NSW GOVERNMENT | Transport for NSW

Centre for Road Safety

Shared paths

Discussion of research findings and key safety issues

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1 Context

Transport systems are faced with the challenge to accommodate cyclists and pedestrians on shared paths safely and while providing amenity. To provide an overview of the safety issues and consolidate knowledge in the area, in 2013/2014 the Centre for Road Safety (CRS) commissioned three pieces of research:

- Review of relevant scientific literature and jurisdictional guidelines, rules and practice
- Observational field study and path user survey
- Shared path advisory speed warning sign study.

It was envisaged this combined research would guide the development of policy and practice guidelines on shared path safety in NSW.

2 Rationale

This research initiative addressed a priority area in the 2009 NSW BikePlan. BikePlan outlined a ten-year bicycle infrastructure plan that includes consideration of shared facilities between pedestrians and cyclists. Shared paths are generally recognised as safer for cyclists than on-road conditions.

The CRS identified a need to examine the current evidence-base on safety considerations pertaining to shared paths. A prior observational research study commissioned by the RTA in 2009 found that although there were few actual conflicts between pedestrians and cyclists, there was still scope to improve safety and the perception of safety on shared paths.

3 Research design

The scope of the literature review was to provide an overview of both empirical and jurisdictional literature on shared path safety. The report examined best practice strategies to maximise safety, including infrastructure elements and regulations. Empirical findings on key elements – path design, usage and crash outcomes, user behaviour and attitudes were also reviewed. The report also flagged gaps in the knowledge base.

The observational field study focussed on cyclist and pedestrian behaviour at 12 shared path locations in NSW over a two-month period. The scope of the report included observational analysis of shared path encounters, actual and potential conflicts, traffic volumes and travel speeds of all users. The fieldwork included 50 hours of observational measurement involving 5932 cyclists and 2408 encounters (passing or meetings) between cyclists and pedestrians. In addition, shared path users from the five busiest sites were surveyed on their knowledge and perceptions of rules, safety risks, facilities and other path users' behaviour. A limitation to the observational findings was the possibility of 'observer effect' - which is associated with socially desirable behaviour in those subject to observation. However, in this study, observer effect was potentially mitigated by the high number of observations, which in turn, added power to the findings. The number of respondents in the survey sample was nominal (n=58; 33 cyclists and 25 pedestrians). Given there is limited research on user perceptions, the survey did offer some preliminary insights into the perceptions of path users that cannot be obtained via observation. Allowing for the above caveats, the field study has provided valuable data on actual shared path behaviour in NSW.

The purpose of the shared path advisory speed warning sign study was to improve understanding of the impact of advisory speed signage on shared paths. This field study essentially measured the impact of speed signage on riding speed, lateral separation between users, other safety risks and user awareness. Two forms of advisory speed signage were trialled – a 'slow warning' 'shared path' message and an advisory speed marking of 10km/h. Both sign types were augmented with pedestrian and bicycle symbols.

The trial involved installation of signage at four treatment sites (each type of marking at two sites) and one control site. The control site was used to account for other potentially confounding factors, such as seasonal factors that may have changed path user behaviour. Before and after measurement of path user behaviour was conducted via tube count and video camera recording for approximately 200 hours. In addition, an intercept attitudinal survey was conducted with 95 (55 pedestrians and 40 cyclists) shared path users.

4 Summary and discussion of key findings

The combined research findings informed this summary and discussion. Findings reported from the two local field studies were broadly consistent with the body of evidence reported in the literature review.

4.1 Design factors

Due to the complexity of shared path use, a combination of factors should be assessed in shared path design.

Australian and overseas guidelines address adequate path width, mode of separation and intersection treatments as well as other elements related to construction maintenance and lighting. In addition to volume, Australian guidelines for determining appropriate path width include operational characteristics such as usage type (commuter vs. recreational), speed & gradient.

Importantly, these guidelines are also used to determine where segregated paths are appropriate. In high volume conditions, segregation or separation of different user groups is proposed as the most effective way to increase users capacity to use the shared path.

