FEASIBILITY OF IMPLEMENTING INTERNATIONAL "PEDESTRIAN CROSSWALK" LAWS IN NEW ZEALAND

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ABSTRACT

New Zealand is relatively unusual in having road rules that do not generally give priority to pedestrians when crossing unsignalised intersections. A project investigated the effects of changing current NZ pedestrian crossing legislation to match many other parts of the world. The objectives were:

- Identifying the effects different rules have on pedestrian behaviour and safety
- Determining road users' understanding and preferences of various rule change options
- Determining the effects of the proposed changes on both pedestrian and motorist delays
- Considering the practical aspects of introducing a rule change in NZ

Analysis of NZ's pedestrian crash data found that, if NZ road rules did change, then crash patterns at unsignalised intersections may change to mirror those at signalised ones.

A survey of road users' understanding/perception of current and potential road rules found that, on average, 78% of people are already willing to give way to pedestrians, although the importance of an education campaign with any future changes was also noted.

VISSIM simulation modelling of predicted delays to pedestrians and motorists found generally no notable effect on total personal delay caused by possible rule changes.

Overall, implementing a rule change in NZ appears to be possible, and the implications of this are discussed further.

1 INTRODUCTION

New Zealand's road rules generally do not give priority to pedestrians when crossing unsignalised intersections. This is a relatively unusual situation as, in many parts of the rest of the world, pedestrians generally have priority when crossing side roads and intersections. Essentially this is an extension of the principles that "turning traffic should give way to straight traffic" and that "side-road traffic should give way to main-road traffic".

An example of this is shown in Figure 1, where a right-turning motor vehicle is entering an unsignalised side road while a pedestrian walking along the main road crosses the side road. In New Zealand (NZ), the left-hand situation would apply (motorists have priority) whereas in many other places the right-hand situation would apply (pedestrian has priority).

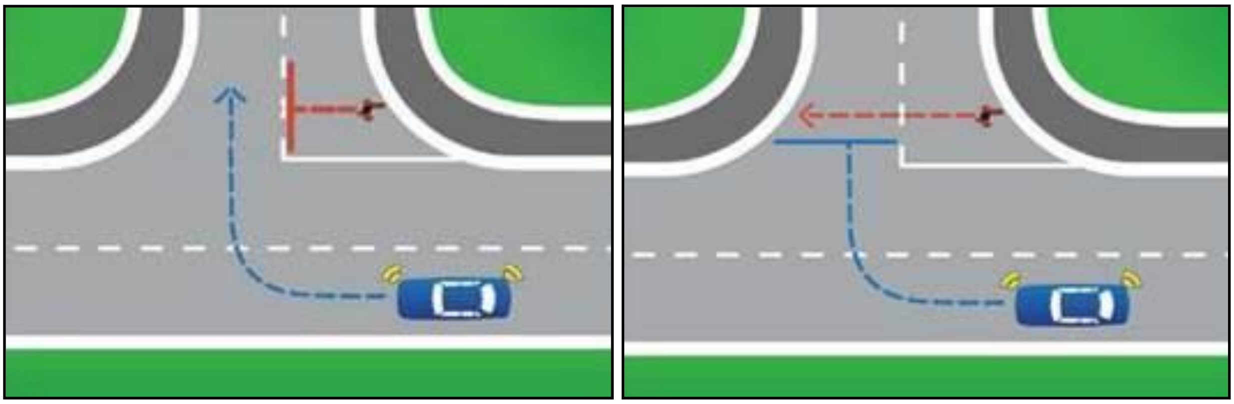

Figure 1: Example of a give-way rule where priority is given to either motorists (left) or pedestrians (right)

Similar rules typically also apply to left turns and motor vehicle movements coming out of the side-road. Living Streets Aotearoa, an advocacy organisation that promotes walking friendly communities, have suggested that the road rules in NZ change in order to bring them in line with many other parts of the world (LSA 2014).

This paper compares the legal provisions for pedestrians in NZ to other parts of the world and considers the implications of changing NZ's current road rules to give pedestrians greater priority. A research project at the University of Canterbury investigated the effects of changing current NZ pedestrian crossing legislation to match many other parts of the world (it should be noted that currently there is no official proposal to do so). The objectives were:

- Identifying the effects different rules have on pedestrian behaviour and safety
- Determining road users' understanding and preferences of various rule change options
- Determining the effects of the proposed changes on both pedestrian and motorist delays
- Considering the practical aspects of introducing a rule change in NZ

The study focuses particularly on "signalised" intersections (i.e. where there are traffic lights in operation) and "unsignalised" intersections (i.e. priority controlled by a Give Way or Stop sign, or with no form of control). Roundabouts can also be referred to as unsignalised intersections, but these were not considered in this project, due to limitations of available time.

2 METHODOLOGY

A preliminary study of the varying laws and legislation throughout Australia, Europe, and North America was undertaken. The related crash data for these areas was also investigated. This ensured a better understanding of how the different laws affect pedestrian behaviour and safety. The international laws were then compared to the NZ laws.

The New Zealand Transport Agency's (NZTA) Crash Analysis System (CAS) was used to retrieve and analyse NZ's pedestrian crash data from the previous five years. This was done to identify current pedestrian crash trends and to see how they may alter if the suggested rule change was implemented. Another investigation into overseas crash data was planned. However, due to the less detailed data collection methods of other countries, this proved to be quite difficult.

