFERENCES

APPENDIX I
THE BIRMINGHAM DIPPED HEADLIGHTS CAMPAIGN 1962–63

A campaign to increase the use of dipped headlights instead of sidelights only on all roads at night was sponsored by Birmingham City Corporation with considerable assistance from Messrs. Joseph Lucas (Electrical) Ltd., and carried out in Birmingham from October, 29th 1962 - March, 30th 1963 inclusive. The numbers of accidents by day and night during the campaign have been compared with those in the corresponding period one year earlier. Accidents on roads where the more important street lighting changes had been made (about 14 per cent of all accidents) have been omitted from the main analysis because it is known that such improvements result in a reduction in accidents at night, and the month of March has been omitted because a similar but shorter campaign was held in Birmingham in March, 1962. Accidents on one-way streets (about 3 per cent of the total) have also been omitted.

The winter of 1962–63 was unusually severe and during a large part of the campaign, especially in January, 1963, there was heavy snow and the weather was exceptionally cold. Counts on a main road in Birmingham during January, 1963, showed that traffic between 7 p.m. and midnight was 9 per cent less than in 1962 but the total for other hours was 2 per cent less. No estimates of pedestrian activity are available but there was almost certainly less than usual, especially at night. The effects of the weather have been allowed for by comparing accidents in Birmingham with those in three similar towns in which no campaigns were held.

Shortly after the campaign began the police in Birmingham introduced radar speedmeter checks and notices warning drivers that the speedmeter was in use were erected on main roads. Although the meter itself was not used at night the notices alone may have affected drivers’ behaviour by night.

Analysis of the accident data for the streets and periods studied indicates that there were 16 per cent fewer accidents in daylight and 19 per cent fewer in the dark in Birmingham than in the corresponding period a year earlier. The difference between these changes could easily have occurred by chance and was not necessarily due to the increased use of dipped headlights, which could have been effective only at night. If all accidents in the 22-week campaign had been used the reductions would have been 16 per cent by day and 17 per cent by night and still not significantly different.

When accidents in Birmingham were classified according to the standard of street lighting it was found that, compared with the number expected if the light to dark accident ratio had remained the same, pedestrian accidents at night were 32 per cent fewer on poorly-lit roads and 13 per cent fewer on well-lit roads; these two changes and the difference between them could have arisen by chance. Accidents in the dark not involving pedestrians were 23 per cent fewer than expected on poorly-lit roads and 24 per cent more on well-lit roads. These two changes could also have occurred by chance but the difference between them was statistically significant and consistent with a real association between the reduction in accidents and the increased use of dipped headlights on poorly-lit roads.
The results obtained and the general conclusions reached were as follows:

(i) Accidents in Birmingham for the roads and period studied were 16 per cent fewer in daylight and 19 per cent fewer in the dark than in the corresponding period a year earlier; they were also slightly fewer (6 per cent and 3 per cent respectively) in the three similar towns in which there were no campaigns.

(ii) The fall in accidents in all four towns was partly associated with the abnormally severe winter and the consequent fall in the amount of travel.

(iii) The greater fall in Birmingham was associated with other aspects of the road safety campaign in that city.

(iv) Since the percentage reduction in night accidents in Birmingham was only slightly greater than the percentage reduction in daylight, it is difficult to conclude that the percentage reduction at night can be reasonably ascribed to the increased use of dipped headlights.

(v) There were more accidents at night in Birmingham on well-lit streets, and fewer on poorly-lit streets, than would have been expected if the light-to-dark accident ratio had remained the same. The difference between these two changes is unlikely to have arisen by chance; this is consistent with the view, often advanced by lighting experts, that the use of dipped headlights has a good effect in badly-lit streets and an adverse effect in well-lit streets. This result supports the advice given in the Highway Code (para. 50): ‘Use dipped headlights at night in built-up areas unless the street lighting is good’.

APPENDIX 2
DIPPED HEADLIGHTS CAMPAIGNS IN 1963–64

The numbers of road accidents and casualties occurring at night during the winter of 1963–64 and during the comparable months of 1961–62 have been studied by the Road Research Laboratory in about 60 large towns of Great Britain, about half of which conducted dipped headlights campaigns in 1963–64.

A detailed assessment of the 1963–64 campaign in Birmingham was arranged by the Laboratory but was abandoned, with the agreement of the city’s Dipped Headlights Campaign Committee, because several major road and traffic changes had occurred between the comparison periods, including reconstruction of the city centre, the introduction of parking meters, and various road safety measures. These made the separate evaluation of the effect of dipped headlights impossible. An Appendix to this Technical Paper contains the Birmingham accident data and shows that if the effects of the other changes, excluding those of street lighting, are combined with those of dipped headlights there was no significant improvement in night accident frequency in Birmingham during the 1963–64 campaign.
As an alternative to Birmingham, a detailed investigation of the campaign held in Bristol was carried out. This showed that, compared with a similar town without a campaign (Southampton), there was no significant improvement in total accidents in the dark in Bristol during the campaign. On roads not well-lit, however, pedestrian accidents were reduced significantly by 60 per cent; other accidents on these roads tended to increase less than on similar roads in Southampton. On well-lit roads in Bristol both pedestrian accidents and other accidents tended to increase more than in Southampton. The differences between the changes in accidents in Bristol and Southampton, however, could have occurred by chance.