4.1.1 Path width

The literature identified adequate path width as a critical element to minimise conflict between cyclists and pedestrians. In NSW, shared path design and infrastructure is currently based on Austroads guidelines. The recommended minimum path width is between 2.5 and 3.0 metres. The recommended path width increases with traffic volume.

4.1.2 Commuter versus recreational use

Usage type (commuter versus recreational) has been identified in the literature as an important consideration. A primary issue is safety and amenity rather than simple capacity. It may be technically possible to carry a large number of users, but if people do not feel safe they will not use the facility.

- Current policies often focus on active travel (compared to cycling and walking for recreation) because many of the associated benefits rely on replacement of motorised transport. If cycling and walking promotion policies are to be

effective then it is crucial that transport systems accommodate both cyclists and walkers safely, and in a manner that encourages active travel.

- In instances of high traffic volumes, segregation or separation of different user groups is proposed as the most effective way to increase their capacity to use the shared path (Department of Transport and Main Roads, 2012).
- There may be a need to design multi-purpose facilities for the 'higher' types of usage where there are multiple types of users, either together or at different times. A path may be recreational (relatively slow cycling and possibly high levels of walking) at weekends but commuter-based during the week.
- Findings indicate that in the determination of shared path design, risk assessment models should include comparison of risk, amenity, and their determinants, by different path uses (commuter and recreational).
- In the observational study, cyclists were more likely to keep to the left on paths with high pedestrian volumes, but were less likely to keep to the left when cycling on wider paths.

4.1.3 Path separation versus segregation

Where feasible, officially-segregated paths are likely to be more effective than dual occupancy.

- The three main modes of separation are level surface separation (centreline), separation by level difference and separation by a barrier.
- The aspect of shared path design/infrastructure that has received most research attention is the presence of a centreline. The literature review identified centreline delineation as effective in increasing left-hand travel, as well as lowering cyclist speeds. The review cited research conducted in Sydney which found 93% of both cyclists and pedestrians kept left on shared paths with a centreline. This positive association between centre-line delineation and left-hand travel was upheld in the local observational study which found that after statistically controlling for other factors, centrelines were independently predictive of left-hand travel. However, centreline delineation was also associated with higher cycling speeds in the observational study. This finding represented a departure from the existing evidence, which had identified a negative association between a centreline and speed.
- Visual separation of cyclists and pedestrians (where an area was indicated for pedestrian travel by using different coloured pavement or an alternative treatment) was not associated with left-hand travel in the observational study. The evidence is inconclusive, due to the lack of confirmatory research on this path design feature.
- Previous findings indicating that intersections pose a particular crash risk for bi-directional cycle paths suggest a similar issue for shared paths. All guidelines advise that where shared paths intersect with roads, appropriate intersection treatment (warning lights, zebra-style/coloured or raised crossings, signals, etc.) is needed to ensure the full awareness of path users and motorists of the presence of an intersection. The observational study did not address this design feature.

4.1.4 Advisory speed signage

The speed signage trial found that neither the 10km/h advisory speed markings nor the slow markings resulted in significant reductions in cyclist speed. Only one in four cyclists reported noticing the markings and of those who did notice, one in three

indicated that the markings would cause them to ride slower. This suggested limited receptiveness from cyclists towards adjusting their speeds. Cyclists preferred the slow marking over the speed limit, however this may have been due to the 10km/h limit. That some cyclists reported they would reduce their speed if there was a speed limit, suggests that speed limit signage could be further investigated using a higher threshold. In addition, greater lateral separation between cyclists and other path users was observed across all sites after the signage was installed. More research is needed on the impact of speed signage due to the lack of comparable studies.

4.1.5 Path design models

More recently, predictive models based on empirical evidence have been developed to determine optimal path widths required for various pedestrian and cyclist volume combinations on shared paths. The method is based on the 'Level of Service' which is a method for quantifying the quality of user experience. It draws on operational as well as user perception data. The model, which originated in the USA, is based on four main factors – path width, design hour user volume, presence of a centreline and mode split (proportion of users going in each direction). Safety has not been factored into the modelling used to determine shared path width; reportedly due to the difficulty of obtaining reliable data. To date, delayed passing threshold has been be used as a proxy for safety. Notably, the model was developed from a cyclist perspective. Victoria and Queensland have recently adapted and extended the model.

