User Perceptions of Bus Stop Bypasses:

Intercept Surveys of Pedestrians and Cyclists

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Contents

Executive Summary

Improving the service levels for active and public modes of transport will provide a safer and more pleasant commute experience for Wellingtonians and encourage more people to shift from private vehicles to walking, cycling, and using public transport to get around. Improving bus stop design is one way this can be done. In current standard bus stop layouts, cyclists must ride between the stopped bus and moving vehicle traffic, either in the road or using a painted cycle lane, which can increase the risk of collisions and decrease the perceived safety of cycling. To provide a safer cycling experience, Wellington City Council have been trialling various designs of bus stop bypasses around the city. Bus stop bypasses route cyclists off the road to allow them to avoid interactions with the bus and other motorized traffic. These layouts create new potential interactions with passengers using the bus stop and other pedestrians on the footpath.

Wellington City Council partnered with Victoria University of Wellington to identify the impacts of these bypass designs on perceived safety and convenience for cyclists and pedestrians. Pedestrians and cyclists were surveyed at seven bus stop bypass sites of varying design and one control site (no bypass) across Wellington City.

Key survey findings/recommendations from this survey were that:

1. Having a bus stop bypass increased perceived safety (compared to the control site) for cyclists with respect to motorised vehicles at four sites: Ngauranga, Rongotai Rd and two at Crawford Rd. However, perceptions safety also decreased significantly for cyclists with respect to pedestrians at Hutt Rd, Rongotai Rd, Victoria St B and Island Bay.
2. Bypasses decreased perceived safety significantly for pedestrians with respect to cyclists at Hutt Road, Rongotai Rd and Victoria St B.
3. The way cyclists ride was impacted by the design at all sites. Slowing down for, and being careful of, pedestrians were the most reported changes.
4. Clearer indications of right of way at shared zones may reduce ambiguity and confusion, and increase feelings of safety, particularly for cyclists.
    a. The additional white concrete strip at Crawford Rd B which is intended to act as a buffer zone for passengers may have unintentionally increased confusion at this shared zone.

b. Several cyclists did not understand the meaning of the red-striped painted markings at Crawford Rd and Rongotai Rd.

5. Increasing the visibility of the bypass behind the stop at Island Bay, for example, with markings on the cycle lane, could help manage pedestrian behaviour and increase feelings of safety for cyclists.
6. A zebra crossing at Hutt Rd may increase feelings of safety for both pedestrians and cyclists.
7. Removing ad signage in bus shelters, for example at Hutt Rd, may improve visibility for cyclists and increase feelings of safety because it allows cyclists to react to pedestrians.
8. Pedestrians tend to feel less safe at sites where they are required to cross dedicated cycle lanes.
9. Alighting passengers will experience bus stop bypass designs differently to boarding passengers and may find it more unsafe to exit directly onto a cycle lane due to being unaware of, or having a limited view of, an adjacent cycle lane.
10. Slow, uphill bypass sites with good visibility were considered safe by both pedestrians and cyclists.
11. Cyclists have other pressing concerns along the cycle way that impact their general feelings of safety, particularly relating to motorist behaviour at driveways and intersections.

Further research at these bypass sites such as video observations would enhance understanding of how cyclists and pedestrians behave at potential interaction areas, especially with respect to the presence of different design elements (eg. signage and painted symbols). Additionally, the views of people with disabilities and people in the older age categories were not well-captured in this study. Thorough consultation with these groups is important to ensure an accessible built environment.

