The Effect of Cycle Lanes on Cycling Numbers and Safety

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ABSTRACT

Marked on-road cycle lanes are a relatively inexpensive means of providing for cycling; however, their use has been questioned in terms of both their safety and their effectiveness in attracting more people to take up cycling. While both questions have been previously researched, the findings were rather inconclusive.

A recent research project in Christchurch, New Zealand investigated the relative effects on cycle count and crash numbers of installing a series of cycle lanes. Twelve routes installed in Christchurch during the mid-2000s were analyzed, together with some control routes that already had cycle lanes. Cycle count data from a series of route locations and dates were used to establish cycling trends before and after installation. These were also compared against cycle crash numbers along these routes during the same periods.

The results generally show no consistent "step" increase in cycling numbers immediately following installation of cycle lanes, with some increasing and decreasing. Changes on cycling growth rates were more positive, although it is clear that other wider trends such as motor traffic growth are having an effect. Taking into account the control routes and relative changes in volumes, the study also found notable reductions in cycle crashes following installation, typically with a 23% average reduction in crash rates. However, this reduction was not statistically significant at the 95% level.

1 INTRODUCTION

In many countries, both local and central governments over the past few decades have been working to encourage and improve the safety of cycling in urban centers. As part of this move, local jurisdictions have installed dedicated on-road painted cycle facilities ("cycle lanes") on their local and arterial roading networks. These treatments have been undertaken with the aim to improve the perceived and actual safety of cycling in the urban environment, and to encourage the use of cycling as a safe mode for commuting and leisure trips, improving environmental outcomes and the general health and wellbeing of riders.

Despite these facilities, many commuters and policy makers still perceive on-road cycling, especially on major traffic routes, as being a hazardous form of commuting, with the potential for incidents involving both parked and moving motor vehicles. Cycle lanes have even been deemed "unsafe" by some parties, who feel that they offer no additional protection over an untreated street. This had led to a growing demand for more "protected" cycling facilities (or "cycle tracks"), typically either located behind parked vehicles or separated from traffic by some physical barrier. However, generally these facilities are considerably more expensive to provide than painted cycle lanes; thus, the latter are still regularly provided.

There has been limited research conducted as to whether cycle lane treatments have induced or increased cycle trips to these routes and whether safety has improved for cyclists on these routes. Elvik et al (*1*) in reviewing the literature, noted that most cycle safety studies to date had not controlled for the numbers of cyclists.

To address this gap in the research, a recent Engineering Masters research project (*2*) investigated the relative effects of installing a series of cycle lanes. Fifteen arterial routes around Christchurch, New Zealand, with cycle lanes installed were analyzed to determine whether the cycle lane treatments impacted on cycle numbers and crash rates, as well as testing the assumption of a step change in the cycle count. Twelve of the routes were treated with cycle lanes in the 2003-2006 period, with three routes that were treated well before this period acting as a control comparison.

2 RESEARCH CONTEXT

2.1 Cycle Lanes and the Impact on Cycle Numbers

Cycling plays a role in the makeup of commuting trips in numerous New Zealand cities and towns. In Christchurch ~7% of total home/work trips are made by bicycle (~9000 trips/day), with a similar share of cycling amongst the student population travelling to schools and tertiary institutions (*3*). As a result of this modal share, facilitating for cycling especially along major commuter and arterial routes and the mitigation of conflicts between cyclists and motor vehicles is a key safety outcome that was targeted by the Christchurch City Council (CCC) in their strategy for cycling (*4*).

The most popular treatment implemented on Christchurch arterial routes to date is the installation of marked cycle lanes between parking and traffic lanes. Another common variation, particularly where space is limited, is the installation of curbside cycle lanes, particularly on sections near intersections and on arterial routes where parking has been removed. FIGURE 1 shows a typical layout investigated, featuring cycle lanes adjacent to parking (top) and curbing (bottom); note that in New Zealand traffic drives on the left-hand side of the road, and dashed lines against the curb indicate no parking allowed.