A perception survey was created and run over four weeks in August 2014. It focused on the public's understanding of the relevant road rules currently in place in NZ and their willingness, as motorists, to give way to pedestrians in different situations. The survey was released online to maximise participation. Invitations to complete the survey were distributed via the Facebook pages of the University of Canterbury, NZ Automobile Association (AA), and Living Streets Aotearoa.

Finally, PTV Vissim, a traffic flow simulation package, was used to model pedestrian and vehicle delays using nine different flow combinations under the current road rules and the suggested change. Two intersection types were considered; an unsignalised T-intersection, and an unsignalised X-intersection. From these simulations, the travel time decrease for pedestrians, and the corresponding travel time increase for vehicles was determined for the different flow rate combinations. The economic costs and savings of the suggested changes were also calculated for each intersection type.

3 LITERATURE REVIEW

3.1 New Zealand Road Rules

The Land Transport (Road User) Rule 2004 (Ministry of Transport, 2014a) provides some limited but clearly defined situations where pedestrians have priority over motor vehicles. Although there is a general duty of care to avoid hitting pedestrians, motorists are only legally required to give way to pedestrians at signalised intersections, zebra and school crossings, driveway thresholds and within shared space zones. It should also be noted that pedestrians are very rarely mentioned in the NZ Road Code when compared to other countries (NZTA, 2012).

While it is technically possible to introduce a zebra crossing at an existing unsignalised intersection, best practice guidance in NZ is generally to avoid their use in these situations (Land Transport NZ 2008). Typically those currently in use around NZ are set slightly back from the actual intersection, so as to create more of a mid-block treatment.

3.2 Australian Road Rules

The Australian Road Rules (Australian Transport Council, 2012) are very similar to the NZ Road Rules. However, they give greater importance to pedestrians by setting up a give way relationship with the motorist. Including the four situations mentioned in the NZ rules, Australian motorists also have to give way to pedestrians:

- when making a U-turn
- when turning left at an unsignalised slip lane
- who are crossing, or about to cross, the street onto which a left or right turning vehicle is turning onto (but *not* the street it is turning from)

It should be noted that individual Australian states are able to vary these road rules and, thus, there are local variations on some regulations.

3.3 European Road Rules

The road rules in Europe vary from country to country but generally most provide far more provisions for pedestrians than in NZ. Some examples of pedestrian crossing laws from various countries are listed below:

- France: "Every motorist is obligated to yield, stopping if necessary, to a pedestrian regularly engaged in crossing a street or clearly manifesting the intention to do so ...." (Matchett, 2011)
- Ireland: "Vehicles do not have an automatic right of way on the road. The overriding rule is, in all circumstances, proceed with caution. You must always yield to pedestrians already crossing at a junction …" (Road Safety Authority Ireland, 2013)
- UK: "You should watch out for pedestrians crossing a road into which you are turning. If they have started to cross they have priority, so give way." (UK Highway Code Rule 170, Dept for Transport
- Switzerland: "Approaching a pedestrian crossing where traffic is not regulated (signalised), drivers shall yield priority to all pedestrians and wheelchair users who are already engaged on the crossing or who are waiting in front of it with the visible intention of using it." (Matchett, 2011)

3.4 North American Road Rules

Whilst often varying between provinces and states, the road rules in Canada and the United States of America (USA) also provide greater priority for pedestrians. For example:

- The *California Vehicle Code* (Section 21950) states "The driver of a vehicle shall yield the right-of-way to a pedestrian crossing the roadway within any marked crosswalk or within any unmarked crosswalk at an intersection" (State of California 2011)
- In Indiana, USA, the law states that motorists "must slow down when approaching an intersection and be prepared to come to a complete stop if a vehicle or pedestrian with the right-of-way is approaching from another direction" (Indiana Bureau of Motor Vehicles, 2013).
- In British Columbia, Canada, drivers must also treat all unmarked crosswalks as marked crosswalks (Insurance Corporation of British Columbia, 2012).

The basis of much of this law is a "legal crosswalk", which is typically defined as the extension of footpaths across an intersection (e.g. a four-leg intersection would have crosswalks on all four sides). However, the ambiguity of its definition and the variability in the marking of such crosswalks (from no markings at all to more recognisable treatments) leads to its inconsistent use between states/provinces. Despite this, the laws still provide good priority for pedestrians.

4 RESULTS

4.1 Crash Analysis

A change in pedestrian priority at unsignalised intersections would result in a situation similar to signalised intersections, where turning traffic is expected to give way to pedestrians crossing parallel to the through traffic. Therefore, it was considered useful to look at the current pedestrian crash patterns at both types of intersection.

The NZTA's CAS database was used to retrieve all of the relevant data relating to pedestrian crashes at signalised and unsignalised (non-roundabout) urban intersections between 2009 and July 2014. Overall, 1,750 crashes fitting these criteria were identified. Of particular interest were the factors contributing to the crashes and the vehicle and pedestrian movements involved in the crashes.

Figure 2 shows the different factors that have contributed to pedestrian crashes in the past five years. "Pedestrian factors" (described later) are by far the largest contributor to pedestrian crashes, making up 46% of the total crash causes for both signalised and unsignalised intersections. Poor observation from the driver makes up 19% of the total crash causes, and failure of the driver to give way or stop makes up only 12%; however, the latter factor is considerably more prevalent at signalised intersections.