Fatal and serious accidents at night in a group of 24 towns with dipped headlights campaigns were 27 per cent more in the winter of 1963-64 than in the winter of 1961-62, compared with an average increase of 25 per cent in a group of 26 similar towns without a campaign. Neither this difference nor the changes in the ratio of accidents in the light and dark were significantly different in the two groups of towns.

Fatal and serious casualties in the dark in Great Britain as a whole increased by 22 per cent between the winters of 1961-62 and 1963-64 on roads with a speed limit (where the campaigns held in 1963-64 would have been most operative) and by an equal percentage on roads without a speed limit. The changes in the ratio of casualties in light and dark hours were not significantly different for the two classes of road.

Observations made by the police showed wide variations from one town to another in the usage of dipped headlights during the campaigns; vehicles reported to be using dipped headlights at night ranged from 3 - 50 per cent of the total on well-lit roads and up to 90 per cent of the total on other roads. No similar observations are available for the non-campaign towns.

In these investigations the only significant change found which can be associated with the use of dipped headlights at night was the reduction in pedestrian accidents on less well-lit roads in Bristol. This result, and the indications of the non-significant changes in other classes of accident, are consistent with the results reported in the Laboratory's investigation of the 1962-63 campaign in Birmingham to the effect that dipped headlights are probably of benefit on less well-lit roads but have no benefit and may even be harmful on well-lit roads.

APPENDIX 3
STATISTICAL TEST OF SIGNIFICANCE FOR R

The statistic R was defined in Section 3 as

\[ R = \frac{a b' A B}{a r b A B'} \]

where the other symbols represent numbers of casualties in corresponding periods before and after the commencement of the campaign as follows:
The test used to determine whether the value of R differs significantly from 1.0 (the value which would arise if there were similar trends in the dark/daylight casualty ratio in the experimental and control areas) is an extension of the well-known 2 x 2 $\chi^2$ test, developed by J. C. Tanner of the Road Research Laboratory. The method consists of first calculating $x$ from

$$(a' + x)(b + x)(A + x)(B' + x) = (a - x)(b' - x)(A' - x)(B - x)$$

Then $\chi^2$ is given by

$$\chi^2 = x^2 \left( \frac{1}{a' + x} + \frac{1}{b + x} + \frac{1}{A + x} + \frac{1}{B' + x} + \frac{1}{a - x} + \frac{1}{b' - x} + \frac{1}{A' - x} + \frac{1}{B - x} \right)$$

The probability of a value of $R$ different from 1.0 arising by chance is 1 in 20 (the usual level accepted as indicating statistical significance) or less if the observed value of $\chi^2$ is equal to or greater than 3.84 respectively.
### APPENDIX 4

Casualty Frequencies for Campaign Towns and other areas

(a) Fatal and serious casualties

<table>
<thead>
<tr>
<th>Area</th>
<th>Year</th>
<th>Pedestrian casualties</th>
<th>Non-pedestrian casualties</th>
<th>All casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daylight</td>
<td>Darkness</td>
<td>Daylight</td>
</tr>
<tr>
<td>Birmingham</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1960</td>
<td>309</td>
<td>209</td>
<td>362</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>303</td>
<td>203</td>
<td>345</td>
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<td>2</td>
<td>336</td>
<td>201</td>
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<td></td>
<td>5</td>
<td>461</td>
<td>297</td>
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<td>4 other Campaign towns</td>
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<tr>
<td></td>
<td>1960</td>
<td>722</td>
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<td>1</td>
<td>711</td>
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Fig. 1. RELATIVE NUMBERS OF CASUALTIES IN DAYLIGHT HOURS IN TOWNS WITH AND WITHOUT DIPPED HEADLIGHT CAMPAIGNS

* The mean of the values for 1960 and 1961 have been taken as 1.0
Fig. 2. RELATIVE NUMBERS OF CASUALTIES IN DARK HOURS IN TOWNS WITH AND WITHOUT DIPPED HEADLIGHT CAMPAIGNS

* The mean of the values for 1960 and 1961 have been taken as 1.0
ABSTRACT


The analyses of the results of dipped headlights campaigns have been extended to include later years than those already investigated. Casualty records for Birmingham and a group of four other large towns holding dipped headlights campaigns have been compared with those for a control group of six large towns not holding campaigns.

The data for Birmingham suggest that the increased usage of dipped headlights had

(i) a beneficial effect on the number of pedestrian casualties during dark hours,

(ii) a smaller adverse effect on the more numerous non-pedestrian casualties during dark hours, and,

(iii) a negligible effect on total casualties during dark hours.

In other campaign towns, where the response appears, on the whole, to have been less than in Birmingham, there was some evidence of an adverse effect on total casualties during dark hours.

It is concluded that the evidence is still insufficient to establish whether the use in all lighted streets of dipped headlights (of the types currently used and with the present standard of aiming) would reduce or increase total casualties during dark hours: the indications are that with a 50 per cent usage (as achieved in Birmingham) the change would be small. However, the effect of 100 per cent usage combined with better aiming and/or a more sharply cut-off beam might well be different.