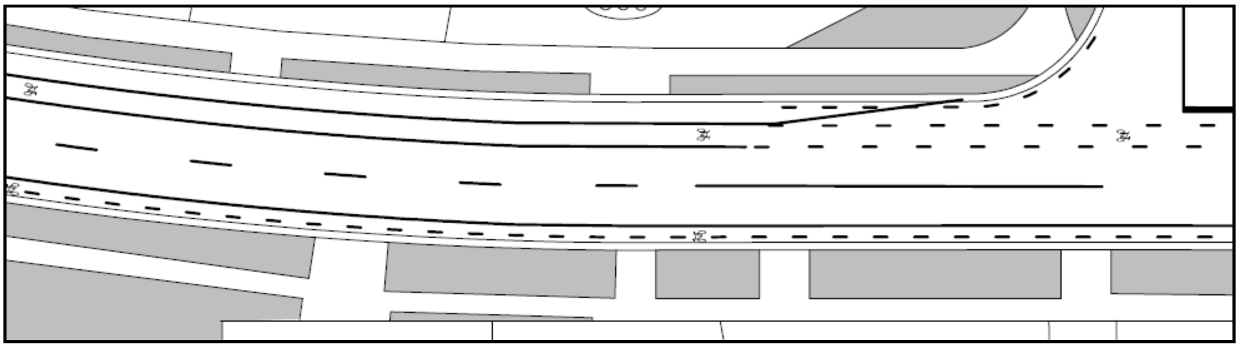

FIGURE 1: Typical Mid-Block Cycle Lane layout investigated in Christchurch

Although on-road cycle lanes has been preferred in New Zealand, there is an absence of comprehensive studies conducted into their impact. Studies to date have focused on estimating the demand for facilities based on scaling up findings on a small number or sites with assumed volume changes, and largely ignoring the impact of motorized traffic growth on cycle counts. This lack of verifiable information in the local context for on-road facilities may be due to the focus by authorities and academia on the impact of lanes on cycle safety rather than cycle volumes.

McDonald *et al.* (*5*) focused on estimating the demand for new cycling facilities in New Zealand. With just five on-road sites for validation, this study assumed that a jump in cycling numbers would occur following the installation of a cycle facility due to dormant demand and greater awareness of a new facility. FIGURE 2 illustrates this assumed relationship, with a jump in cycle numbers at implementation (Year Y_0).

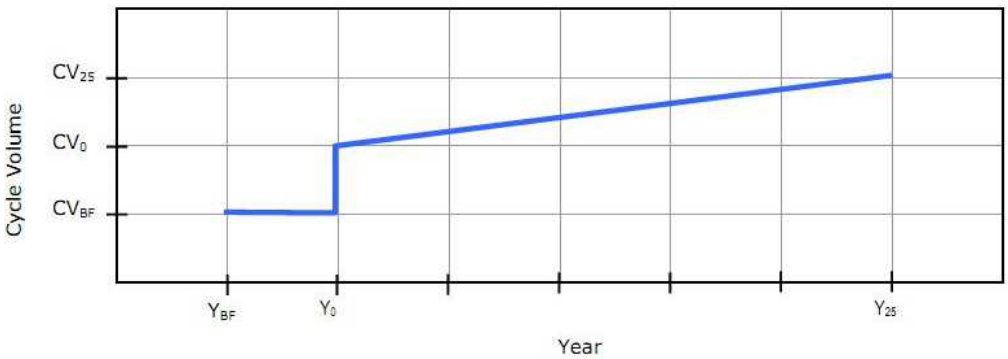

FIGURE 2: Assumed "Step Change" after cycle lane treatment (*5*)

This "step change" assumption is used in the economic evaluation of cycle projects in New Zealand (*6*), although no subsequent validation as to its occurrence has been carried out on a large scale.

A before and after study on cycle lanes in Copenhagen by Jensen (*7*) suggests that the construction of cycle lane treatments has a minor impact on both cycle and motor vehicle traffic volumes post-implementation. Jensen noted in his report that the marking of cycle lanes along routes in Copenhagen resulted in a 5% increase in cycle traffic mileage and a 1% decrease in motor vehicle traffic mileage along the treated routes. Although this result is noted as not being statistically significant in this case (with the 95% confidence intervals suggesting a possible impact of -4% to +14% impact on mileage) the impact of *separated* cycle tracks noted a 20% increase in cycle mileage and a 10% decrease in vehicle mileage.

The higher volume change under the separated cycle lane scenario suggests that, when presented with a more comprehensive separated cycle network, as seen in Copenhagen, the impact on traffic volumes can be noticeable. In the New Zealand context, generally cities and towns largely lack such comprehensive cycle facilities and networks, with mostly on-road linkages and poor facilitation for the needs of cyclists at route endings. These network and infrastructure factors make it hard to assess whether cycle lane treatments in New Zealand would have a similar impact on volumes (it may have a bigger effect due to tapping assumed latent demand for facilities).