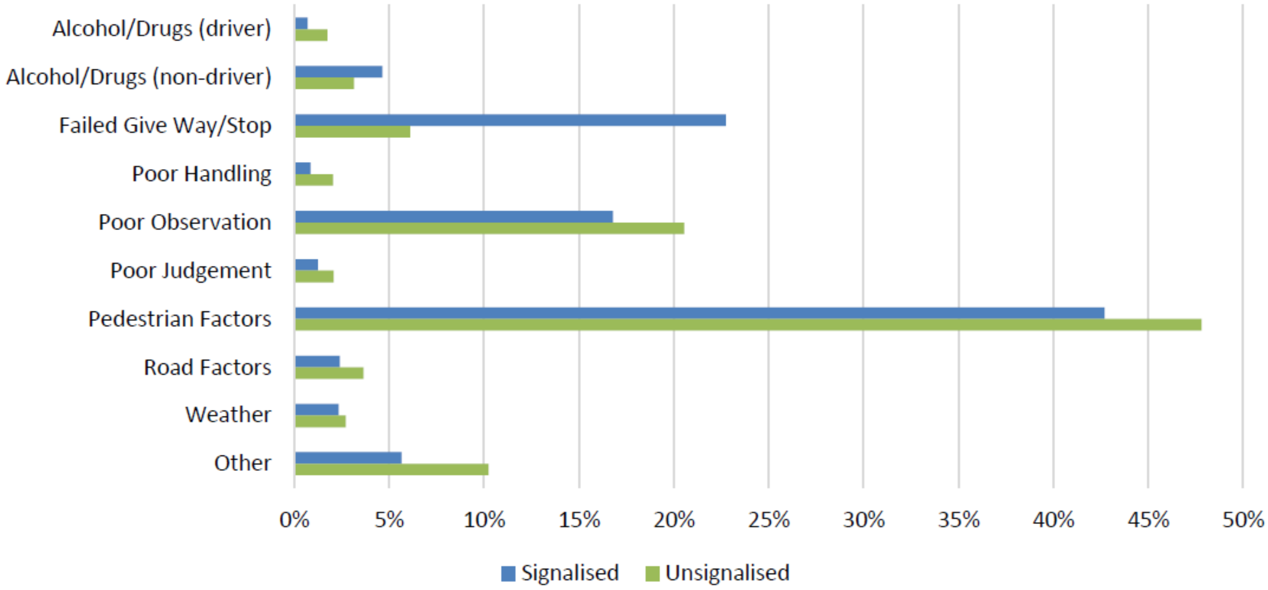

Figure 2: Factors contributing to pedestrian crashes at urban signalised/unsignalised intersections

Figure 3 shows the breakdown of the major individual "pedestrian factors". Pedestrians walking or running heedless of traffic are the largest contributors and account for approximately 23% of all crash cause factors. It should be noted that, when the data is split between signalised and unsignalised intersections, pedestrians walk heedless of traffic 5% more at unsignalised intersections than at signalised intersections. However, there is only a 1% difference for pedestrians running heedless of traffic at signalised and unsignalised intersections.

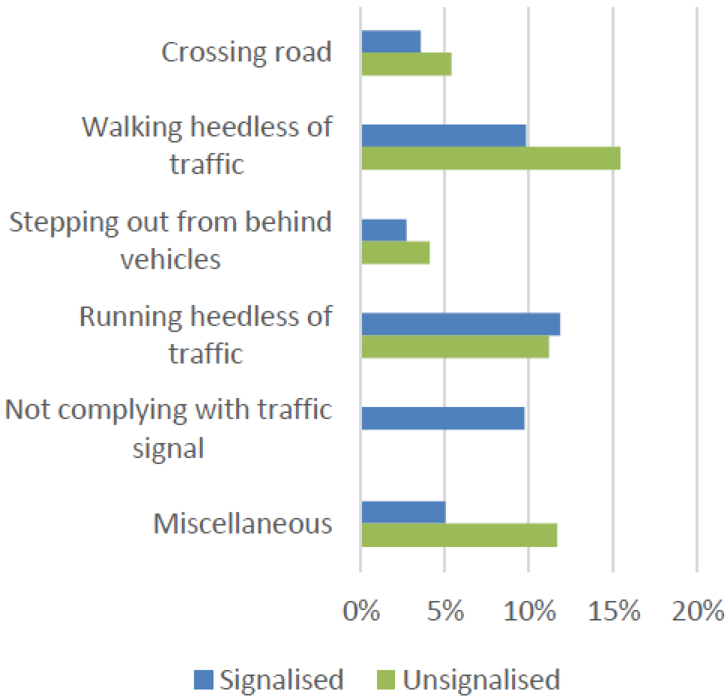

Figure 3: Pedestrian factors contributing to urban pedestrian intersection crashes

Figure 4 shows the distribution of vehicle and pedestrian movements involved in pedestrian crashes; Table 1 explains the CAS movement codes used. The two most common movements involved in pedestrian crashes are the NA (left side crash) and NB (right side crash) movements. Some of these crashes will relate to vehicles turning out of a side road; however, these crashes cannot be separated from the rest of the NA and NB data. Nevertheless, it could be reasonable to presume that the proportions of these crashes may go down at unsignalised intersections if a rule change was introduced. The rest of the main turning movements (NC, ND, NE, NF) would largely equate (at unsignalised intersections) to traffic entering side-roads colliding with parallel pedestrians. If this became more similar to the signalised crash distributions with a rule change, their respective proportions would increase. What's not entirely clear is what the absolute changes in crash numbers might be.

