Cyclist Safety In Queensland: Crash Factors and Countermeasures

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Abstract

Increasing the amount of cycling in our communities has many positive benefits. However, the perception of cycling as a dangerous form of transport may hinder desired increase. To address this issue, the State Cycle Unit, Queensland Transport, has undertaken a comprehensive analysis of bicycle crash data from 1994-1999, in order to obtain a better understanding of the causes and extent of cycling crashes. This data was obtained from the Queensland Police Service. Findings suggest that angle crashes represent a high number of incidents involving cyclists. These crashes involve two or more vehicles colliding on an orthogonal path. Contrary to accepted wisdom; mid-block accidents were also highly represented. Further analysis of these crashes revealed a variety of causes, such as driveway incidents, car door openings, and unsafe distances for overtaking. These findings have various practical implications. Specifically, strategic educational campaigns targeting the problem areas identified would assist in enhancing community awareness of the issues encountered by cyclists. Cyclist safety can also be improved through the development and implementation of engineering countermeasures. However the physical and temporal data available for this analysis limit the cost-effectiveness and suitability of countermeasure selection. It is not until further detailed data is available on cyclist exposure patterns and behaviour and on traffic environments (traffic speed, volume and composition) that the key factors leading to crashes can be determined and appropriate specific countermeasures implemented with some confidence. Through appropriate and visible education, engineering, and enforcement it is hoped that the broader community will be encouraged to cycle, making it an integral and viable part of the wider transport system.

Introduction

Increasing cycling as a mode of transport has several key benefits in the areas of environment, energy savings, health, social justice, and the economy. Cycling does not cause health-threatening impacts on air quality, is one of the most energy efficient forms of transport, and has positive effects on personal health, fitness and recreation. Further, cycling delivers social justice advantages by providing choice and improved mobility for those who do not have access to a car, and can result in travel time and parking cost saving, which is particularly applicable in congested inner urban areas (Queensland Transport/Main Roads (1)).

The Integrated Regional Transport Plan for South East Queensland adopted by the State Government in 1996, aims to reduce predicted car travel demand by 20% compared to the trend scenario. The contribution of cycling to the target was to increase from 2% of total trips to 5% by the year 2011. Since 1996, the State Government has emphasised their commitment to cycling, increasing the target to 8%. This represents an additional 805,400 cycling trips across the region each day compared to current cycling trips (Queensland Transport/Main Roads (1)). As such, it is evident that increasing cycling is a priority in Queensland.

Over the past six years in Queensland, an average of 11 cyclists were killed each year and 243 cyclists admitted to hospital each year following injuries sustained in road crashes. International and other Australian research suggests that the majority of cyclist casualties are less than 20 years old and are predominately male. For example, in a study of bicycle crashes in New Zealand, Collins et al identified young males in the 5-14 year age group as having the highest rates of injury (in Hendrie et al (2)). Hendrie et al (2) also reported similar findings in a study of police-reported bicycle crashes in Western Australia. This study found that 29% of cyclists involved in crashes were under 16 years of age, and 81% of cyclists involved in crashes were male.

Due to the lack of exposure data on cycling, it is difficult to ascertain whether cycling is more dangerous than other forms of transport. In addition to the actual safety of cycling, there is the issue of perceived safety. For example, the SafeST report (BCM Partnership/Queensland Transport (3)) found that approximately 20% of people surveyed did not cycle due to the perception that cycling is a dangerous mode of transport.

In light of this, the current study aimed to examine the safety of cycling as a mode of transport, and to investigate potential countermeasures in the areas of education, enforcement and engineering. The development of specific engineering countermeasures is hindered by the lack of sufficient detailed data on the key factors leading to crashes. These data limitations are presented in the discussion section of this paper. More detailed reliable data on these key factors will greatly assist in the selection of well-targeted countermeasures.

It is hoped that by gaining a comprehensive picture of cycling crashes and related factors, that safe cycling can be increased, making it an integral and viable part of the wider transport system in Queensland.