2.2 Cycle Lanes and the Impact on Cycle Safety

Like motor vehicle crashes, statistics of crashes involving cyclists suffer from under-reporting or non-reporting, especially non-injury and minor injury crashes.

In New Zealand, road crashes involving cyclists have been required to be reported to police since 1998, although data for incidents that do not involve operated motor vehicles and non-hospitalized injuries tend to fall through the cracks. Evidence presented in Turner *et al.* (*8*) suggested that the reporting rate for cycling crashes may be as low as 21%, with overseas rates (such as the Netherlands at 20%) similarly low. As a result of the non-collection of data in these cases there is the potential for bias towards certain types and injuries that may not necessarily make up a large proportion of actual crash types (*9*).

Studies conducted in Christchurch by Turner *et al.* (*8*) of on-road cyclist crash casualties (who had made accident compensation claims for their injuries) suggested that 73% of those hospitalized had been involved in an crash involving a motor vehicle, compared to 24% whom were involved in cyclist-only incidents. These figures are in contrast to other studies such as Munster *et al.* (*10*), which suggested that on-road injury crashes involving cyclists only were at least two times as frequent as cycle crashes involving a motor vehicle, also based on hospital and accident compensation data.

The absence in standardized data and variance in reporting rates is an issue that afflicts not only New Zealand data but overseas studies as well, leading to a wide variance in study results and a tendency to focus on certain crash types and injuries at the expense of complete data sets.

Wilke & Buckley's (*11*) earlier study of cycle lane performance in Christchurch found that there was a notable reduction in cycle crashes after route treatment. They focused on five arterial routes in Christchurch to determine the cycle and pedestrian safety impacts. Post-treatment analysis of data obtained from the national CAS (Crash Analysis System) database, showed that a

9% reduction in cycle crashes was found across the routes. These findings led the authors to contend that cyclist crash rates are reduced following cycle lane treatment.

Other studies in New Zealand (*12*,*13*) suggest that the installation of cycle lanes at midblock locations resulted in a 10% reduction in cycle crashes, although it was noted that other treatments such as flush medians and the removal of curbside parking appeared to have even greater crash reductions. Turner *et al.* (*12*) were surprised that the crash reduction was not greater and speculated that it may be due to increases in cycle numbers (attracted to the new facility) minimizing the absolute safety benefits obtained.

Duthie *et al.* (*14*) studied the impact that cycle lanes in the US have on cyclist positioning and the safety benefits to cyclists and motor vehicles. Cycle lanes were found to shift the lateral position of the cyclist further away from the doors of parked cars and the curb, implying greater comfort and confidence in being able to defend the lane space. The positioning of motor vehicles on the road was affected by the provision of cycle lanes, finding that motor vehicles do not deviate as much in their lateral position on the roadway, with motor vehicles tending not to move out of lane to pass cyclists (which is potentially hazardous, especially on arterial routes) as sometimes found in wide traffic lanes.

The main factor that dictates the effectiveness of cycle lanes on user safety is the relationship between lane positioning and the relationship with vehicle parking. Evidence from Turner *et al.* (*12*) indicates that the absence of adjacent parking can reduce the rate of midblock cycle crashes by up to 75%. In addition, sites that had infrequent or spasmodic parking loadings (marked but mostly unused) had between 30 to 120% higher crash rates than routes with average or high parking loadings. Duthie *et al.* (*14*) backs up this contention, finding that lateral positioning of cyclists shifted further out in response to continuous or high parking loadings relative to discrete or intermittent parking loadings. This indicates that cyclists were more willing to take a gamble on passing by the door of a single car, or feel more confident in being able to predict a door opening in this case than if there was a row of cars, thus maintaining a smaller gap than otherwise. It could also reflect the propensity for some cyclists to swing in and out between infrequent parking, as opposed to maintaining a consistent line next to frequent parking.

A common issue with most of the studies listed above is the lack of control of cycle numbers when examining cycle crash rates. Given the likely influence of cycle facilities themselves on attracting cycling numbers, this is a key input when considering whether crash rates have improved or not. This has led to other crash analysis methods, such as case-crossover studies (*15*); however, they are limited in their ability to account fully for the effect of installing new facilities.

3 INITIAL DATA COLLECTION

This study focused on determining the impact of cycle lane treatments on cycling numbers and crash rates, whilst also examining whether there was a noticeable step change in cycling numbers following implementation.