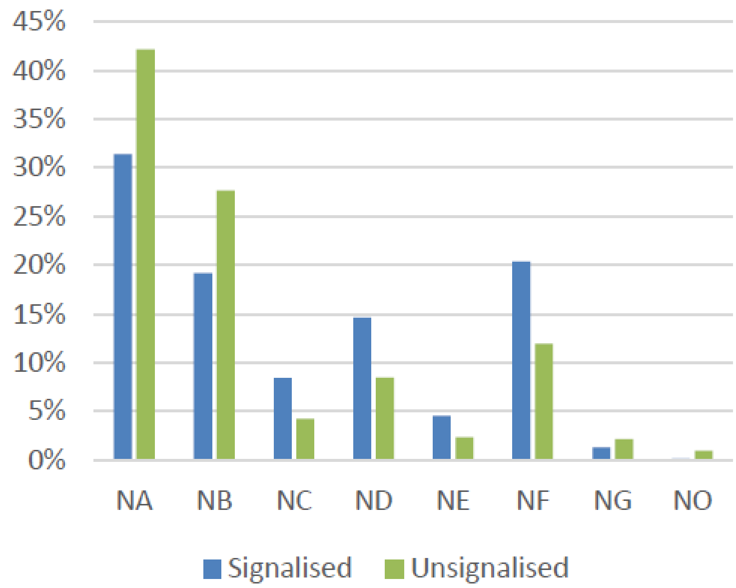

Figure 4: Movements involved in pedestrian crashes at signalised and unsignalised intersections in urban areas

Table 1: Vehicle movement codes for pedestrians crossing the road

	A	B	C	D	E	F	G	O
N	LEFT SIDE	RIGHT SIDE	LEFT TURN LEFT SIDE	RIGHT TURN RIGHT SIDE	LEFT TURN RIGHT SIDE	RIGHT TURN LEFT SIDE	MANOEUVRING VEHICLE	Other

It was hoped that the vehicle movement and causal factor data collected from CAS would be able to be compared to similar pedestrian crash data from overseas. This would have shown if there were any noticeable differences in crash types between the data sets. It would have also indicated the possible effects of the suggested rule change in terms of absolute numbers. However, it was not possible to find suitable data for comparison, as most others countries investigated collect less detailed information for pedestrian crashes.

One other aspect not investigated was the effect of any rule change on non-pedestrian motor vehicle crashes. It is possible, for example, that rear-end crashes could increase, due to motorists stopping to wait for a crossing pedestrian and being hit from behind by another vehicle.

4.2 Perception Survey

4.2.1 Overview

A perception survey on pedestrian right of way was created and distributed. It focused on the public's understanding of the relevant road rules currently in place in NZ and how willing they would be to give way to pedestrians in various situations if different road rules were introduced. A variety of different unsignalised T-intersection and X-intersection scenarios were presented for consideration, with each respondent randomly allocated a sub-set of these scenarios.

The survey also investigated how having additional markings on the road, to define the pedestrian crosswalk, affected responses. If a respondent initially stated that the car should have right of way for a particular scenario, a follow-up question asked whether their response changed if markings were shown. The public's preference for six different marking types was also explored.

The survey was conducted online using the University's Qualtrics survey software. The survey was live from August 15th until September 12th 2014, and was widely advertised via various university and road user groups. During this time, 876 people completed the survey.

4.2.2 Survey Results

The survey found that, in general, people's understanding of the current NZ rules regarding pedestrian right of way was quite high, as shown in Figure 5. However, 35% of respondents did not know that they were required to give way to pedestrians on the footpath when entering or leaving driveways.

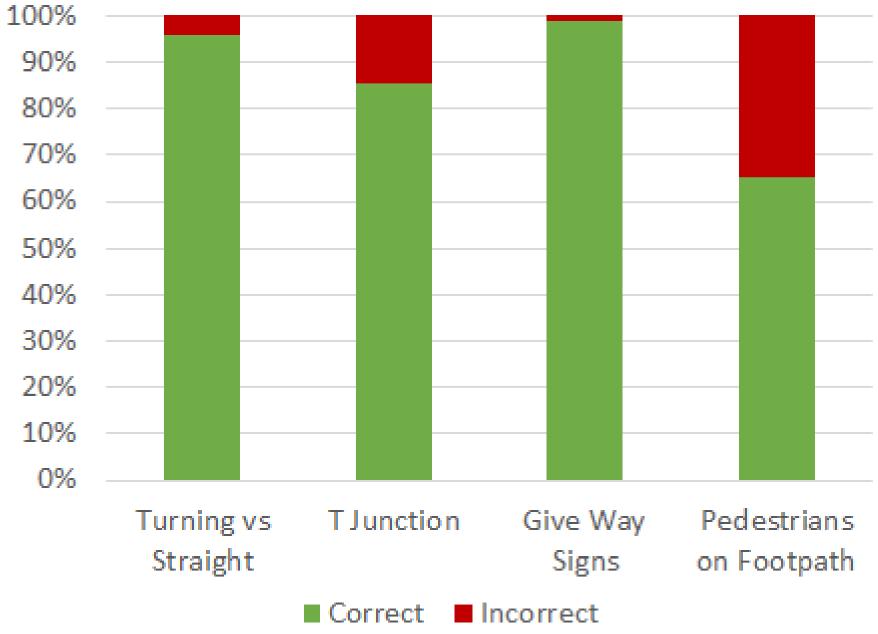

Figure 5: Understanding of current pedestrian priority road rules

The respondents' average willingness to give way to pedestrians (or to give way if crosswalk markings were present) is shown in Figure 6. The results are split depending on how frequently the respondents travelled by foot or car. 'Often' was defined as two to three times a week or more, and 'rarely' was defined as once a week or less. Table 2 shows how the frequency of travel mode for the respondents was spread; it is notable that most reported travelling often by both modes. Twenty four respondents identified as travelling rarely by both foot and car and were excluded from this analysis.