1 Introduction

1.1 Bus Stop Bypasses

Increasing the attractiveness and uptake of public and active (walking and cycling) transport modes compared to private vehicle use is an essential part of managing congestion and reducing carbon emissions from transport. Cycling made up only 2.7% of mode share for trips to work in the Wellington Region in 2018 and has only increased slightly overall in the last 20 years.[1] A 2014 survey demonstrated that there is significant latent demand for cycling that is unfulfilled in part due to either a lack, or a perceived lack, of safe, segregated cycle infrastructure. The survey found that while 31% of respondents selected cycling as their preferred travel mode, only 9% actually travelled by bicycle.[2] The study further identified that a third of respondents- the largest group in the study- could be classified as "Safe Cyclists". This type of cyclist prefers cycling as their mode of transport, but require the provision of improved cycling infrastructure, in particular, barrier-separated or fully segregated cycle lanes, to encourage them to cycle, or to cycle more frequently.[3]

Designing layouts that allow cyclists to safely bypass bus stops is an important part of providing improved cycle infrastructure that is segregated from moving traffic. Traditional layouts at bus stops require cyclists to travel around the outside of a stopped bus, positioning them between the bus and moving vehicle traffic. Along a bus route with frequent stops, this kind of interaction may occur several times as cyclists overtake a stopped bus, are overtaken between stops, and must overtake again at the next stop. Bus stop bypasses are a type of road layout designed to enable cyclists to avoid these interactions by routing cyclists on the inside of the bus, either between the bus stop shelter and the bus bay or behind the bus stop shelter.

The term bus stop bypass encompasses a range of designs that allow cyclists to bypass a bus at a bus stop without having to move out into general traffic. Some designs also allow cyclists to continue to cycle straight without using the bypass when there is no bus present. Bus stop bypasses are already being used in other towns and cities around the world. Bypass infrastructure can be seen in North America[4], the UK[5][6], the Netherlands, and other European cities.[7]

There is inconsistent coverage amongst transport guidelines on the provision of cycling infrastructure around bus stops. For example, in New Zealand specifically, the 2013 Auckland Transport code of practice either recommends interrupting cycle lanes with bus stops or provides examples of cycle

[1] Greater Wellington Regional Council, *2019/20 Annual Monitoring Report on the Regional Land Transport Plan,* (Wellington, 2020)
[2] Tom Pettit and Nadine Dodge, *Cycling Demand Analysis,* (Wellington: Wellington City Council, 2014), 52
[3] Ibid., 24
[4] National Association of City Transportation Officials, *Transit Street Design Guide,* Accessed 16 March 2021, https://nacto.org/publication/transit-street-design-guide/
[5] S Greenshields and S Davidson, *Bus Stop Bypasses: Surveys of Pedestrians and Cyclists* (Wokingham: TRL, 2018)
[6] National Transport Authority, "5.1 Bus Stops", *National Cycle Manual,* Accessed 16 March 2021, https://www.cyclemanual.ie/manual/detailsright/busstops/#
[7] Cycling Embassy of Great Britain, "Floating bus stop", Accessed 16 March 2021, https://www.cycling-embassy.org.uk/dictionary/floating-bus-stop

lanes that pass on the outside of the bus bay, with no guidance on bypassing bus stops.[8] The 2013 Christchurch Cycle Design Guidelines offer two design options- a bus stop island and an inline concept similar to traditional design, but that also allows cyclists to manoeuver left onto a shared pedestrian pathway.[9] Although Waka Kotahi New Zealand Transport Authority (NZTA), does not currently provide guidelines on cycle lane/bus stop infrastructure, this issue is noted as a sub-topic of "immediate priority" (at the time of writing this report) as part of the imminent provision of a national public transport design guidelines resource.[10] The National Association of City Transportation Officials (NACTO) provides reasonably comprehensive design guidelines for various treatments of cycle lanes at bus stops in their Transit Street Design Guide[11], as does Ireland's National Transport Authority.[12]

