TRIAL OF PEDESTRIAN SIGNALS INCORPORATING A NUMERICAL COUNTDOWN DISPLAY IN AUCKLAND CBD

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ABSTRACT:

A trial of pedestrian countdown signals was undertaken at two busy signalised crossings in Auckland CBD (Queen Street / Victoria Street and Quay Street, Ferry Building). It was hypothesised that they would be associated with a reduction in unsafe pedestrian crossing behaviour.

Data was collected before installation, immediately after installation and at follow up (between 1 and 3 months after installation) stages. Results were analysed statistically using one-way ANOVA and unpaired t-tests by considering the proportion of pedestrians within each cycle who displayed specific crossing behaviours. A 5% significance level was adopted.

Significant improvements in pedestrian crossing behaviour followed the introduction of pedestrian countdown signals at Queen Street / Victoria Street. However they were associated with a significant increase in risky crossing behaviour at the second signalised crossing, which links 2 key transport nodes in Auckland CBD (Quay Street). The results indicate that countdown clocks are capable of favourably affecting pedestrian behaviour, if placed in suitable locations. However, they may lead to an increase in risky crossing behaviour at unsuitable locations.

It is recommended that further investigation be carried out to confirm the improvements seen at the Queen Street / Victoria Street intersection and to determine whether the hypothesised unsuitability of sites such as Quay Street, based on the data collected in this study, is jjustified.

Introduction

Pedestrian countdown signal displays consist of a numerical display of the time remaining (in seconds) until the end of the crossing phase. They are supplementary to traditional pedestrian signal displays. The countdown commences when the flashing red man is first displayed and reaches zero as the solid red man is displayed at the end of the crossing phase.

A literature reviewed indicated that countdown pedestrian signals are associated with a reduction in undesirable events such as aborted crossings, running, and pedestrian-vehicle conflicts. Contrary to some concerns, countdown pedestrian signals do not appear to cause drivers to increase their speeds.

There is no clear indication in the literature of the effect on pedestrian behaviour with regard to the decision to begin crossing during the FLASHING RED MAN phase. Huang and Zegeer (2000) found a higher incidence of commencing crossing during the FLASHING RED MAN phase at intersections with countdown signals as compared with "control" intersections. Conversely, the PHA study (2005) found a reduction in this measure at intersections following the introduction of countdown displays. Markowitz et al. (2006) found no significant difference. The finding that pedestrians would accelerate their crossing pace to complete the crossing during the countdown time was a more consistent finding across different studies. The implication is that pedestrian countdown displays do provide pedestrians with additional information that helps them to cross the street more successfully. This hypothesis finds support in the data of Eccles, Tao and Mangum (2003), Huang and Zegeer (2000), Markowitz et al. (2006) and the PHA study (2005).

The outcomes of questionnaire surveys seem to indicate that pedestrians overwhelmingly prefer countdown pedestrian signals to conventional signals and feel that countdown pedestrian signals make them safer and more informed pedestrians. The findings of Lerner and Singer (2005) seem to indicate overall benefits for comprehension of the meaning of pedestrian displays with the use of countdown timers, particularly for older pedestrians, although countdown displays do seem to lead to the belief that pedestrians are allowed to commence crossing during the FLASHING RED MAN phase, particularly among younger males.

It is important to note that the design of studies and the methods used for data analysis and interpretation demand that more weight be given to the findings of some studies than others. Only the study of Eccles, Tao and Mangum (2003) displays both the robust design required for an intervention study and relevant analysis by standard statistical techniques to establish significance of results. Eccles, Tao and Mangum (2003) found that pedestrian countdown signals had a generally positive effect on pedestrian behaviour and did not have a negative effect on motorist behaviour.

Notwithstanding the caution on interpretation above, the literature reviewed offers useful insights into effects observed where countdown signals are installed. The review also highlights the need for further robust evaluation studies to statistically confirm some of the findings that are directly relevant to the effectiveness and safety of the use of pedestrian countdown signals as a supplementary display at busy urban intersections.

Auckland CBD has New Zealand's highest concentration of pedestrians (approximately 46,000 per day on Queen Street). The use of pedestrian countdown displays at key signalised intersections has been highlighted as one of the possible measures to improve pedestrian safety and amenity around Auckland's CBD, by providing pedestrians with information to allow them to adopt safer crossing behaviour.