Fifteen routes from around Christchurch were chosen for analysis; twelve of these routes had cycle lanes installed during 2003-2006 and three other routes with existing cycle lanes (constructed prior to 2000) were selected to control for any underlying trends in cycling and crash numbers. TABLE 1 summarizes the routes investigated. Note that all routes featured at least one side with cycle lanes adjacent to curbside parking.

TABLE 1: Selected Cycle Lane routes and Characteristics

Route	Length	Area of City	Implementation Timeframe	AADT (000's)	Road Class
Blighs Road	800m	W	2006-2007	10-12	Minor Arterial
Centaurus Road	2750m	SE	2003-2004	5-8	Minor Arterial
Greers Road	850m	NW	Early 2004	16-18	Major Arterial
Hoon Hay Road	2900m	SW	Early 2004	6-7	Minor Arterial
Lincoln Road	850m	SW	Mid 2004	21-26	Major Arterial
Lyttelton Street	1800m	SW	2004-2006	7-8	Collector
Moorhouse Avenue	2250m	CBD	2004-2006	32-39	Major Arterial
New Brighton Road	3100m	NE	2004-2005	6-7	Minor Arterial
Pages Road	3800m	E	2004-2006	24-25	Major Arterial
Strickland Street	1300m	S	Mid 2004	6-8	Minor Arterial
Wainoni Road	2400m	E	Mid/Late 2004	20-22	Minor Arterial
Wairakei Road	2100m	NW	Early 2003	15-17	Minor Arterial
Creyke-Kilmarnock Route	*3150m*	*W*	*Pre-2000 (Control)*	*12-14*	*Minor Arterial*
Marshland Road	*2000m*	*N*	*Pre-2000 (Control)*	*20-25*	*Minor Arterial*
Milton Street	*1100m*	*SW*	*Pre-2000 (Control)*	*14-16*	*Minor Arterial*

New Zealand cycling guidance (*16*) provides a cycling count scaling method based on research using CCC continuous count-station data. This method uses scaling factors based on the time of day, day of the week, and time of year (e.g. school holidays or not) to scale up short-term cycle counts of a few hours into an Annual Average Daily Traffic (AADT) estimate.

This method is based on the assumption that cycle numbers follow a common cycling profile, which is determined by whether the route is considered to be a commuter (and thus more cyclical with morning and evening peaks) or non-commuter site, with the respective scaling factors changing based on this cycle profile. Given the use of local data, this method of data analysis was used for this study.

Cycle count data was obtained from CCC for the intersections along the studied routes (as cyclists are not generally recorded at midblock locations by CCC) with the routes being broken up into section lengths based on the distance between count sites. Count data from 1999 onwards was used, to enable at least five years either side of treatment. Two types of counts exist in the council database:

- historic (pre-2004) manually collected cycle-only counts, typically counted in the 7:30-9:00am and 4:15-5:45pm time periods; and
- post-2004 shared counts (counts conducted at the same time as motorized traffic, either manually or electronically) typically counted between 7-9am and 4-6pm.

Both were treated equally in this study. Each of these cycle counts were converted into AADT estimates using the scaling calculation. Whilst individually there is considerable scatter in the AADT estimates, collectively they provide robust averages.

AADT estimates were sorted into pre-treatment, treatment-impacted (i.e. during the construction period) and post-treatment periods for each site and for the overall route, and then graphed. AADTs for each site and for the route as a whole were also graphed to display an overall cycle trend. These graphs were then linearly regressed to determine the average growth rate before, during and after treatment as well as overall.

The estimated million vehicle-kilometers travelled (MVKT) for each period, site and route was determined by integrating the graphs, and then multiplying by the section lengths.

Cycle crash data for all 15 routes was obtained from the national CAS (Crash Analysis System) database for the years between 1999 and 2009 inclusive (typically five years pre-treatment, five years post-treatment and one treatment affected year). At least three years pre- and post- data was obtained, to minimize regression-to-the-mean effects (note that most treatment sites were not ostensibly selected on the basis of their crash record).

The crash data was grouped to the nearest count site and then used to calculate the crash rate per MVKT for each site and for the route overall, in the pre- and post-treatment periods and for the overall study period. These rates were analyzed to determine the impact of the cycle lane treatment on crash rates. Whilst most literature (e.g. *12*) suggests that the effect of cycle volumes on crashes is not strictly linear, generally the relatively minor changes in volumes should limit the inaccuracy.

The cycle growth rates per year were determined using the graphed trends in the pre-treatment, treatment-impacted and post-treatment periods to determine the impact on cycle numbers, with the existence of any step change during the treatment period analyzed.