Method

The study covered the 6-year period from 1994-1999. Data on bicycle crashes and the units involved were obtained from the Road Crash Data Base. The Queensland Police Service (QPS) and Queensland Transport (QT) jointly maintain this database. The database contains detailed information on the characteristics of the individuals and vehicles involved in road crashes, and outlines the crash circumstances. Crashes involving cyclists (and other road user types where relevant) were identified and used in the analysis. A total of 2851 crashes over the six-year period were identified. These crashes involved 5046 units (ie vehicles or individuals).

The study used descriptive statistical methods to analyse the road crash data. Frequency tables and cross-tabulations were generated using the Statistical Package for the Social Sciences (SPSS). Due to the nature of the data collected by the QPS and the lack of baseline data on cycling, causal and/or correlational relationships between characteristics of crashes cannot be established.

Results

Cyclist Profile

General analyses were conducted to ascertain the number of cycling accidents and information about cyclists involved in crashes over the period 1994-1999. There was an average of 841 police reported bicycle crashes per year, and descriptive analysis suggests a stable trend in crashes over the six-year period. Results also suggest that 13-16 year old cyclists tend to be involved in proportionately more crashes than other age groups. This age group accounts for 25% of all bicycle accidents (n=1281).

Further analysis indicates that within severity categories, 23% of fatal bicycle accidents occurred in the 13-16 year age group, however the numbers in this case are quite small (n=15). Overall, it appears that regardless of age, a large proportion of bicycle accidents result in medical treatment. This may be skewed due to the tendency for police-reported crashes to be more serious in nature(4).

Analysis of gender shows that 79% of cyclists involved in crashes are male, and considerably more males than females are involved in crashes in every age group. The age group with the highest percentage of males was 60+ (91%) and the lowest was 17 to 24 year olds (76%). Excluding unknown cases, 90% of females and 84% of male cyclists involved in police-reported crashes were aged between 6 and 39 years old. Over one third of the cyclists involved in incidents were young males aged 16 years or less. It should be noted however, that these findings may be related to increased exposure rates rather than accident rates.

Crash Profile

Overall, the peak times for bicycle crashes are 2pm to 4pm when 20% of crashes occurred, 4pm to 6pm when 23% of crashes occurred, and 8am to 10am when 15% of crashes occurred. The time period 2pm to 4pm represented the peak time for crashes on a weekday and the 4pm to 6pm time period representing the peak time for crashes on the weekend. Further examination of time of crash, day of crash, and age group suggests that these peak times may be related to increased exposure rates from commuting to school and employment. In addition a seasonal transition is apparent, with lowest incident rates in December and January, and highest incident rates in March.

Analysis also indicates that 91% of police-reported crashes involving cyclists occur on roads with a speed limit up to and including 60 kph. Further examination of the severity of crashes across speed zones suggests that crashes which occur in high speed zones (80 kph) are more likely to result in hospitalisation, whereas crashes which occurred in speed zones of 70 kph or less are more likely to require medical treatment.

Crash Severity

QPS records five levels of crash severity; death within 30 days, hospital admission, medical treatment with no hospital admission, injured with no medical treatment (minor injury), and property damage only. From the crash data over the six year period, 65 cyclists (1% of all cyclists involved in crashes) were killed in road crashes, 1457 (28%) were reported to have been admitted to hospital, 2428 (47%) required medical attention, 1214 (23%) were injured but required no treatment, and 49 (1%) were involved in property damage only crashes. It is likely that the property damage only figures are substantially under-reported due to the nature of bicycle incidents.

Crash Type

Due to the small number of cases in several of the data categories, this variable was recoded into angle, rear-end, sideswipe, head-on, cycle fall or drop, hit object, and other. Descriptive analysis reveals that two types of crashes account for 81% of all crashes involving bicycles; angle crashes (66%) and sideswipe crashes (15%).

Further analysis shows that angle crashes (51%) and rear-end crashes (19%) account for 71% of the 65 fatalities that occurred over the six year period. Angle crashes also account for 62% of all reported hospital admissions and 66% of medical treatment injuries.

If the percentage of crashes resulting in a hospital admission or fatality are examined by crash type, then angle and sideswipe crashes are the most serious types of crashes, with 60% and 15% respectively resulting in a fatality or reported hospital admission. However, most accidents, regardless of crash nature result in medical treatment.