Two sites were chosen for the trial:

1. The Queen Street / Victoria Street intersection
2. The Quay Street crossing outside the Ferry Building

These sites were chosen as both are CBD crossings that experience heavy pedestrian traffic, but have different characteristics. The two sites differ in several respects. The Queen Street / Victoria Street intersection is a cross intersection on the main pedestrian thoroughfare in the retail and commercial heart of Auckland's CBD. It allows crossing movements in all directions simultaneously (including diagonals) whilst all vehicle movements are held. The Quay Street crossing is a single crossing across one of the key arterial routes through the CBD, linking two key public transport nodes across Quay Street (the Britomart transport centre and the ferry terminal).

It was hypothesised that the installation of countdown signals at these two sites would be associated with the following changes in pedestrian crossing behaviour:

1. Reduced occurrence of pedestrians remaining in the road when the SOLID RED MAN signal is displayed.
2. No increase in the occurrence of pedestrians commencing crossing when the FLASHING RED MAN signal is displayed.
3. Reduced occurrence of pedestrian-vehicle conflicts.
4. Reduced occurrence of pedestrians running to complete or aborting their crossing attempt once they have entered the road.

Methodology and Data Collection

Data regarding pedestrian behaviour was collected before installation (pre install), immediately after installation (within 1 week) (post install I) and at follow up (between 1 and 3 months after installation) (post install II) stages. In each case data was collected at lunchtimes and evenings on Tuesday, Wednesday and Thursday. CCTV footage from two existing operational traffic cameras was used at the Queen Street / Victoria Street intersection. Manual counts were used at the Quay Street crossing since no existing traffic cameras provided an adequate view of the intersection. At the Queen Street / Victoria Street intersection the total number of signal cycles for which data was available were 231 (pre install), 305 (post install I) and 133 (post install II). At the Quay Street intersection the data was collected on 397 cycles pre-installation, 398 cycles immediately after installation (post install I) and 408 cycles at the follow up stage (post install II).

Questionnaires were also administered at both sites during both post installation surveys to provide data on pedestrian comprehension of the countdown signal displays. These were administered to pedestrians who had just completed a crossing.

Results

Comparisons of results between pre-install, post install I and post install II were used to assess the 4 hypotheses by considering the proportion of pedestrians within each cycle who displayed the relevant behaviour. One-way ANOVA and unpaired t-tests were employed to establish the significance of results, with a 5% significance level adopted.

The key findings were:

1. There was a significant reduction in the proportion of pedestrians remaining in the road when the SOLID RED MAN was displayed at the end of crossing phases at the Queen Street / Victoria Street intersection ($F = 42.74; p = 3.4\times10^{-18}$).
2. There was a significant increase in the proportion of pedestrians remaining in the road when the SOLID RED MAN was displayed at the end of crossing phases at the Quay Street crossing ($F = 51.51$, $p = 3.45 \times 10^{-22}$).
3. There was no significant change in the proportion of pedestrians per cycle commencing crossing on the FLASHING RED MAN at the Queen Street / Victoria Street intersection ($F = 42.74$, $p = 3.4 \times 10^{-18}$).
4. There was a small (but statistically significant) increase in the proportion of pedestrians commencing crossing on the FLASHING RED MAN per cycle at the Quay Street crossing ($F = 18.30$, $p = 1.48 \times 10^{-8}$).
5. There was a significant reduction in the proportion of pedestrian-vehicle conflicts at Queen Street / Victoria Street ($F = 8.01$, $p = 0.00036$). However, given the very low incidence of such conflicts in all data collected this result should be seen in context. There was no significant change in this parameter at Quay Street ($F = 0.95$, $p = 0.389$).
6. There was no significant change in the proportion of pedestrians running to complete or aborting their crossing per cycle at either site (Queen Street / Victoria Street, $F = 0.33$, $p = 0.72$; Quay Street; $F = 0.76$, $p = 0.4703$).

The number of respondents in the questionnaire surveys were as follows:

- ♦ Queen Street / Victoria Street intersection n = 530 immediately after (post install I); n = 375 follow up (post install II).