There is only limited research into the effectiveness and impact of bus stop bypass design, at least in English-language publications. Research on interactions at new bus stop island infrastructure in Cambridgeshire, UK, found that most pedestrian-cyclist interactions occurred during peak times and involved safe or controlled manoeuvers by either pedestrian or cyclists. Additionally, large groups of pedestrians, particularly of school children, were identified as likely causes of future conflicts.[13] Transport Research Laboratory (TRL) researched the impacts on pedestrians and cyclists of different crossing types (unmarked vs zebra) at bus stop bypasses in London through intercept surveys[14], video footage[15] and accompanied visits with people with disabilities.[16] Similar to findings in the Cambridgeshire study, the majority of pedestrian-cyclist interactions at the London sites were low level (safe or controlled).[17] Further, the TRL study found that zebra crossings increased pedestrian safety and comfort at the bypass.[18] Researchers of cyclist-pedestrian conflicts at bus stops in Nanjing also recommended crossings, as well as increased separation, to improve stop safety.[19] Several factors were identified in the TRL study that may play a role in leading to serious interactions at bypasses (emergency braking, collision) including poor sightlines/visibility, constrained pedestrian or cyclist movements, crowded sites, and lack of pedestrian awareness.[20] Finally, visits to bypass sites with

[8] Auckland Transport, "Chapter 13: Cycling Infrastructure Design" in *Auckland Transport Code of Practice,* (2013), 348
[9] Christchurch City Council, *Christchurch Cycle Design Guidelines*, (Christchurch, 2013), 40-43
[10] Waka Kotahi NZ Transport Agency, *Public Transport Design Guidelines,* Last Updated 29 July 2019, https://www.nzta.govt.nz/walking-cycling-and-public-transport/public-transport/planning-and-investing-in-public-transport/public-transport-design-guidelines/
[11] National Association of City Transportation Officials, *Transit Street Design Guide*
[12] National Transport Authority, "5.1 Bus Stops", *National Cycle Manual*
[13] Sustrans, *Cambridgeshire 'floating bus stop' interaction analysis: Final report,* (Bristol, 2015)
[14] Greenshields and Davidson, Bus Stop Bypasses: *Surveys*
[15] S Greenshields, S Chowdhury and P Jones, *Bus Stop Bypasses: Analysis of Pedestrian and Cyclist Behaviour via Video,* (Wokingham: TRL, 2018)
[16] S Greenshields, *Bus Stop Bypasses: Accompanied Visits of People with Disabilities to Bus Stop Bypasses,* (Wokingham: TRL, 2018)
[17] Greenshields, Chowdhury and Jones, *Bus Stop Bypasses: Video Analysis*
[18] Greenshields and Davidson, *Bus Stop Bypasses: Surveys*
[19] Xingchen Yan et al., "Analysis of the Characteristics and Number of Bicycle-Passenger Conflicts at Bus Stops for Improving Safety", *Sustainability* 11, no. 19 (2019): 5263
[20] Greenshields, Chowdhury and Jones, *Bus Stop Bypasses: Video Analysis*

people with disabilities found that tactile paving and small bus stop islands hindered manoeuvrability for wheelchair users, while confusing layouts created difficulties for visually impaired bus passengers.[21]

1.2 Research Objectives

Understanding how bus stop bypass designs are experienced by users will help transport and urban planners make well-informed design decisions that improve the perceived safety and attractiveness of cycling, ideally without significantly impacting on service levels for pedestrians and bus passengers. The trial of several different bus stop bypass designs around Wellington City provides the opportunity to research the impact of existing bypass designs on pedestrians' and cyclists' experiences in terms of safety and comfort. Research findings will identify areas for further improvement and inform future bypass design and implementation in Wellington City, and around New Zealand.

Research Questions

Bus stop bypasses increase the potential for interactions between pedestrians and cyclists while decreasing the potential for interactions between cyclists and motorized vehicles at bypasses. Considering the impacts of these interactions on safety and comfort of cyclists and pedestrians using the bypasses, this research aims to answer the following research questions:

1. In what ways do bus stop bypass designs impact perceptions of safety for pedestrians?

2. In what ways do bus stop bypass designs impact perceptions of safety for cyclists?

3. In what ways do bus stop bypass designs impact the way cyclists ride?

1.3 Method:

To find out perceptions of bypass users, intercept surveys were conducted at seven bus stop bypasses in Wellington City. This method has been used to assess impact of cycle path design on users in London.[22]