4.2 Path user factors

According to the evidence, left-hand travel is associated with safer behaviour among both cyclists and pedestrians and by association any design feature that is predictive of left-hand travel also represents a safer option.

4.2.1 Speeding

Shared path research has not provided conclusive evidence on the effectiveness of speed limits.

- Cyclists typically travel above the speeds that would be recommended based on safety considerations for bicycle-pedestrian collisions – 10km/h. Below about 12km/h bicycle instability increases, possibly increasing the risk of falls. Pedestrians usually walk at around 5km/h.
- In the observational study, around two in three riders cycled at an average speed of 11-20 km/h. Just 3% cycled at 10km/h or less. The overall average speed was 18.4km/h (range 4.2 – 43.2). Riders were more likely to cycle above the average speed on wider paths and paths with a centreline, and were less likely to cycle above the average speed on paths with higher pedestrian volumes.
- When observational study participants (n=58) were asked about the minimum speed a cyclist should be able to travel on a shared path for commuting by bicycle to be attractive, the greatest rider-pedestrian concurrence was observed for speeds between 15 and 20 km/h.
- In the speed signage study, two in three cyclists surveyed in the speed advisory trial sites believed a safe travel speed was between 10 and 20km/h. However, pedestrians at the same sites most commonly selected up to 10km/h as the safest travel speed.
- Slowing down - the overall evidence regarding whether cyclists slow for pedestrians is equivocal. In the observational study, only 10% were observed

to slow down when passing pedestrians and three per cent of riders were observed to warn pedestrians before passing.

Based on the available evidence, speeding does not appear to be a key issue on shared paths because generally both cyclists and pedestrians understand that a practical cycling speed is appropriate for the environment.

4.2.2 Conflict

There is very little research specifically addressing pedestrian crash risk on shared paths relative to footpaths. This is because pedestrian safety studies have tended to focus on pedestrian-MV collisions at intersections and crossings. The limited research on collisions between cyclists and pedestrians on shared paths suggests that crashes are fairly uncommon. However, according to survey research, crashes between cyclists and pedestrians are underreported and therefore underrepresented in official records.

- In the observational study, of 2408 encounters between cyclists and pedestrians, one non-injury collision and eight near misses were observed. In the speed signage study, one major conflict was observed (< 1% of encounters).
- Prior research conducted in Sydney found that bicycle-pedestrian collisions were more likely at locations with high traffic volumes and these factors:
    - relationship with co-location of bus-stops
    - curvilinear relationship with path width; narrow (<1.5m) and wide paths (>2.7m) being less safe than medium-width paths, suggesting that medium-width paths represent an optimal sufficient width
    - relationship between the distance from the roadway that depends on the speed limit of the road.
- Aggressive behaviour contributes to reduced amenity on shared paths and according to the literature such exchanges occur occasionally on shared paths. The observational study recorded a nominal number of aggressive exchanges (<1%) relative to the number of encounters between cyclists and pedestrians. However, in the survey sample, two in five cyclists and more than one in four pedestrians reported they had experienced an aggressive exchange on a shared path in the past.

4.2.3 Close passing

Close passing has been used as an index of safety (as a risk hazard) and of amenity for pedestrians in previous studies. In the observational study, passing in the same third of the path was treated as an index of close passing. In 11% of cases, cyclists and pedestrians met each other on the same third of the path. Statistical modelling showed that the chance of riders and pedestrians passing or meeting each other on the same third of the path was:

- reduced on paths wider than 3.5m compared to narrower paths, reduced during meetings compared to passings and when riders cycled at the centre of the path or on the right of the path while interacting with a pedestrian compared to riding on the left side.
- increased when 3 or more other path users were within 3m of the rider during passing compared to when no other path user was present and when pedestrians walked to the right while interacting with a rider compared to walking on the left side.

4.2.4 Path user perceptions and preferences

A noted gap in the literature was research into the views and perceptions of path users. It is worth noting, the observational study's low survey sample size limits the generalisation of its findings. Those findings showing consistency with prior research have been reported.