- ♦ Quay Street n = 233 immediately after (post install I); n = 344 follow up (post install II).

The majority of respondents noticed the countdown signal displays at the immediately after (post install I) and follow up (post install II) stages (between 73% and 81%). At both sites the proportion of respondents reporting that they changed their crossing behaviour as a result of the new displays increased between the immediately after and follow up surveys (Queen Street / Victoria Street intersection 34% increasing to 42%; Quay Street 16% increasing to 53%).

Virtually all respondents noticing the countdown signal displays correctly interpreted their meaning at both sites at both immediately after (post install I) and follow up (post install II) stages (between 93% and 97%).

Discussion

The findings that there was a significant reduction in the number of pedestrians remaining in the road at the SOLID RED MAN and no significant increase in the number of pedestrians commencing crossing on the FLASHING RED MAN at the Queen Street / Victoria Street intersection represents an improvement in the safety of pedestrian crossing behaviour at this site. At the Quay Street site there was a significant increase in both the number of pedestrians commencing crossing on the FLASHING RED MAN and the number of pedestrians completing crossing on the SOLID RED MAN at the follow up stage. These unexpected results were only evident at the follow up survey (post install II) at Quay Street, not the immediately after (post install I) survey. Two factors were identified that may have contributed to this result:

1 A possible over-representation of tourists in the follow up sample surveyed.

2 The differences between the two sites causing pedestrians to change their behaviour differently in response to the countdown signal displays at Quay Street than at the Queen Street / Victoria Street intersection.

Whilst the degree to which the possible over-representation of tourists affected the results was indeterminate, it was felt that the possible effect of the differences in characteristics between the two sites should not be overlooked. It was hypothesised that pedestrians in more of a hurry at the Quay Street crossing than the Queen Street / Victoria Street intersection (say, to catch a bus, train or ferry) may have felt more confident to use the countdown display signals to make more risky crossing decisions, resulting in an increase in pedestrians commencing crossing on the FLASHING RED MAN. This in conjunction with pedestrians' poor ability to judge the time actually needed to complete the crossing (as documented by Botha et al. 2002) could lead to more pedestrians being caught short of their destination kerb when the SOLID RED MAN is displayed. The questionnaire survey results for Quay Street offer some support to this theory: of those who reported changing their crossing behaviour in the follow up survey at Quay Street, the majority indicated they crossed more quickly. However, without knowing whether the countdown signal displays affected the decision to cross / not cross of those questionnaire respondents, or merely was associated with them speeding up on the latter stages of a crossing that would have been made anyway, it is not clear to what degree the questionnaire data supports this theory.

It is possible that the differing physical and traffic environment between the two sites has something to do with this. The Queen Street / Victoria Street intersection is within the heart of the CBD, in an area dominated by pedestrians, on routes which are less used by cross city traffic and more used by traffic which has an origin or destination within the Queen Street vicinity. The Quay Street crossing is on the main arterial route into/out of the CBD to the east and forms part of the main through route for traffic to/from Fanshawe Street. Vehicle speeds are generally lower at the Queen Street / Victoria Street intersection with drivers seemingly more vigilant with respect to pedestrian activity than at Quay Street, possibly as consequence of high concentrations of pedestrians on all approaches to the intersection and a narrower road environment than Quay Street.

It is interesting to note that although the Quay Street intersection showed a deterioration in the proportions of pedestrians commencing crossing on the FLASHING RED MAN and completing crossing on the SOLID RED MAN following the installation of countdown signals, this intersection displayed much better compliance on both these measures prior to the installation of the countdown clocks than the Queen St / Victoria Street intersection.

Conclusion

The results obtained provide support for the view that countdown signal displays are associated with adaptation in pedestrian behaviour that favourably affects safety of crossing, if placed in suitable locations. However, the results also indicated that they could be associated with an increase in risky crossing behaviour at unsuitable locations.

It is recommended that further investigation be carried out to confirm the benefits seen in this study for intersections sharing the characteristics of Queen Street / Victoria Street and to determine whether the hypothesised unsuitability of sites such as the Quay Street crossing, based on the data collected in this study, is justified.

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