

Balancing the Needs of Motorists and Cyclists: Nine Myths about Cyclists and the Road Shoulder

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Between 2002-2004 a four-part research programme was undertaken to identify the hazards presented to cyclists by features of the road network that are provided 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 research investigated: cycle stability over obstacles; how cyclists manage potential hazards; the aerodynamic effect of trucks on cycle stability; and the influence of perceptions of safety on choice of cycling as a travel mode.

The research is designed to recognise and understand the conflicting needs of cyclists and motorists who share a road corridor to facilitate better and more informed decision-making in the design, maintenance and management of the road corridor. In investigating hazard effect and management by cyclists, the research provides evidence to debunk nine myths regarding cycle safety and the road environment.

Study One was an experimental study involving an instrumented cycle ridden across road obstacles. The method examines the stability of cyclists encountering roadside obstacles including a variety of line marking types (see Walton and Dravitzki, 2003). 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 may be restricted in their use, despite their superior benefits to motorists, because of concerns for cyclists. Studies Two and Three help define the amount and quality of space towards the lane edge needed for cyclists. Study Two observes the aerodynamic effects of passing trucks 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 study One. Study Three involved the observation of cyclists as they negotiate roadside obstacles, including utility covers, pedestrian crossings, pinch points, line-markings, parked vehicles and gravel. Study Four established how much the design of the road corridor is perceived as hazardous and a consequent deterrent for cycling. This study involved a survey of parents of children in two groups: those who cycle to school, and those taken by car. The research identifies the relationship between the two groups to the extent that they perceive cycling as hazardous and to the extent that they encourage their children to cycle to school. All four studies are described in a larger report (Walton, Dravitzki, Cleland et al 2004).

In this paper, the evidence gathered from the four studies is presented to counter nine popular concerns for the nature of cycling and the road environment. These 'myths' have varying degrees of popularity, with some being restricted to the concerns of specialised groups such as roading engineers. Other myths are popular among cyclists themselves. In generating the information from the research it is hoped that any ongoing debate about the real nature of these concerns has a base in evidence, particularly as this relates to ways of obtaining useful information in the new methods used.

The nine myths are as follows:

1. Road markings are for cars and have no influence on the riding behaviour of cyclists

2. Cyclists should be easily able to manage roadside hazards by themselves
3. The public has little awareness that line markings may be a hazard
4. Cyclists ride on line markings to improve their ride quality
5. Cyclists avoid pedestrian crossings and actively use cycle refuges
6. Cat's-eyes and road buttons are not hazards to cyclists
7. All thermoplastic lines are hazardous to cyclists
8. Cyclists would be safest if they are 'locked' into a separate lane by the provision of continuous raised pavement markers
9. Cyclists need at least 1.2 metres of road shoulder to avoid bringing them into conflict with other traffic

Myth 1: Road markings are for cars and have no influence on the riding behaviour of cyclists

Examination of Figure 3.1 indicates that cyclists do not follow a strict 'keep left' rule. The provision of a line marking draws the cyclists to the line and they will cycle close to the line, either to its left or right. Ten percent of cyclists consistently spend their time to the right of the line in the traffic lane despite there being a road shoulder, a more than 1.5 metre-wide clear, smooth space that is free from debris and free from other encumbrances for at least 300 metres. At other observational sites it was established that once forced out into the lane by some obstacle in their pathway a larger percentage than baseline stay to the right of the line using this to define their forward pathway.

Myth 2: Cyclists should be easily able to manage roadside hazards by themselves.

A combination of evidence was derived from the findings of Study One and Study Three that brings forward an important finding of the research. The first piece of evidence is gathered from the recording of stability under conditions such as 'looking back' to observe traffic when merging or through the avoidance of an obstacle. 'Looking back to observe traffic has a compound effect on cycle stability which interacts with the instability induced by the obstacles. Consequently, looking back to observe traffic is in itself a difficult activity, especially in the presence of a 'perceived' hazard, which makes looking back a hazard in itself.