Road Feature

Descriptive analysis found that proportionately more crashes involving cyclists occur mid-block (39%) or at T Intersections (32%). Cross intersections are also highly represented (20% of crashes). A large percentage of serious injury crashes involving cyclists (i.e., fatal and hospitalisation) occur mid-block or at T Junctions.

The large proportion of cycling accidents that occurred mid-block was further investigated by examining mid-block crash descriptions to identify key crash themes (see Table 1). This analysis indicates that mid-block accidents involving bicycles occur as a result of a motor vehicle exiting a driveway (13%), cyclist lane change/turn (11%), cyclist error (7%), motor vehicle driven without due care and attention (7%) and opening motor vehicle door (6%). These crash types suggest a need to increase physical road space for cyclists. An increase in the space and facilities dedicated to bicycle traffic in the road environment will help road users to establish a more positive mindset towards cyclists. The presence of bicycle facilities (bike lanes etc) allows the presence of cyclists to be a natural occurrence expected by motorists. This change of attitude can be seen as motorists providing “head space” for cyclists (or being bicycle aware). Such a change can be induced through the provision of physical space on the road.

Table 1: Mid-Block accidents: Police Reported Data, Queensland, 1994-1999.

	NUMBER	PERCENT
BICYCLE CATEGORIES		
Bike coming out of driveway	83	4%
Bike going into driveway	14	1%
Bike lane change/turn	215	11%
Bike moving between stationary vehicles	22	1%
Bike U turn	24	1%
Cyclist crossing	120	6%
Cyclist crossing at pedestrian crossing	39	2%
Cyclist error	139	7%
Cyclist leaving footpath	102	5%
Cyclist not obeying road rules	83	4%
Racing	3	0%
MOTOR VEHICLE CATEGORIES		
Motor vehicle due care and attention	147	7%
Motor vehicle improper overtaking	85	4%
Motor vehicle pull into on-road parking	21	1%
Motor vehicle pull out of on-road parking	19	1%
Motor vehicle coming out of driveway	254	13%
Motor vehicle going into driveway	105	5%
Motor vehicle lane change or turn	38	2%
Motor vehicle U-turn	44	2%
Car park incident	1	0%
Malicious	7	0%
Open car door	119	6%
OTHER CATEGORY		
Other	308	15%
TOTAL	**1992**	**100%**

Discussion

This study aimed to investigate the safety of cycling in Queensland by providing an overview of police-reported crashes and the circumstances that contribute to these crashes.

Descriptive analysis indicates that males, and 13 to 16 year old cyclists, tended to have proportionately more crashes than females and other age groups. These findings are similar to that found by other researchers (e.g., Collins et al (in Hendrie et al (2)), Hendrie et al (2)), however the results should be interpreted with caution due to the lack of baseline data on exposure rates.

Crashes tended to occur during peak commuting times, and there appeared to be seasonal variation in the number of crashes, with most incidents occurring in March.

Proportionally more incidents involving cyclists resulted in medical treatment. Angle crashes represented a high number of incidents involving cyclists. These crashes involve two or more vehicles colliding on an orthogonal path (Wilks et al (5)). In addition, contrary to accepted wisdom about the nature of bicycle crashes, mid-block accidents were highly represented. Further analysis of these crashes revealed a variety of causes, such as driveway incidents, motor vehicle door openings, cyclist error, cyclist lane change/turns, and motor vehicle driven without due care and attention.

The findings of this study suggest that several educational, engineering and enforcement countermeasures may be beneficial to increase safe cycling. For example, educational campaigns that target 13 to 16 year olds may be advantageous. Bailey (6) concluded that current cycle training programs, such as the Australian Bike-Ed course that targets 8-13 year olds, have some educational advantages, particularly in the case of the on-road program content. This program could be extended to the age group identified in the current study 13-16 year olds.

In addition, educational promotions such as Queensland Transport's "Share the Road" campaign serve to address the problem areas identified in this study, by encouraging motorists to check for cyclists, move over for cyclists, and give way to cyclists. However, evaluating the effectiveness of such campaigns is problematic, due to the difficulties of measuring behaviour change rather than assessing recall of the campaign.

