

Executive Summary

Between 2002-2004 a four-part research programme was undertaken to identify hazards to cyclists from features of the road network that are designed to benefit motorists. Such features include, for example, profiled markings for wet/night visibility and flush medians that enable easy right turns but narrow the available lane width. The perspective of the research is to recognise and understand the conflicting needs of cyclists and motorists who share a road corridor. The outcome is to facilitate more informed decision-making in design, maintenance and management of the road corridor by balancing the needs of cyclists and motorists.

Study 1 examines the stability of cyclists encountering roadside obstacles including a variety of line-marking types. Lines examined included new types of marking that are of potential benefit to motorists because of the wet night visibility and extended service life. These are restricted in their use, despite their superior benefits to motorists, because of concerns for cyclists.

Studies 2 and 3 help define the amount and quality of space towards the lane edge needed for cyclists. Study 2 observes the effects of a passing truck on cycle stability by measuring the forces from the vehicle slipstream that cyclists are exposed to, and then measuring the cyclists' reaction to these forces using the methodology developed for measuring cyclists' stability. Study 3 involves the observation of cyclists as they negotiate roadside obstacles, including utility covers, pedestrian crossings, pinch points, line markings, parked vehicles and gravel.

Study 4 establishes to what extent the design of the road corridor is perceived by cyclists as hazardous and a consequent deterrent for cycling. This study also surveys parents of children in two groups: those who cycle to school, and those taken by car. It identifies the relationship between the two groups and how that affects whether they encourage their children to cycle to school.

Study 1: The effects of roadside obstacles on cycle stability

Participants completed multiple passes over 20 objects (1600 trials in all) on an instrumented racing cycle. Recordings were compared with a baseline of recordings of normal riding over smooth asphalt. New techniques of control for learning effects were used and the methodology proved to be reliable.

The analysis of the trials revealed a correlation between trends in increasing marking thickness and increasing instability, but this correlation was not consistent, indicating that selecting markings as safe for cyclists on the single criterion of marking thickness is not appropriate.

Some general findings of the trial are:

- Sixteen of the objects, including rough ground, a round utility access cover, oversized thermoplastic lines (7 mm thick), and an audio-tactile line show significant effects on the stability of cycles.

- Traditional painted road markings, chlorinated rubber lines, and a low profile thermoplastic marking show no significant impact on cycling. Relative assessment of the effect of the objects on cycle stability is reported and the validity and reliability of the method is discussed.
- A reliable method for assessing the impact of roadside obstacles on cyclists has been developed. This method can be used to assess new objects as new products are developed for the benefits of road users.
- The current practice of limiting markings to less than 4 mm thickness (and preferably 2.5 mm or less) in spaces shared by cyclists should continue.
- Where lines greater than 4 mm thickness are used, then there should be a site-specific study that identifies specific risks to cyclists. Measures could be to lessen these risks, for example not using these lines at the natural crossing point for cyclists.
- Thermoplastic lines equal to and above 4 mm produced effects on cyclists similar to those experienced when riding over lines that have been shown to be problematic by independent assessment, e.g. audio-tactile lines.
- Thermoplastic lines 3 mm thick produced effects on cyclist stability that are little different from existing paint markings.
- New structured markings produce effects that are equivocal, but the markings are thicker than the normal case.
- Cycle stability is actively managed by the cyclist, but seriously interfered with normal cycling activities such as looking back to assess traffic flow.

Study 1 specific recommendations

- Any new product considered for widespread use throughout the roading network should be assessed for its effects on cyclists using methods similar to those outlined.
- The current 'height-based' standard (Transit NZ Specification TNZ P/22) should be replaced by a performance-based standard, including a testing regime using a methodology similar to that used in this study.
- Wherever merging and conflict points are identified as necessary, additional attention should be given to removing other hazards such as cat's-eyes, thick line markings, utility covers and loose gravel.
- The concept of locking cyclists into a cycling space and locking motorists out of this same space with a continuous raised profiled marking, or another type of restricting device (e.g. close-spaced raised pavement marker) is strongly not recommended. Such a concept will mean the common method of avoiding hazards within the cycle space by entering into the vehicle lane would require the negotiation of an even more significant hazard.

Study 2: The effects of trucks passing on cycle stability

This study involved measuring the physical forces produced by a large truck as it passes by a cyclist, and included the measurement of the real impact trucks have on cyclists' stability, using the instrumented cycle from Study 1.

No 'wobble' effects due to these forces under normal riding conditions were detected. Also the force generated by the truck increases proportionally to the square of truck speed, but the separation distance within the 0.5 to 1.5 m tested has no significant effect.

Study 2 specific recommendation

- In areas with high numbers of cyclists, and where shoulder space for cyclists is narrow (e.g. <1 m), so they cannot accommodate momentary instability, truck speed should be limited to 50 km/h or less, or cyclists be accommodated by other provisions.

Study 3: The effects of roadside obstacles on cyclists' behaviour

Understanding how cyclists identified the natural cycling path even when unmarked, and their behaviour when encountering obstacles in their path, was established by observing cyclists riding around a 15 kilometre pre-identified course. The obstacles included a round utility access cover; a bull-nosed pedestrian crossing facility; a square utility access cover; a parked truck; a narrow bridge; drainage grates; a section of rough surface; a patch of loose gravel; and a baseline smooth asphalt section.

