Safety Evaluation of Fully-Controlled Right Turn Phasing at Signalised Intersections: Full-Time and Part-Time Applications

Chris Jurewicz[a], Amir Sobhani[b], Tariro Makwasha[a]

[a]Australian Road Research Board, Australia, [b]VicRoads, Australia

Abstract

This paper presents results of safety evaluation of fully-controlled right turn (FCRT) phasing at signalised intersections in Melbourne, Australia. Full-time and part-time (off-peak only) applications of the treatment were evaluated. The evaluation produced full-time FCRT crash reduction factor (CRF) of 52% for all-casualty crashes and 69% for severe casualty crashes, both statistically significant. Part-time FCRT showed lesser safety benefits: CRF of 11% for all-casualty crashes, and 36% for severe casualty crashes (lower statistical significance). This research provides valuable inputs into revision of road agency policies, especially in relation to choice between safer full-time FCRT and a more efficient part-time FCRT.

Background

Risk of casualty and serious casualty crashes due to right turns at signalised intersections (left turns in the right-hand-drive traffic) is greatly increased if drivers have to select gaps in opposing traffic. For many years, road agencies made efforts to provide signal phasing which fully controls right turn movements with intent to reduce incidence of right-through casualty crashes. Effectiveness of this treatment is very high (45%), but has not been evaluated in Australia for a long time (Bui, Cameron & Foong 1991).

This paper presents results of an evaluation of all-casualty and severe casualty crash reduction effectiveness of fully-controlled right turn (FCRT) phasing at signalised intersections in Melbourne, Australia. Two applications of this treatment were evaluated: full-time and part-time.

The full-time application of FCRT was evaluated to test if the effectiveness has been retained since the original evaluation in 1991. The part-time application of FCRT, which means FCRT is activated only during off-peak periods, was evaluated separately. This application permits filter right turns during peak periods, when speeds are deemed to be lower, to reduce traffic delays. This evaluation sought to test the current assumption that effectiveness of part-time FCRT application is equally as safe as of full-time FCRT application.

Methods

The authors used a quasi-experimental, retrospective, matched-control study design to develop generalized linear models (GLM) models to estimate all-casualty and severe casualty crash modification factors (CMFs) for each of the treatment types. The approach is well established for this purpose (Bruhning & Ernst 1985; Scully, Newstead & Corben 2008). All crash types were considered to maximise the available sample size. Crash data was obtained from past signalised intersection black-spot projects completed by VicRoads, where at least one approach was retrofitted with FCRT phasing and hardware (typically two or four approaches). Sites where part-time operation of FCRT was part of the retrofit design were set aside accordingly.

Full-time FCRT evaluation was based on 35 sites for all-casualty crash analysis, and 16 sites for severe casualty crash analysis. Part-time FCRT evaluation was based on 31 sites for all-casualty crash analysis, and 16 sites for severe casualty crash analysis.

The treatment sites were matched with signalised comparison sites which were not treated during the same period. These sites were of similar size, similar traffic flow and road function, with emphasis on selecting sites in the same part of the city, but without FCRT installed.

The part-time FCRT evaluation did not explicitly control for the differences in traffic flows during peak and off-peak times. The same methods were used to evaluate the two applications of FCRT treatment.

Results

The findings for the full-time application of FCRT phasing confirmed the earlier findings by Bui, Cameron & Foong (1991), also based on Melbourne sites, showing the CMF of 0.48 for all-casualty crashes and 0.31 for severe casualty crashes (i.e. crash reductions of 52% and 69% respectively), both statistically significant ($p \leq 0.05$).

The part-time application of FCRT phasing produced lesser safety benefits: a CMF of 0.89 for all-casualty crashes, and 0.64 for severe casualty crashes (i.e. crash reductions of 11% and 36% respectively). Statistical significance of the all-casualty crash result was low ($p=0.32$), but the finding for severe casualty crashes was significant at $p=0.08$, i.e. close to the desirable standard. The lack of robustness was due the lower treatment effects combined with a limited number of sites and crashes available for the study.

Conclusions

These findings show that full-time application of FCRT phasing maintained its safety effectiveness since the original evaluation in the early 1990s. The part-time application of FCRT, during off-peak periods, also provided some safety improvement, especially for severe crashes. Importantly, the evaluation showed that this approach was not as effective for safety improvement as the full-time application. This raises policy questions about future trading-off of safety improvement for assumed delay reduction.

This research can provide valuable inputs into future revisions of road agency traffic signal design policies.

References

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