Further, enforcement of road rules and rules concerning the roadworthiness of bicycles, for example, through the Bicycle Offence Penalty Scheme (BOPS) is necessary to increase the safety of cycling. However, enforcement of these factors is quite difficult due to a number of reasons including a police desire to not generate negative relationships with young cyclists.

As such, it is the contention of this paper that, although educational and enforcement countermeasures may serve to increase safe cycling, they are likely to provide benefit only in the short term. In light of this, it is proposed that engineering countermeasures that focus on changing the road environment to give cyclists their own space are imperative to increase safe cycling in the long term. Such countermeasures would realise and consolidate perceptions that cyclists are legitimate road users, thus providing "head space" in the minds of motorists as well as road space.

Research suggests several engineering countermeasures that would be useful in this regard. For example, the Austroads Guide to Traffic Engineering Practice Part 14 (Bicycles) (7) provides practical guidelines for uniform design, construction and operation of road facilities that provide for cyclists. These facilities compare well to international countermeasures for improving cycling safety. Commitment to the provision of facilities of at least this standard for cyclists in all new work and when upgrades are carried is required. However, it should be noted that there is relatively little published work in Australia on testing of different engineering treatments in an experimental sense (Hendrie et al (2)).

It is firstly important to determine where countermeasures are required. A number of studies have been carried out in the United States to assess the effectiveness and friendliness of the existing environment (e.g., Harkey et al (8)); Turner et al (9)). These studies have resulted in the development of an objective measure; the Bicycle Compatibility Index (BCI). This process measures physical characteristics of the road and traffic, and produces a replicable score that represents the desirability of the road for cycling. Such a process can be implemented when bicycle network plans are retrofitted to existing environments, in addition to assessing existing cycle networks.

Due to the relatively low incidence of cyclist-involved crashes, it is difficult to identify hazardous sites in the traditional sense. Sayed et al (10) suggest "traditional Black Spot programs start with a problem (high accident occurrence) and attempts to find solutions (countermeasures)." A countermeasure-based approach would reverse this process, by first identifying main accident patterns that can be targeted by specific countermeasures and then searching for locations that have an overrepresentation of these patterns. This process is more suitable to cyclist-involved crashes.

In the Queensland context, it is difficult to proceed to the next phase of countermeasure development: determining the most appropriate well-targeted cost-effective countermeasures for the environment. This is because of a lack of reliable and comprehensive data on the following:

- Cyclist exposure: cyclist numbers and usage levels for age groups and trip purposes.
- Helmet usage rates
- Use of bicycle lighting systems and conspicuity aids
- Detailed, accurate information regarding the road and traffic environment at the time of the crash (lane widths, vehicle size and speed, traffic volumes etc).

Other issues include under-reporting of cyclist-involved accidents, the fact that a high percentage of hospital presenting cyclists were involved in single vehicle crashes (ie no motor vehicle involved) and the number of crashes that occur on footpaths and bike paths. Further analysis and improved data are required to determine the key factors leading to crashes. It is only with this data, along with the physical and temporal data already available that appropriate countermeasures can be developed and implemented.

Policy recommendations from the study include the use of the Austroads Guide to Traffic Engineering Practice Part 14 (Bicycles) (7) as a minimum design guideline for all new work and for any retrofitting of existing road environments. Research and data improvement recommendations include the observation of bicycle traffic where crash rates are relatively high and the monitoring of motorised traffic speed, volume and composition along key cycling routes.

Finally, there is evidence to suggest that conflicting traffic events are more dangerous if they happen infrequently. European studies have found that an increase in cycling does not lead to a proportional increase in cycling accidents (Traffic Planning Division, (11)). This is because a community that has cycling as an integral component of its transport options is more accepting of cyclists and is not so confronted by infrequent interactions with them. In light of this, increasing cycling may serve to increase *safe* cycling.

In conclusion, measures implemented to increase cycling need to be visible not only in the physical sense in terms of infrastructure provision, but in educational and encouragement terms. A cyclist-friendly environment will assist to increase cycling and cycling safety, thus making it an integral and viable part of the wider transport system.

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