Key findings are:

- Cyclists manage hazards they encounter by 'occupying the space', even when this is in conflict with other vehicles. A roadside hazard such as a raised utility cover will, when combined with a cyclist, become a problem to be managed by motorists. Cyclists have a tendency to move out into the vehicle lane (and rarely look back) and rely on motorists to respond. Thus the influence of roadside hazards extends well beyond a limited interest group. Every road user is affected by and manages a roadside hazard.
- With reference to Study 1, a reasonable supposition is that cyclists occupy the space without looking back because either they forget to look, or the hazard of 'looking back' is greater than, or interacts with, the risk of occupying the traffic space and obliging motorists to manage the cycle/vehicle conflict. Communicating this idea to motorists would significantly improve cycle/vehicle interaction with the attendant benefits.
- The likelihood of a cyclist moving into conflict is modulated by the size of the available connected space. The indications of this study are that a connected pathway with a width of as little as 30 cm is sufficient to significantly reduce the likelihood of cycle/vehicle conflict. Although there are optimal design parameters for cycleways, no minimal design parameters have been specified to assist road designers. Further research is needed to develop minimum design parameters, and to test that this minimum space is consistent across most obstacles, or is obstacle-specific.

- Where edge lines are marked, cyclists have a tendency to ride on the shoulder near the left of the edge line, though the idea that they ride on the line to improve smoothness of ride was not supported in this research. The reasons for the tendency are unclear and require further research. This natural tendency of cyclists staying to the left of the edge line and motorists to the right, if consistent, could be exploited to allocate space where full cycle lanes are not practical.

Study 3 specific recommendations

- Guidelines are needed for road asset managers on how to interpret the natural cycling path and how to allocate space within the roadway. These guidelines should assist road managers to identify obstacles that cyclists will avoid, and develop maintenance plans to either remove these obstacles or create alternative road space for cyclists. The use of extensive flush medians to aid traffic manoeuvres needs to be balanced against an obstruction-free natural cycle pathway that is free of unexpected cycle/vehicle conflicts.
- Education is needed so that motorists have an appreciation of cyclist behaviour, and can scan the road ahead from a cyclist's perspective to identify cycle obstacles that will force the cyclist into their path. This is particularly important near intersections, or at pedestrian crossing facilities, where road managers often constrict the space available to cyclists.
- Further research is needed to identify a minimum cycle space around obstacles, and whether an edge line can effectively partition cycle and vehicle paths.

Study 4: Parents' perceptions of cycle safety for high-school children

This study was undertaken to identify whether perceptions of a lack of safety acted as a deterrent to cycling for high school children. Questionnaires were delivered to 204 parents of teenage children who lived within normal cycle-riding distance from their high school.

The parents occupied two distinct groups: those identified as allowing their child/children to regularly cycle to school, and those who were observed to drop their child/children at school by motor vehicle. Improving the attitudes of parents towards cycling by reducing anxiety regarding cycle safety, or improving their perceived enjoyment of cycling, is likely to encourage cycling behaviour among their children.

Key findings are:

- Overall, parents regard cycling to school as slightly dangerous. Parents who drive their children to school appear to be more risk-averse than parents who allow their children to cycle.
- Parents vary in their assessment of the riskiness of different modes of travel to school, with parents who drive their children to school perceiving cycling to be the riskiest mode.

- The perceived safety of the particular route relates to whether the child/children cycle or are driven to school. Around 7% of the choice to drive rather than cycle is explained by a perception of the safety of the cycle route.
- Features of the road environment that create a safety concern include known factors associated with cycle injuries.

Whether or not parents used to cycle to school is related to the likelihood of their high school children cycling to school. Given the current decline in cycling, as a cohort effect, future efforts to encourage cycling to school will be further impeded by the absence of a cycling history in parents.

Study 4 specific recommendations

- Address the cohort effect concerning cycling experience and its likely influence on reducing cycling in school-aged children. This can be done by promoting cycling in schools, recognising that there will be a long-term benefit that is currently not recognised in the evaluation of such programmes.
- Address the heightened perception of the relative riskiness of cycling with information that targets parental concerns for safety of the roading context, and balances these concerns with information concerning the benefits of cycling.
- Any effort to improve the roading environment to reduce parental perception of cycling danger should address cycle/traffic conflict as this, more than road features in themselves, appears to be the basis of the heightened concern for the safety of cycling.

Abstract

Between 2002-2004 a four-part research programme was undertaken to identify hazards to cyclists from features of the road network that are designed to benefit motorists. The four studies were: 1: The effects of roadside obstacles on cycle stability; 2: The effects of trucks passing on cycle stability; 3: The effects of roadside obstacles on cyclists' behaviour; 4: Parents' perceptions of cycle safety for high-school children.

The perspective of the research is to recognise and understand the conflicting needs of cyclists and motorists who share a road corridor. The outcome is to facilitate more informed decision-making in design, maintenance and management of the road corridor by balancing the needs of cyclists and motorists.