Table 2: Distribution of frequency of travel

Description	Count
Often by foot, rarely by car	159
Often by car and foot	482
Often by car, rarely by foot	189

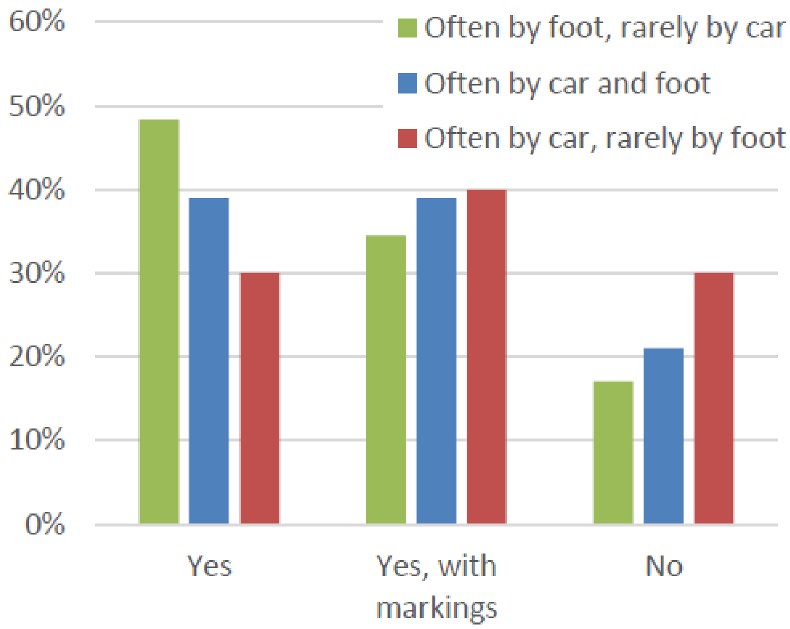

Figure 6: Willingness of respondents to give way to pedestrians, by frequency of travel mode

Perhaps not surprisingly, those who walked more often were more supportive of giving way to pedestrians than those who drove more often. The presence of crosswalk markings roughly doubled the number of people who would be willing to give way to pedestrians (78% average). There was reasonable similarity in support between the different scenarios presented, although probably slightly greater support for giving way to pedestrians when turning into a side-road as opposed to turning out. A separate series of questions asked for preferences for the type of crosswalk marking; Figure 8 shows the most popular marking type, a ladder marking.

4.2.3 Survey Biases

Bias occurs when a selection of people are over-represented in the survey sample. This can cause the results to vary from what is expected in the overall population. As this survey was distributed online and via certain targeted groups, there is potential for bias to occur.

There was an even distribution of respondents across gender. The age group distribution was varied, but also seemed reasonably reflective of the adult driving population (Ministry of Transport 2014b). The smallest group represented was those under 20, who accounted for 5% of the total respondents, and the largest group represented was those who were 45 to 54 and accounted for 21% of the total respondents.

The older the respondents were, the more likely they were to support giving way to the pedestrian. Of the 876 respondents 43% had driven overseas sometime in the last five years. These people were also much more likely to give way to pedestrians than those who had not. As noted previously, the frequency of travel mode also had a significant effect on the survey results.

Figure 7: Possible crosswalk marking (“ladder”)

4.3 Modelling

4.3.1 Software

PTV Vissim was used to model pedestrian and vehicle delays under the current road rules in NZ and the suggested change in rules. PTV Vissim is a microscopic multi-modal traffic flow simulation software package. Microscopic simulation means that each entity is simulated individually, with the interactions between them handled dynamically as they occur. As PTV Vissim is multi-modal it has the ability to simulate more than one type of travel mode, including cars, trucks, buses, trams, motorcycles, bicycles, and pedestrians. Only cars and pedestrians were used during these simulations.

4.3.2 Set Up

Two intersection layouts were considered; a T-intersection and an X-intersection (both unsignalised). The T-intersection had one pedestrian crossing point on its minor leg, and the X-intersection had a pedestrian crossing on both of its minor legs. Both intersections’ minor legs were controlled by Give Way signs. Simulations were run for both intersection types under the current NZ Road Rules and the suggested change (whereby pedestrians crossing the side roads would have priority). Three different flow rates were used for each of the pedestrian and vehicle flows. These were combined to give nine different flow combinations that were used during the simulations. The different pedestrian and vehicle flow rates used per leg are shown in Table 3, as well as the total flow rates through each intersection type. Note that the maximum traffic volumes are not particularly high because, typically, higher volumes would be controlled by a roundabout or traffic signals instead.