4 STUDY FINDINGS

The Hoon Hay Road route provides an example of a typical result found in this study; the route has three sample sites across a 2900m length that was treated with cycle lanes (parking retained on one side, and a painted median also installed). FIGURE 3 shows a timeline plot of all cycle counts recorded along this route, before treatment (blue data), during treatment (yellow data), and after implementation (pink data). Note that the variable nature of short-term cycle counts leads to considerable scatter of the individual AADT estimates.

The Hoon Hay Road route demonstrates a positive impact on cycle numbers from the cycle treatment. Pre-treatment Hoon Hay Road had a declining cycle count, which was arrested by a slight increase in cycle numbers immediately following implementation, implying that there is an impact on cycle numbers on this route corresponding to the cycle lane treatment.

Overall cycle numbers on the Hoon Hay Road route slightly decreased over the entire study period, with a trend of -2 cyclists per annum (cp/a). However, the step change at the time of treatment for the overall route is positive, with all sites showing a positive step change impact on cycle numbers (18 c/pa increase). The pre-implementation decline (-32 c/pa), has also reverted to an increasing cycle count trend (+8 c/pa) in the post-implementation period.

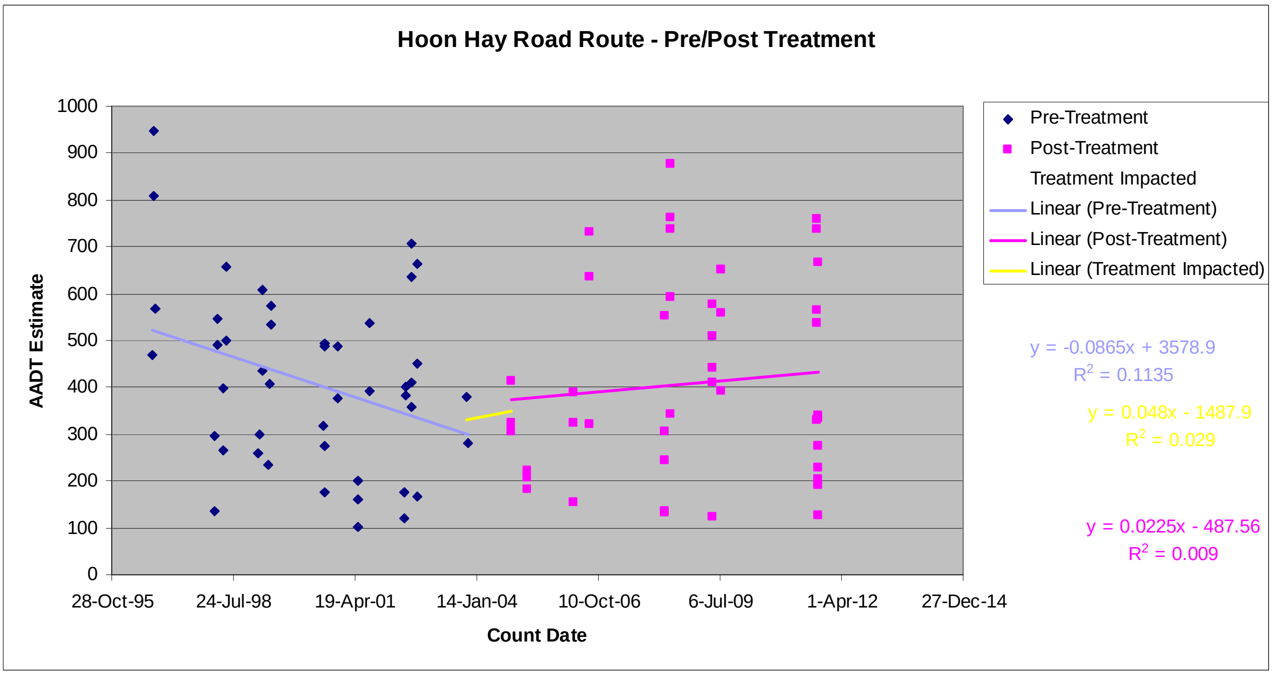

FIGURE 3: Hoon Hay Road route – Cycle Counts pre-, during and post-treatment

TABLE 2 summarizes the key statistics for this route, alongside million vehicle (cycle) kilometers travelled for each site and route. Note that the MVKT values for the overall route do not equal the sum of the three sub-section MVKTs because of overlaps in the section lengths used.