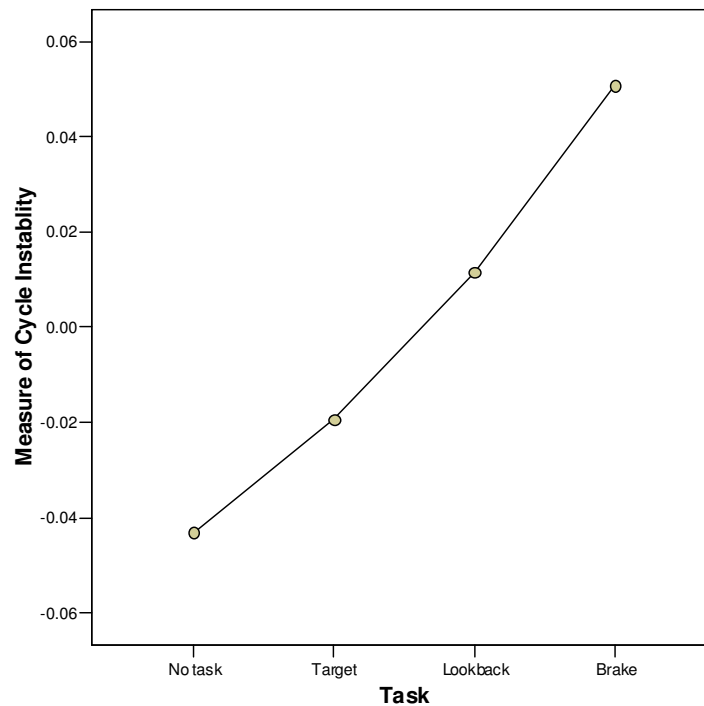


Figure 1. Stability of cycling by the task performed while riding over obstacles in an experimental setting. The measure of stability is a combination of physical measures of handlebar angle and lateral acceleration, with larger values indicating greater instability. The three tasks were (1) Target: cyclists were instructed to keep the frame-mounted laser pointer on the target board (2) Lookback: cyclists were instructed to look back and report the time indicated by a large clock held by the experimenter (on each trial the experimenter changed the position of the clock hands) (3) Brake: participants were told “Brake” (they were instructed that this meant to come to a complete stop, and place one foot on the ground). For further details see Walton, Dravitzki, and Cleland (2003).

This key piece of evidence helps explain the observations made in Study Three. Cyclists will avoid many road objects, for example utility cars, loose gravel and rough surface, which would be of no concern to a motorist. Cyclists manage hazards they encounter by ‘occupying the space’, even when this is in conflict with other vehicles. Cyclists will move out into the vehicle lane (and rarely look back) to avoid the hazard and rely on motorists to respond. Therefore, a roadside hazard for cyclists, such as a raised utility cover will, when combined with a cyclist, becomes a problem that has to be managed by motorists. Thus the influence of roadside hazards extends well beyond a limited interest group—every road users is affected by and manages a roadside hazard. With reference to Study One, it is reasonable to suppose that cyclists occupy the space without looking back because they are intuitively aware that the hazard of ‘looking back’ is either greater or interacts with the hazard to be a greater risk than occupying the space and allowing motorists to manage the cycling/vehicle conflict.

Myth 3: The public has little awareness that line markings may be a hazard.

Study Four involved the survey of parents who both drop off their children and allow them to ride to school. Of the nine road features examined, concern for the physical qualities of road markings was ranked sixth but still drew around 75% agreement as being a hazard when wet. This can be contrasted with loose gravel that attracts only around 30% agreement that it is a hazard despite this being identified in independent studies as being a key factor in cycle-only accidents causing injury (Munster, Koorey, Walton, 2001).

Table 2.1. The road feature statements, means, and standard deviations (SD) for parents of cyclists and parents who drove their children to school. The probability values indicating significant differences between the groups, and the overall percentage agreement to each statement.