Table 3: Flow rates used in the models

Intersection		Max	Med	Min
T	(veh/hr per leg)	150	50	17
	(veh/hr per inters'n)	**450**	**150**	**51**
	(ped/hr per crossing)	500	200	60
	(ped/hr per inters'n)	**500**	**200**	**60**
X	(veh/hr per leg)	150	50	13
	(veh/hr per inters'n)	**600**	**200**	**52**
	(ped/hr per crossing)	500	200	60
	(ped/hr per inters'n)	**1000**	**400**	**120**

Ten simulations were run for each of the combinations with the maximum and medium vehicle flows. For the combinations with minimum vehicle flows, 25 simulations were run. This was done to account for the fewer interactions between pedestrians and vehicles at the lower vehicle flow rate.

The time taken for each pedestrian to cross the road and for each vehicle to travel through the intersection was recorded during each simulation. This data was exported from PTV Vissim, and MATLAB was then used to collate the data and calculate the average time taken for the pedestrians to cross the road and each vehicle movement to occur. The difference between the travel times for the current NZ rules and the suggested change was then used to estimate the (typically) decrease in pedestrian delay and increase in vehicle delay caused by the suggested rule change. The *Economic Evaluation Manual* (NZTA, 2013) was then used to calculate the costs associated with the change in delays. This was done assuming that pedestrians and motorists travel time has a value of $16.23 per hour.

For ease of reference, the results presented in the following tables are colour-coded to show positive (yellow → green) and negative (orange → red) gradations of values. In all cases, positive values are beneficial to the road user concerned, and vice versa.

4.4 T-intersections

Figure 8 shows the intersection set up used for the T-intersection simulations. Note that the "zebra crossing" markings shown simply reflect VISSIM's representation of a pedestrian crossing point and do not necessarily represent the physical markings used. The total pedestrian time savings are shown in Table 4 and the associated annual cost savings are shown in Table 5 (using the simplistic assumption that the same flows applied continuously each day). Note that, for the min-min combination, there was actually a slight increase in total pedestrian delays.

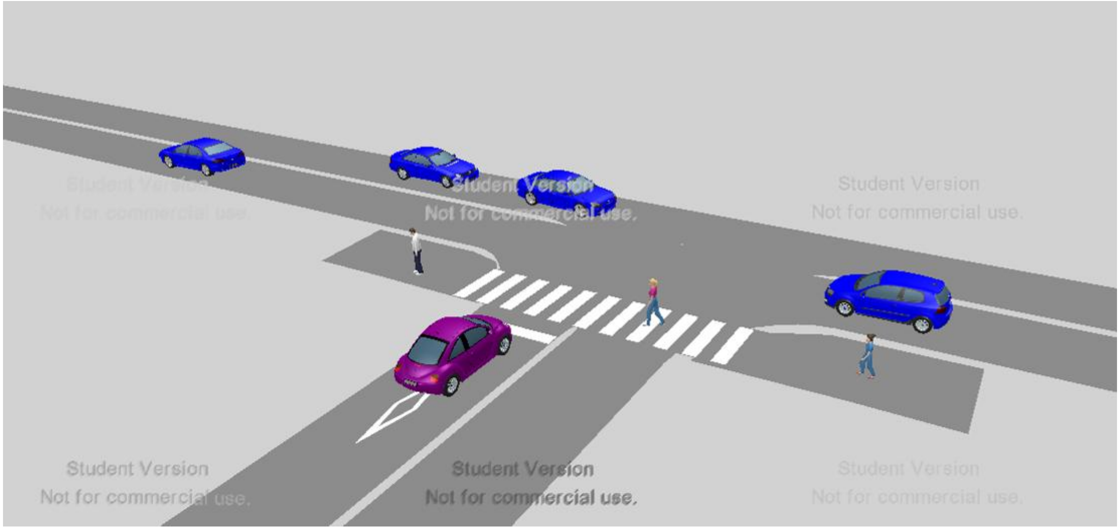

Figure 8: T-intersection layout for simulations

Table 4: Change to pedestrian delays at a T-intersection (seconds saved / hour)

		Vehicle Max	Vehicle Med	Vehicle Min
Pedestrians	Max	1360	366	144
	Med	432	135	35
	Min	144	89	-6

Table 5: Pedestrian cost savings at a T-intersection ($ saved / year)

		Vehicle Max	Vehicle Med	Vehicle Min
Pedestrians	Max	$53,728	$14,468	$5,671
	Med	$17,050	$5,328	$1,401
	Min	$5,668	$3,532	-$234

The total vehicle travel time losses for all six vehicle movements are shown in Table 6 and the associated annual cost increases are shown in Table 7.

Table 6: Change to vehicle delays at a T-intersection (seconds gained / hour)

		Vehicle Max	Vehicle Med	Vehicle Min
Pedestrians	Max	-1599	-476	-133
	Med	-461	-150	-46
	Min	-110	-44	-18

Table 7: Vehicle cost increases at a T-intersection ($ spent / year)

		Vehicle Max	Vehicle Med	Vehicle Min
Pedestrians	Max	-$63,147	-$18,814	-$5,260
	Med	-$18,210	-$5,914	-$1,804
	Min	-$4,333	-$1,722	-$729

The net annual cost to road users of the rule change for T-intersections, based on travel time for pedestrians and motorists together, is given in Table 8. Note that negative values imply a net increase in overall road user costs, i.e. a dis-benefit.