- Prior research has indicated that generally pedestrians feel comfortable on shared paths. Similarly, in the observational study around three-quarters of surveyed pedestrians and cyclists agreed they enjoyed shared paths, while recognising some safety concerns and annoyances with other users. According to prior work, older pedestrians are more likely to feel uncomfortable on shared paths.
- Combined results from NSW attitude surveys suggest pedestrians perceive cyclists as behaving moderately well.
- Feelings of intrusion and inappropriate closeness have been linked to conflict on shared paths. Comparably, in the observational study around seven in ten cyclists believed that pedestrians get in their way on shared paths. Most surveyed pedestrians identified cyclists as *travelling too fast, not signalling when they pass* and *passing too close*. In the speed signage study, most pedestrians perceived greater discomfort due to close passing by cyclists than for their speed.
- Surveyed path users' observations on the acceptability of countermeasures for shared path safety include:
  - widening the path and improving the surface
  - separation of different user groups when path volumes are high
  - speed control
  - clear communication of path operating rules.
- Surveyed path users' observed associations with path amenity include - a negative association with density and segregation and a positive association with width, separation from traffic and pleasant path scenery.

4.3 Regulatory factors

In Australia, bicycle riders are required to keep to the left and give way to pedestrians on shared paths and also to have a bell fitted to their bicycles. The law does not require pedestrians to keep to the left.

- Currently in NSW, councils are required to submit shared path proposals to traffic committees (including those paths that are not adjacent to state roads).
- There is very limited information on the effectiveness of using and enforcing advisory speed limits on shared paths. As already stated, the speed signage study found no net decrease in the risk of potential conflict that could be attributed to the installation of speed limit or slow markings.
- Penalties currently exist for reckless behaviour by cyclists. A potential option for deterring high-risk behaviour among cyclists is the increase of penalties for reckless behaviour.

5 Concluding remarks

Based on current evidence shared paths represent a relatively low safety risk. Overall, there was not a strong evidential basis for introducing further regulation of cyclist and pedestrian behaviour on shared path usage. In addition, as most surveyed cyclists and pedestrians stated a preference for segregated paths (cycle paths and footpaths), it is proposed that segregated paths be a policy priority where appropriate over the construction of shared paths in the first instance. Targeted design and evidence-based behavioural improvements to maximise safety and amenity are warranted for existing shared paths.

The most conclusive finding on shared path design was the positive association between centreline delineation and keeping to the left, which in turn, was associated with other safe behaviours when cyclists and pedestrians interacted. This is a non-regulatory measure that effectively communicates delineation to shared path users. From the available findings, visual separation was not associated with left-hand travel. Hence, centreline delineation would appear to be the most effective lane treatment where officially segregated paths (physical separation) are not feasible.

There is a lack of evidence on the effectiveness of advisory speed signage to support its general use on shared paths. Findings from the recent speed signage study did not provide support for the use of such signage, as it was not associated with speed reduction among cyclists.

For the construction of new shared paths, the review of shared path evidence flagged a need to establish mechanisms to promote compliance with Austroads guidelines and also to promote the use of risk assessment models.

Based on current best practice, in the design of new paths (particularly in terms of width) a range of risk factors should also be considered, including estimates of path use (commuter versus recreational), traffic volume, mode split, gradient and sight lines. NSW should review and where appropriate align current standards with best practice. In some high volume, high-risk settings, greater consideration should be given to path segregation (physical separation) to safe guard path users and their amenity. Practical considerations such as appropriateness of construction location, lighting and maintenance are additional factors that have been found to mediate the safety and appeal of shared paths.

Findings were suggestive of a need for certain behavioural and attitudinal improvements in both populations. Further promotion of considerate and safe use of shared paths for both pedestrians and cyclists may foster safer behaviours and improve amenity. Results suggest that behavioural factors requiring attention among cyclists are signalling their presence to other users, and slowing down especially when approaching pedestrians. Whereas, for pedestrians, factors such as left-hand travel and not blocking the path are indicated.

In addition, a potential option for deterring high-risk behaviour among cyclists is the increase of penalties for high-risk behaviour.

There also exists a need for ongoing monitoring of traffic volumes and crash events and further empirical evidence on user behaviours and perceptions and contributors to crash events, and emerging user trends.