TABLE 2: Hoon Hay Road Route - Cycling Counts & Crash Numbers

Hoon Hay Road Route **(Early 2004 Cycle Lane Implementation)**

Length = 2900m MVKT = Million Vehicle Kilometers Travelled

Route Count Site	Halswell Road		Sparks Road		Cashmere Road		Overall Route	
	MVKT	Trend	MVKT	Trend	MVKT	Trend	MVKT	Trend
Pre-Treatment	1.96	-0.170	1.20	-0.100	0.39	-0.056	3.08	-0.087
Treatment-impacted	0.55	0.084	0.38	0.007	0.43	0.142	0.35	0.048
Post-Treatment	2.35	0.067	1.12	0.060	0.76	-0.049	3.81	0.023
Total Study Period	4.86	0.011	2.69	-0.008	1.58	0.015	7.24	-0.005

Crash Data	Total	Mid-Block	Junction	Halswell	Sparks	Cashmere
1999 - Implementation	3	2	1	2	1	0
Implementation - 2009	0	0	0	0	0	0
Total - 1999-2009	3	2	1	2	1	0

The reported cycle crash data for the Hoon Hay Road route were collected for the period 1999-2009 (11 years, 5 years either side of treatment) with this data being grouped to the nearest count site to determine the crash rate per million vehicle kilometers for each site and the route overall. The findings are detailed TABLE 3, with this route recording a 100% reduction in reported crash numbers post-implementation, albeit from very small prior crash numbers (three).

TABLE 3: Hoon Hay Road Route – Site crash rate changes

Crashes Per MVKT	Halswell Rd	Sparks Rd	Cashmere Rd	Overall Route
Pre: 1999 - 2003	1.02	0.83	0	0.98
Post: 2005 - 2009	0	0	0	0
%Change	*-100%*	*-100%*	-	*-100%*
Overall: 1999-2009	0.41	0.36	0	0.46
Rate Per Km	0.24	0.21	0	0.16

Obviously crash numbers like these for a single route are too small to draw any conclusions from. Likewise, the count data trends are not necessarily conclusive on an individual route basis. Therefore, more attention was paid to the overall trends across all of the routes investigated, as discussed later.

4.1 Study-Wide Cycle counts

The cycle counts for all routes and dates city-wide were plotted to determine whether there is an underlying trend across the city. Cycle numbers city-wide slightly increased over the study period, with a trend of +2 cp/a. Although the data is highly scattered due to the variety of sites included, the overall trend falls in line with the three untreated routes in the city (i.e. stagnant or slight increase in the cycle growth rate).

TABLE 4 summarizes the results for all of the studied routes. Slightly over half of all routes demonstrated a negative step-change during the treatment-impacted stage, questioning the validity of the assumption of an immediate positive jump in cycle counts. The overall step-change trend for all routes collectively was also overwhelmingly negative. Interestingly, the individual count sites within each route were fairly evenly split, in terms of positive and negative step-changes.

However, some of the most extreme negative step-changes appear to be predominantly due to background trends such as route shifting or long periods of road works on these routes. Ignoring these sites, the average-step change shifts to a slightly positive impact overall, but it is still arguably inconclusive.

By contrast, the longer-term changes in cycle counts post-treatment were strongly positive, with an average increase in cycle count trends of over 200% across all routes.

TABLE 4: All Routes - Cycle Counts – Impacts and Trends

	Growth Rate - Cycles p/a			Pre/Step	Pre/Post
Route	**Pre**	**Step**	**Post**	**Change**	**Change**
Blighs Road	–55	–24	+3	+31 (+56%)	+58 (+105%)
Centaurus Road	+4	+33	+15	+29 (+725%)	+11 (+275%)
Greers Road	–26	+49	+2	+75 (+288%)	+28 (+106%)
Hoon Hay Road	–32	+18	+8	+50 (+156%)	+40 (+125%)
Lincoln Road	–7	+36	+31	+43 (+614%)	+38 (+542%)
Lyttelton Street	+41	–187	+40	–228 (–556%)	–1 (–2%)
Moorhouse Avenue	–25	+201	+53	+226 (+904%)	+78 (+312%)
New Brighton Road	+6	–98	–18	–104 (–1733%)	–24 (–400%)
Pages Road	0	–26	–13	–26 (–)	–13 (–)
Strickland Street	+35	–42	+23	–77 (–220%)	–12 (–34%)
Wainoni Road	–13	–191	–6	–178 (–1369%)	+7 (+54%)
Wairakei Road	–16	–60	–18	–44 (–275%)	–2 (–13%)
Overall Treated Routes	**–88**	**–291**	**+120**	**–203 (–231%)**	**+208 (+236%)**
Creyke-Kilmarnock Route	*+6*				
Marshland Road	*–22*				
Milton Street	*+3*				

One possible reason for the decline in the cycle counts during the implementation period is the shifting to adjacent or parallel routes during the construction and early post-implementation stage (e.g. as seen with in the Lyttelton and Strickland Street routes). Many cyclists would avoid long-term roadworks if possible, with those cyclists returning to the route or new cyclists shifting to the route in the years post-implementation.