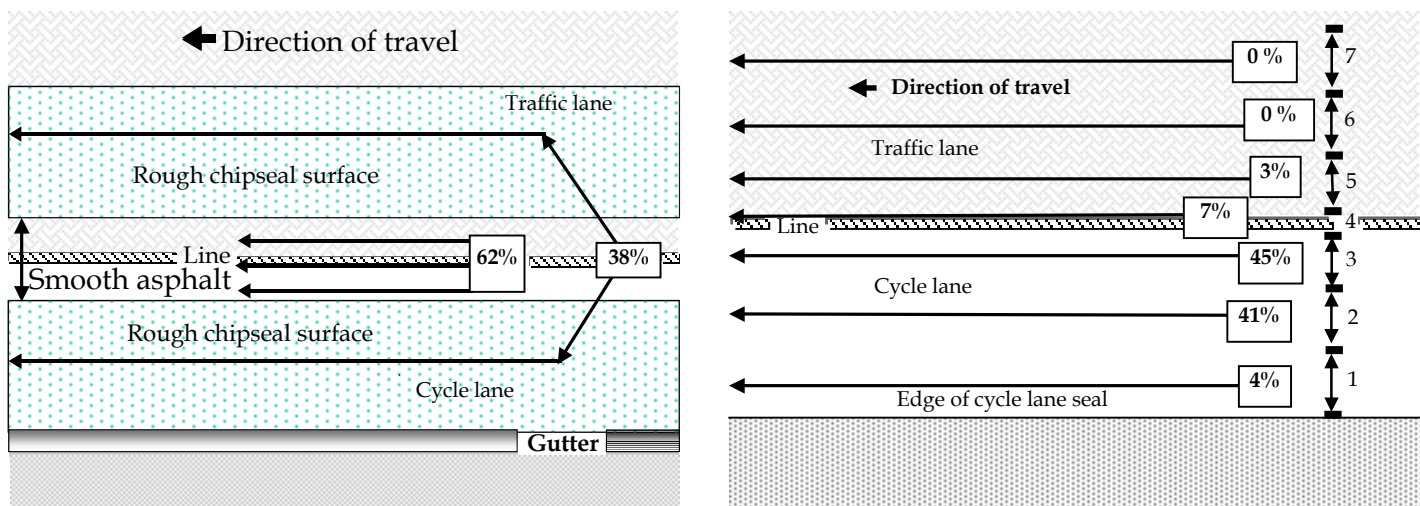
Road feature statements	Cyclist group		Driving group		p	% Agree
	Mean	SD	Mean	SD		
Q29 Roads that are narrow make cyclists vulnerable to accidents	1.81	0.70	1.81	0.56	0.98	96
Q12 Narrow road shoulders force cyclists into the driver lane	1.84	0.69	2.13	0.60	0.03	88
Q15 Even when cycling in a cycle lane, being passed by big trucks is hazardous for cyclists	1.97	0.83	1.96	0.82	0.95	84
Q14 Roads with 100 kph speed limits are dangerous for cyclists	2.11	1.09	1.87	0.79	0.25	82
Q8 Parked cars present a significant hazard to cyclists	2.19	1.13	2.19	0.89	0.99	76
Q2 Road markings can be difficult for cyclists to negotiate when wet	1.97	0.93	2.12	0.91	0.47	76
Q6 Cyclists are forced into dangerous situations by the poor design of roads	2.42	1.06	2.75	0.99	0.14	55
Q21 The road shoulder is too rough to cycle on	2.92	1.01	3.04	0.91	0.57	37
Q11 There is too much loose gravel to cycle safely on the road shoulder	3.08	0.95	3.02	0.88	0.76	30

Note: All questions except Q.11 were ranked from 1 “Strongly agree” to 5 “Strongly Disagree”. Q.11 was reverse coded.