Cyclists and pedestrians were surveyed using separate surveys. Scooter users were also surveyed using the cyclist survey. However, because only three scooters users were surveyed across all sites, they are subsumed under the category of cyclists, where cyclists are being referred to as survey respondents (as opposed to a potential hazard to pedestrians). The full text of the surveys can be found in Appendix A (pedestrians) and B (cyclists). A

[21] Greenshields, *Bus Stop Bypasses: Accompanied Visits*
[22] Greenshields and Davidson, *Bus Stop Bypasses: Surveys*

target sample of 20 pedestrians and 20 cyclists were surveyed at each site, although a higher number of surveys were collected at most of the sites. Surveying was carried out during peak morning and afternoon traffic flows between 1 and 26 February 2021. Inbound sites (travelling from the suburbs towards the central city) were surveyed during the morning peak hours between 7am and 10am, while outbound sites (travelling away from the central city towards the suburbs) were surveyed during the afternoon peak between 3.30pm and 6pm.

Pedestrians using the bus stop (passing through, waiting for a bus, or alighting from the bus) were approached and asked if they wanted to take part in the survey as long as both the surveyor and the respondent were available. Pedestrians who appeared to be either waiting for the bus stop or had just alighted were prioritized over pedestrians passing through. In some cases, pedestrians needed to stop the survey early to catch an arriving bus. The survey was considered complete if the core questions had been answered.

To survey cyclists, the surveyor wore a high-visibility vest and stood in a location that allowed cyclists to come to a stop safely. Cyclists approaching the bus stop bypass were waved down by the surveyor and asked if they wanted to take part in the survey.

In general, respondents were surveyed by the researcher reading out questions from a paper survey and writing down responses. If potential respondents indicated that they were interested but short on time, the researcher gave them a sheet of paper with a link to an online version of the survey. 21 pedestrian responses (of 185 total) and 27 cyclist responses (of 198 total) were completed online.

1.4 Site Selection

Survey sites of interest were selected by members of the City Design and Place Planning team at Wellington City Council to capture the experience of pedestrians and cyclists at a range of bus stop bypass designs. Survey sites all had a moderate to high frequency of bus users (Each selected site had 30 or more total passengers boarding or alighting per day in May 2019, based on data collected from Snapper Card usage). One Victoria St site was also selected which did not have a bypass design, but instead requires cyclists to pass around the outside of the bus, between the parked bus and moving traffic. Surveying at this site was intended to allow comparisons to be made between a standard design and the more newly implemented bypass designs.

Inbound = travelling from the suburbs towards the central city. Outbound = travelling from the central city towards the suburbs.

Stop 6710, Victoria St at Ghuznee St (Victoria St A (Control))

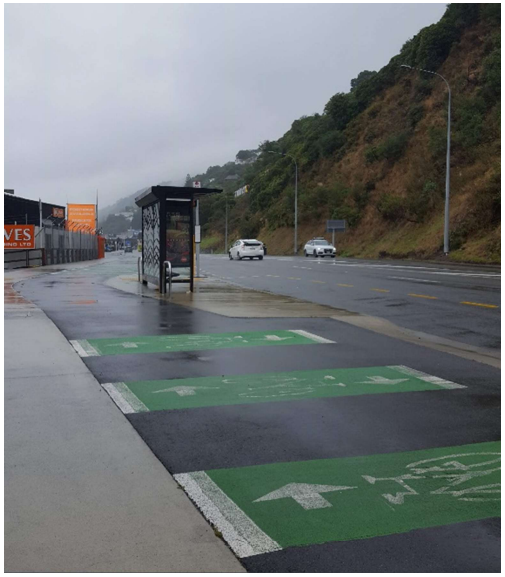
Control site. Cycle lane passes between the bus and moving traffic. Outbound. Daily boardings: 79, alightings: 86, total: 165

Stop 3254, Centennial Highway at Glover St, Ngauranga

Cycle lane passes behind bus shelter. Pedestrian crossing to bus stop island is marked by a raised section of the cycle lane and tactile paving. Inbound. Daily boardings: 27, alightings: 11, total: 38