Table 8: Net cost of implementing rule change at a T-intersection ($ / intersection / year)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	-$9,419	-$4,346	$411
	Med	-$1,160	-$586	-$403
	Min	$1,335	$1,810	-$963

4.5 X-intersections

Figure 9 shows the intersection set up used for the X-intersection simulations. The total pedestrian time savings across the two crossings are shown in Table 9. The associated annual cost savings are shown in Table 10.

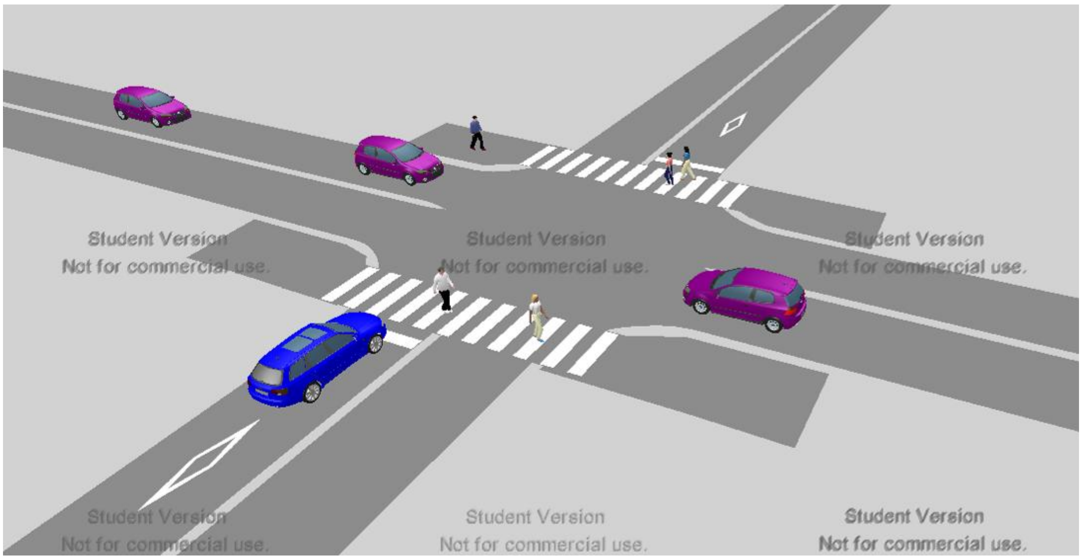

Figure 9: X-intersection layout for simulations

Table 9: Pedestrian time savings at an X-intersection (seconds saved / hour)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	2425	588	193
	Med	942	310	81
	Min	309	95	-8

Table 10: Pedestrian cost savings at an X-intersection ($ saved / year)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	$95,755	$23,234	$7,618
	Med	$37,217	$12,224	$3,193
	Min	$12,186	$3,747	-$329

Again, it is interesting to note the slight increase in pedestrian delays with the min-min combination. The total vehicle travel time losses for all twelve vehicle movements are shown in Table 11: and the associated annual cost increases are shown in Table 12.

Table 11: Increase in vehicle delay at an X-intersection (seconds gained / hour)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	-4069	-1408	-280
	Med	-1104	-316	-99
	Min	-1109	-38	-33

Table 12: Vehicle cost increases at an X-intersection ($ spent / year)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	-$160,710	-$55,623	-$11,077
	Med	-$43,607	-$12,486	-$3,911
	Min	-$43,799	-$1,489	-$1,312

The net annual cost of the rule change for X-intersections, based on travel time for pedestrians and motorists together, is given in Table 13. In all but one case, there is an increase in total road user costs, i.e. a dis-benefit.

Table 13: Net cost of implementing the rules change at an X-intersection ($ / intersection / year)

		Vehicle		
		Max	Med	Min
Pedestrians	Max	-$64,955	-$32,389	-$3,458
	Med	-$6,390	-$262	-$719
	Min	-$31,613	2,259	-$1,641

4.6 Application to Average Hourly Traffic Flows

The above analyses are simplistic in applying the hourly changes to a total annual cost. In reality, there is likely to be variation in both the pedestrian and traffic flows at all intersections where a rule change was implemented. Figure 10 shows the average hourly flow profiles for pedestrians and vehicles (adapted from Turner *et al* (2006), and Traffic Design Group Ltd (2001)). If it is assumed that the peaks represent the maximum flows used in the model, the mid-day lull is the medium flow, and outside the peaks is the minimum flow, then the approximate cost of the proposed change can be calculated for “busier” T and X-intersections (it is assumed that, for more minor intersections, the costs would be less). This gives an average net cost increase of $1,979 per intersection per year for T-intersections and $11,939 per intersection per year for X-intersections.

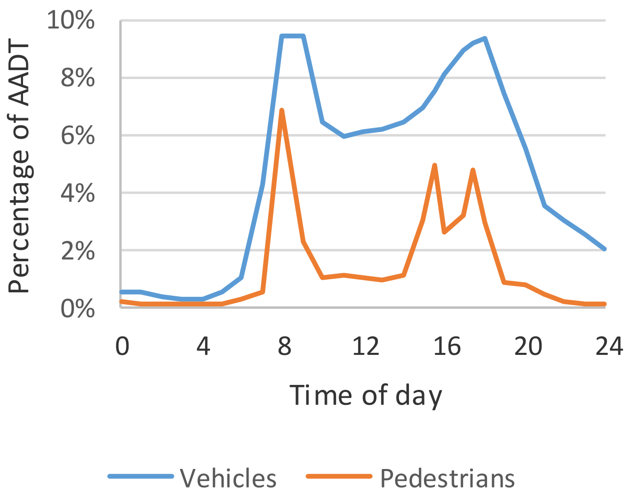

Figure 10: Hourly flow profiles for pedestrians and vehicles

If a 40-year evaluation period and a discount rate of 6% are assumed (uniform series present worth factor for these assumptions is 15.4933), then the life-cycle costs of the proposed rule change can be calculated. Assuming no growth in volumes, this gives a total life-cycle cost of $30,661 for a “busy” T-intersection and $184,975 for a busy X-intersection. As mentioned above, it is likely that for many “quieter” intersections, the cost would be much less.