Myth 4: To improve ride quality cyclists will ride on line markings

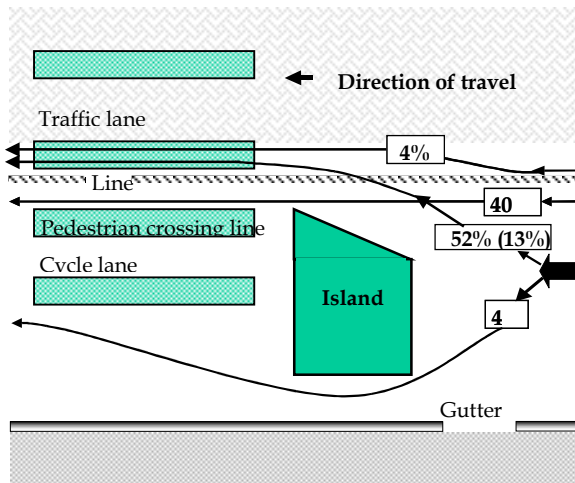
Study Three examined the smoothness of ride in a number of opportunities. Independent studies have provided evidence of cyclists’ ability to assess ride quality (Cairney, 2002). In Study Three we observed cyclists riding in a baseline condition of a wide straight section of road. A second condition examined a rough and smooth surfacing created by the provision of services making a long thin strip with asphalt compared to the surrounding rough grade three chipseal surface. The line marking was placed on top of this smooth section. Here it was observed that cyclists preferred the smoother surface, but cyclists were not typically observed to ride on the line for any appreciable distance under either of these conditions or the other ten observation sites.

Figure 3. 1 Left: The proportions of cyclists electing to travel on the relatively smooth surface compared to the grade 3 chipseal. Right: Baseline conditions of a straight asphalt road with edgeline.



Myth 5: Cyclists avoid pedestrian crossings and actively use cycle refuges.

Despite the provision of a cycleway refuge, cyclists fail to take the opportunity to use this device, and at times conflict with traffic and even pedestrians. Only 1 cyclist took the opportunity to use the refuge, induced perhaps because there is no signage, nor a coloured pavement clearly indicating the possibility of using the refuge.



The cyclists observed at this site actively avoided hitting the thick thermoplastic line markings of the pedestrian crossing.

Myths 6 & 7: Cat's-eyes and road buttons are not hazards to cyclists.

All thermoplastic lines are hazardous to cyclists.

Study One has been previously reported concerning the relative instability created by various types of line markings (see Walton, Dravitzki, Cleland, 2003). A planned extension to this work was the investigation of objects such as utility access covers, gravel, cats-eyes and rough uneven surfaces. Table 6.1 below outlines the relative influence of such objects when tested under the methodology of Walton et al 2004). While rough ground may be an unsurprising result, it can be seen that wet utility access covers, domes, raised pavement markers and loose gravel all feature as producing the highest levels of instability above a comparison to baseline and higher than those associated with objects that present a significant concern to road authorities such as audio tactile line and oversized thermoplastic lines.

Myth 7 is largely countered by previous presentations but bears emphasis due to the fact that local authorities have adopted policies not allowing the use of the thermoplastics because of a concern for cyclists. Our testing established that thinly laid thermoplastic line markings show no impact on cycle stability above the effects observed by our control (see in Table 6.1 that a 2mm thermoplastic line had no measured impact on the cyclists' stability). Our testing procedures have led to the recommendation that the current 'height-based' standard (Transit 2003a) should be replaced by a performance-based standard, including a testing regime using a methodology similar to that used in our study. There is simply not enough evidence to suppose that the height of the line alone underlies the instability observed in the cyclists.

Table 6.1. ANOVA comparisons for the combined measure, with each object compared to baseline. Shown is the difference when each mean is subtracted from baseline, the standard error, and significance. Objects are ordered by mean difference from negative to positive. The means are ordered by the difference between the baseline and object means from negative to positive. A negative number indicates that an object has an adverse effect on stability.