Stop 5486 Hutt Road at School Rd

View of Hutt Rd site from the South



View of Hutt Rd site from the North

Bidirectional cycleway passes behind bus shelter. Pedestrian crossing to bus stop island is marked by tactile paving south of the stop.
Inbound. Daily boardings: 111, alightings: 48, total: 159

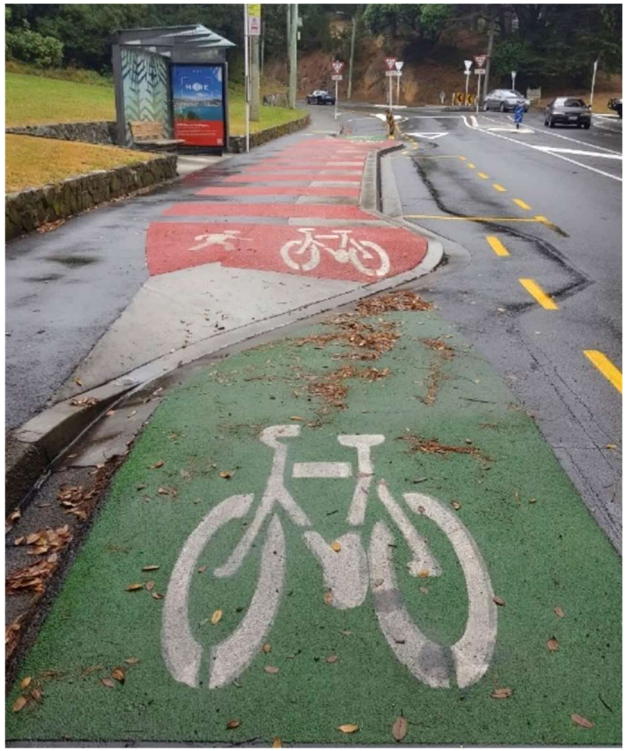
Stop 6027, near 119 Rongotai Rd

Cycleway passes between bus shelter and bus bay. Shared zone for cyclists and pedestrians is denoted by red stripes and painted symbols.
Outbound. Daily boardings: 36, alightings: 58, total: 94

Stop 6711, Victoria St at Abel Smith St (Victoria St B)

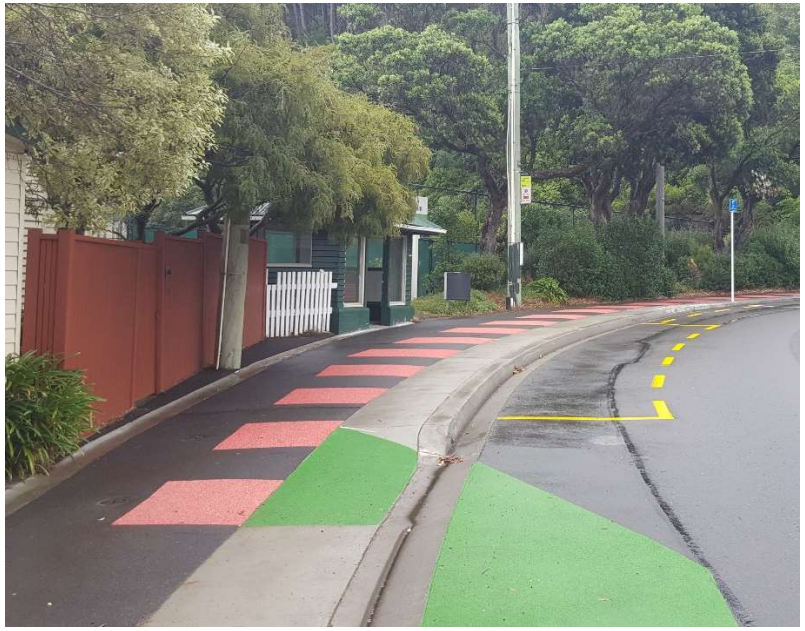
Cycle lane passes between bus shelter and bus bay. Cyclists are required to give way to pedestrians.
Outbound. Daily boardings: 79, alightings: 86, total: 165