One exception to this is the Moorhouse Avenue route, which recorded large positive step changes at seven of the nine count sites. Sites in the south and south west of the city recorded positive step changes (with the exception of Lyttelton Street), while sites in the east all recorded strongly negative step changes.

The control routes (that were treated pre-2000) recorded slightly positive growth rates over the period (although barely above the slight city-wide growth), with the exception of the Marshland Road route of which the QEII Drive site recorded a large decline, amplifying the overall decline.

On a count site-by-site basis the change in trend was positive, with sites having negative cycle counts post-implementation recording a reduction in the magnitude of the negative trend. These results indicate that the cycle lane treatments have had a measurable positive impact on cycle counts post-implementation.

4.2 Study-Wide Cycle Crash Rates

TABLE 5 summarizes the changes in reported crash rates for each route. The majority of routes studied experienced a decrease in crash rates after cycle lane treatment, with nine out of the twelve routes recording a lower reported crash rate. Overall the average reduction in the crash rate is 43%, with seven of 12 treated routes experiencing a reduction in crash rates of 40% or greater.

The control routes (that were treated pre-2000) also experienced an overall reduction in reported crash rate of 25%. Therefore it is likely that some of the crash reduction experienced at the study sites would have occurred anyway, regardless of cycle lane treatment. Nevertheless, eight out of the 12 routes experienced reported crash reductions greater than the control routes, in many cases considerably more.

TABLE 5: All Routes – Reported Crash Rates – Impacts and Trends

Route	Cycle MVKT		Crashes		Crash Rate / MVKT		Pre/Post Change
	Pre	Post	Pre	Post	Pre	Post	
Blighs Road	1.45	0.62	2	1	1.38	1.61	+16%
Centaurus Road	1.79	3.11	3	6	1.67	1.93	+15%
Greers Road	1.00	0.69	3	0	3.00	0	–100%
Hoon Hay Road	3.08	3.81	3	0	0.98	0	–100%
Lincoln Road	1.08	1.32	4	1	3.70	0.76	–79%
Lyttelton Street	2.07	2.90	4	4	1.94	1.38	–28%
Moorhouse Avenue	3.41	3.64	15	7	4.40	1.93	–56%
New Brighton Road	1.93	2.14	9	6	4.66	2.81	–40%
Pages Road	2.92	2.32	17	7	5.82	3.02	–48%
Strickland Street	1.71	2.89	3	2	1.75	0.69	–61%
Wainoni Road	3.00	1.38	5	2	1.67	1.45	–13%
Wairakei Road	2.90	1.36	4	5	1.38	3.68	+167%
Overall Treated Routes	**26.34**	**26.18**	**72**	**41**	**2.73**	**1.57**	**-43%**
Creyke-Kilmarnock Route	*3.74*	*3.95*	*14*	*10*	*3.74*	*2.53*	*–32%*
Marshland Road	*1.53*	*1.04*	*1*	*2*	*0.65*	*1.92*	*+196%*
Milton Street	*5.81*	*6.12*	*1*	*0*	*0.17*	*0*	*–100%*
Overall Control Routes	***11.08***	***11.11***	***16***	***12***	***1.44***	***1.08***	***-25%***

The overall decline in reported crash rates post-implementation indicates that the cycle lane treatment has had a notable positive impact on cycle crash rates. Adjusting for the expected control route crash reduction, the expected overall crash reduction after installing cycle lanes is **23%** (or a Crash Modification Factor of 0.77). However, the 95% confidence interval for the change is [0.18, 1.14], indicating that the reduction is not statistically significant.