N	Type	Height	Beads	Calcite	BPN	M_{Diff}	SE
17	Rough Ground					-.462***	.039
16	Round Utility Access Cover					-.231***	.024
20	Domes	22.5				-.230***	.034
18	Loose Gravel					-.212***	.031
19	Rrmps	19				-.189***	.042
6	Thermoplastic	7	None	No	67	-.179***	.035
1	Thermoplastic	3.5	Large beads	Yes	58	-.120***	.028
10	Thermoplastic	7	Dropon	Yes	57	-.118**	.039
14	Audio Tactile		None	No	59	-.104**	.034
7	Thermoplastic	3	Dropon	Yes	54	-.103**	.034
11	Thermoplastic	4.5	Dropon	Yes	58	-.100*	.041
9	Waterborne Paint	.5	Dropon	No	50	-.099***	.024
8	Thermoplastic	3.5	None	No	70	-.076*	.033
12	Structured Marking	3	Dropon	No	68	-.066**	.019
13	Profiled Thermoplastic		None	No	91	-.062*	.024
4	Waterborne Paint	.5	Large beads	No	52	-.062*	.026
3	Thermoplastic	2	None	No	63	-.026	.027
15	Waterborne Paint	.2	None	No	41	-.012	.017
2	Waterborne Paint	.5	Large beads	Yes	59	.032	.016
5	Chlorinated Rubber	.2	None	No	46	.039	.021

Note: $p < .05$, ** $p < .01$, *** $p < .001$ (those scores with asterisks are deemed significantly different [worse] than the comparison baseline asphalt).

BPN stands for *British Pendulum Number*: it is a measure of skid resistance.

Myth 8: Cyclists would be safest if they are 'locked' into a separate lane by the provision of continuous raise pavement markers

It is true that cyclists are safest when completely separated from traffic but not if there is still the occasion to enter into the traffic stream. The evidence suggests that the road shoulder is unlikely to ever be clear of hazardous debris to create a safe environment. Cyclists actively manage the inherent instability created running over obstacles and the like, and for the most part can negotiate hazards with little risk of accident. However, the management of the hazard is achieved only when the risk is recognised and does not interact with such activities as looking back at traffic. Our evidence indicates that one of the most hazardous activities is crossing of cat's-eyes while looking back to observe the traffic. Locking a cyclist into the lane would be acceptable only if the cyclist's path were free from being blocked by, for example, vehicles that were stopped by breakdown.

Myth 9: Cyclists need at least 1.2 metres of road shoulder to avoid bringing them into conflict with other traffic.

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 30cm is sufficient to significantly reduce the likelihood of cyclists going out of shoulder into lane. Although there are optimal design parameters for cycle ways, 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. A key significant finding of the research is the aerodynamic force of a passing truck increases proportional to the square of the truck speed, but the separation distance within the 0.5 to 1.5 metres tested has no significant effect.

Conclusions

The methods used within the four studies contribute to the evidence road controlling authorities and asset managers can use to make decisions supporting the needs of all users of the road corridor. Concerns for types of line markings, the provision of cycle lanes, the placement of utilities and the maintenance of the road shoulder can occur with some supporting evidence about how cyclists actually manage hazards. Important conclusions derive from the recognition that a normally safe activity such as crossing a line is made potentially hazardous when combined with a need to look back to observe the traffic. Edge line markings are important for cyclists. They ride close to them and have an awareness of their potential hazards. If there is inadequate space between the feature and the edge line (300mm), they will unexpectedly and deliberately move into the traffic lane usually without looking back. Cyclists 'occupy space' to manage hazards and this impacts on motorists as a competition for the road, implicating drivers in the management of roadside objects.

References

- Walton, D and Dravitzki, V. (2003). Does providing wet/night visibility formotorists compromise cyclist safety? New Zealand roadmarkers federation conference 2003, Sept 18-19th Auckland.
- Walton, D., Dravitzki, V., Cleland, B, & Thomas, J and Jackett, R. (2004). *Balancing the needs of cyclists and motorists* (in Press)
- Cairney, Peter (2003) *User acceptability as the basis for performance-based specifications for a major cycling facility. Road and Transport Research.*
- Walton, D., Dravitzki, V and Cleland, B.S.(2003). The effects of line markings for wet/night visibility on cycle safety. 26th Australasian Transport Research Forum Wellington, New Zealand 1-3 October 2003
- Transit New Zealand (2003a) Specification for Reflectorised Pavement Marking TNZP/22. SP/SP22-030320*
- Munster, D., Koorey, G. and Walton, D. (2001). The Role of road features in cycle-only crashes in New Zealand. Wellington: Transfund New Zealand Research Report No. 211