Stop 7023, Crawford Rd at Wellington Rd Roundabout (Crawford Rd A)



Cycle lane transitions onto footpath and passes between bus shelter and bus bay. Shared zone for cyclists and pedestrians is denoted by red stripes and painted symbols. Site is on an uphill gradient.
Inbound. Daily boardings: 47, alightings: 5, total: 52

Stop 7024, Crawford Rd at Kilbirnie Tennis Club (Crawford Rd B)



Cycle lane diverts onto footpath and passes between bus shelter and bus bay. Shared zone for cyclists and pedestrians is denoted by red stripes. A white concrete strip provides a boarding and alighting area for passengers. Site is on an uphill gradient.
Inbound. Daily boardings: 75, alightings: 2, total: 77

Stop 7133, near 206 The Parade, Island Bay

Cycle way diverts onto footpath behind bus stop.
Inbound. Daily boardings: 277, alightings: 1, total: 278

2 Results

2.1 Safety Ratings

Safety Ratings by Pedestrians

Pedestrians were asked to provide a rating from 1-very unsafe to 5-very safe (or don't know/no opinion) in response to the questions "Thinking about your potential interactions with cyclists at this bus stop, how would you rate this bus stop in terms of safety?" and "Thinking about your potential interactions with scooters at this bus stop, how would you rate this bus stop in terms of safety?" Figure 1 shows the proportion of different responses from pedestrians at each site.

A two-tailed Mann-Whitney U test (significance level 0.05) was conducted to compare the difference in distribution of pedestrians' ratings of safety with respect to interactions with cyclists between each bypass site and the control site, Victoria St A. Tests were carried out using an online calculator[23] and 'don't know/no opinion' responses were removed before testing. Results are displayed in Table 1.

As expected, Victoria St A, which does not create potential interactions between cyclists and pedestrians, received the highest proportion of safe (either 'somewhat safe' or 'very safe') ratings for pedestrians, both in terms of interactions with cyclists (81% of pedestrians rated it safe) and scooter users (71% rated it safe).

Of the sites with a bypass, Island Bay had the highest proportion of pedestrians that rated the site safe (66% with respect to cyclists) followed by Crawford Rd B (60%), Crawford Rd A (57%) and Ngauranga (52%). Pedestrians at Hutt Rd were slightly more likely to rate the site safe compared to unsafe (41% compared to 32%).

Rongotai Rd and Victoria St B, where cyclists pass between the bus stop shelter and the bus bay in a dedicated cycle lane, were perceived to be the least safe by pedestrians. With respect to cyclists, 55% of pedestrians rated Rongotai Rd unsafe, and 59% rated Victoria St B unsafe. These sites were also the considered the least safe when considering scooter users, with 50% of pedestrians rating Rongotai Rd unsafe and 41% rating Victoria St B unsafe. Rongotai Rd received the highest proportion of 'very unsafe' responses from pedestrians of all sites, both with respect to potential interactions with cyclists and scooter users. The reductions in pedestrians' feelings of safety with respect to potential interactions with cyclists at Hutt Road, Rongotai Rd and Victoria St B when compared to the Victoria St A control site are statistically significant (Table 1).

Scooter users typically received a similar proportion to cyclists of 'safe' ratings at each site, except at Ngauranga and Crawford Rd A where there were a higher proportion of pedestrians who responded 'don't know/no opinion' or 3-'neither safe nor unsafe'.