4.7 Modelling Limitations

The observed pedestrian delay increase for the “minimum pedestrian, minimum vehicle” simulations will most likely be due to the limits of the PTV Vissim software when interactions are very low. The number of runs for those simulations was increased from 10 to 25 to try and minimise the potential for “random seed” error. The average delay increase per pedestrian in these cases was actually never more than 0.1s, and thus can be considered negligible.

PTV Vissim is able to create Surrogate Safety Assessment Model (SSAM) files. These files map potential traffic conflicts where two road users will collide if they do not take evasive action. An increase in conflicts recorded could be inferred to mean a likely increase in crashes. This data was collected for each simulation run and was going to be analysed if possible to estimate the likely safety impacts of the suggested changes. However, due to issues with running the SSAM software, this was not completed.

5 DISCUSSION AND CONCLUSIONS

The results provide some promising indicators of the relative scale and acceptance of change if pedestrian priority rules at unsignalised intersections were to change in NZ.

If the NZ road rules did change, it is expected that crash patterns at unsignalised intersections would become more similar to those at signalised intersections. However, what is not fully clear yet is what the absolute change in crashes would be. If it was treated like current zebra crossings, then research would suggest that crashes could increase (Land Transport NZ 2008). However, if drivers become more vigilant at these intersections, and slow down in general, then crashes may reduce. Unfortunately comparison of NZ’s pedestrian crash data to other countries (where the rules are different) could not be completed due to the other countries having less detailed pedestrian crash recording systems. Other differences in “road user culture”, and the presence of a no-fault accident compensation system in NZ, may also affect the transferability of data from overseas.

The perception survey results are very promising as, on average, 78% of people are already willing to give way to pedestrians, provided there is some form of additional marking to delineate the pedestrians' right of way. This was much higher than expected. Additional road user education campaigns could be expected to improve this figure if a rule change was introduced.

The modelling results and analysis shows that any decrease in pedestrian travel time is matched by a (slightly larger) increase in vehicle travel time. However, the life-cycle costs of the suggested change per intersection are relatively small. The maximum delays observed for motor vehicles undertaking some movements were up to 2-3s per vehicle at T-intersections and 3-4s for X-intersections, but typically a lot less for quieter intersections and for other movements.

All up, the maximum expected road user costs over 40 years for a "busy" intersection were about $30k for a T-intersection and $180k for an X-intersection. It should be noted that this analysis does not take into account any potential pedestrian safety benefits or costs the suggested rule change may make. Given that the crash cost for a single pedestrian fatality in a 50 km/h zone is approximately $3.05 million (NZTA, 2013), the safety aspects of this proposal may be more important.

It is fair to state that, the biggest likely benefit of such a change in road rules would simply be the improved status of pedestrians in our road networks. By slightly re-prioritising people walking over those driving, it would help to make walking a more attractive transport mode (with all the respective societal and personal benefits that brings). In that respect, a slight increase in driving travel times may well be worth it.

One consideration to think about is whether the introduction of such a rule would apply universally to all unsignalised intersections (regardless of markings), or whether it would only apply at those sites where the necessary crosswalk markings were provided. The latter would allow for more targeted introduction at locations where it would provide the greatest benefit for pedestrians, but the relative inconsistency of treatments nation-wide could be considered more confusing. However, targeted introduction could also avoid problems at locations where right-turning motorists may be focusing on small gaps in opposing traffic and, only after turning, then realise they have to stop for a pedestrian, leading to possible conflicts with main road traffic.

It is also possible that a new rule could also apply to off-road cycleways running parallel to roadways. These are becoming increasingly common in New Zealand, but their success with users may depend on whether the same level of priority is afforded to off-road riders at side-roads as those who remain on-road. Safety considerations may also need further investigation, given the relatively high speed of a moving cycle approaching an intersection, compared with a pedestrian.

Currently, the suggested rule change seems feasible here in NZ. There is no overwhelming economic reason to dismiss it, although safety aspects need more consideration, and the public have shown that they are willing to give way to pedestrians.

6 RECOMMENDATIONS

Before the suggested rule change is progressed any further, more research needs to be completed on the possible safety effects that the change may have. This could be completed through either simulations of traffic conflicts (e.g. PTV Vissim's SSAM data), driver simulators, or physical trials by implementing the rule at a selected few sites. If there are significant safety effects, the economic evaluation should be reassessed.

The results suggest that some form of crosswalk marking should form part of locations where pedestrians have priority. Further investigation into how different crosswalk markings affect pedestrians and motorists should also be considered, again by either simulator or physical trial.

As mentioned earlier, roundabouts were not investigated as part of this study. It is recommended that these intersections also be considered further regarding whether such a rule change should also apply there.

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