5 DISCUSSION

5.1 Christchurch Earthquakes and the Impact on Cycle Numbers

The 2010-11 Christchurch Earthquakes caused extensive damage to the city's road infrastructure, especially in the eastern suburbs. Counts undertaken post-earthquake are noticeably lower, in some cases 20% lower than counts undertaken under 12-24 months beforehand. This decrease in counts has influenced overall trend data, leading to post-implementation and overall site counts to either present a more negative than trend cycle count (drags down the trend) or the flattening out or reversal of positive cycle growth rates. To minimize post-earthquake impacts on the study crash rates, sampling of CAS data was ceased at 2009. Further study into the long term impact of the earthquake on cycling rates will be required in order to determine whether these counts are reflective of new travel patterns or are just a short term impact on cycle numbers.

5.2 Route Influencing Factors

One of the largest route influencing factors found in this study was competition from other cycle facilities. The Railway Cycleway, a dedicated off-road cycle path, intersects three of the study routes. These routes had a noticeable decline in cycle counts, which correspond to the completion of new stages of this more direct and preferred off-road route. Competition between cycle lane treated routes also occurred between two of the study routes, Lyttelton Street and Hoon Hay Road, which are parallel. A decline in the cycle numbers on the Lyttelton Street route corresponded with an increase at the Hoon Hay Road route, indicating the potential for some shift between the two routes.

Changes to traffic conditions and types of traffic may have influenced some of the sample sites in the study. Sites that saw an increase in motor vehicle traffic, especially heavy vehicle traffic, corresponded to falling cycle counts. For example, two count sites in the northeast of the city, with a growing trend of heavy vehicles along the State Highway 74 corridor, declined at a greater rate than other sites in the area. This factor may have also influenced the cycle counts at the Blighs and Wairakei Road route sites, which declined substantially over the study period. These sites saw stagnant overall motorized traffic growth but an increasing share of heavy vehicles using these routes, especially on Blighs Road, suggesting some influence of cycle attractiveness of this route. These changing conditions may have contributed to a greater cycling shift to the Railway Cycleway over the period, even as the cycle lanes were being introduced.

5.3 Data Integrity and Sampling Methods

Mid way through the study period, the data collection method and times changed with historical (pre-2004) manually-collected cycle only counts, typically counted in the 7:30-9am and 4:15-5:45pm time periods, and the post-2004 shared counts (counts collected at the same time as motorized traffic, either manually or electronically via tube counter) typically counted between 7-9am and 4-6pm. The change in the count method also corresponded with a change in sampling methodology, with counts now only being done on Tuesdays to Thursdays, to reflect motorized traffic trends.

Counts undertaken using this shared method tend to be lower than the cycle-only counts, especially on high traffic routes. This lower count rate may have contributed to some of the decline in cycle counts in the post-treatment period. In higher traffic locations, manual counts of motor traffic may overlook some cyclists, while electronic counts of motor vehicles may “mask” some cycle detections.

6 CONCLUSIONS AND RECOMMENDATIONS

Overall the study has demonstrated that cycle lane treatments are effective at meeting the policy and road safety aims postulated in the in the literature.

The change in cycle count trends post-treatment were strongly positive, with an average increase in annual count trends of more than +200%. Even sites with decreasing trends post-implementation typically recorded a reduction in the magnitude of the negative trend. These results indicate that the cycle lane treatments had a measurable positive impact on cycling numbers post-implementation.

However, immediate step-changes in count were found to be negative overall; with an average step-change of over -200%. Just over half of all individual sites demonstrated a negative step-change during the treatment-impacted stage, questioning the validity of the assumed short-term positive jump in cycling numbers. However, ignoring sites affected by external factors, the average step-change shifts to a slightly positive (but inconclusive) impact overall.

The majority of routes experienced a decrease in cycle crash rates after cycle lane treatment, with nine out of the twelve routes recording a lower crash rate. Overall the average reduction the crash rate is 43% with seven of 12 treated routes experiencing a reduction in crash rates of 40% or greater. The strong decline in crash rates post-implementation indicates that the cycle lane treatment has had a very positive impact on cycle crash rate. Allowing for crash reductions experienced by the control routes, an average 23% reduction in crash rates was observed following cycle lane implementation. However, this reduction was not statistically significant at the 95% level.

It is evident that on-road cycle lanes do not greatly attract new cycling numbers in the way that some protected cycle facilities do. However, they serve an important role in improving the relative safety of the *existing* people cycling.

This study raised areas to be researched further, including:

- Conduct further analysis of pre/post-treatment count numbers and rates at a variety of sites elsewhere to assess whether the assumption of an immediate step change is valid.
- Undertake further long term research as to the impact of the Christchurch Earthquakes on cycle growth rates.
- Conduct research into the influence of traffic conditions and types of traffic on counts.

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