[23] https://www.socscistatistics.com/tests/mannwhitney/default2.aspx

Figure 1: Pedestrian perceptions of safety at bus stop bypasses when considering potential interactions with other users

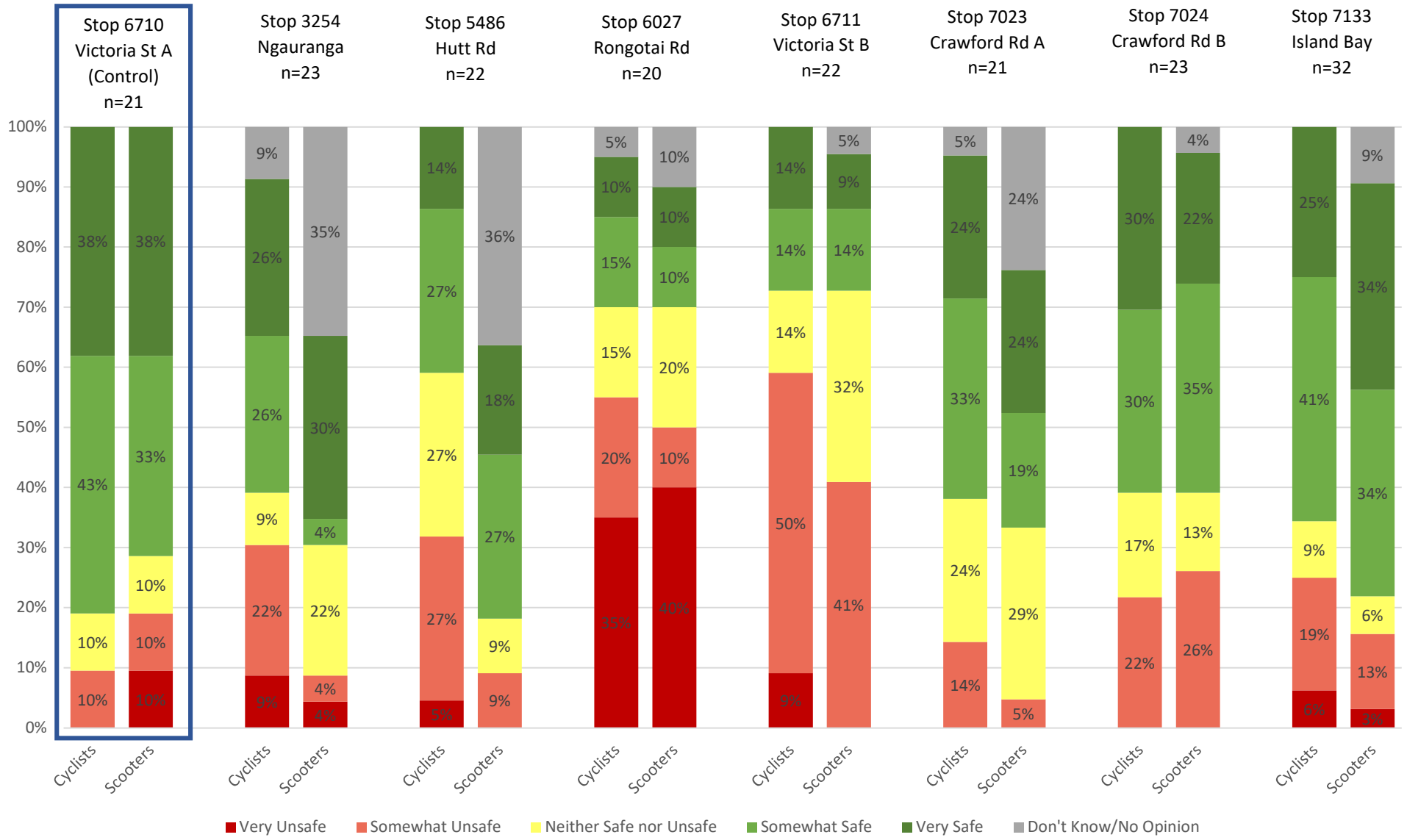


Table 1: Results of two-tailed Mann-Whitney U tests between bypass sites and control for pedestrian perceptions of safety when considering interactions with cyclists ($median_{control}$ = 4 (somewhat safe), $n_{control}$ = 21, α = 0.05)

Results in red = difference between distributions is not statistically significant
Results in blue = difference between distributions is statistically significant

Site (tested against Victoria St A (control))	Median	U	n_{site}	P
Stop 3254 Ngauranga	4 (somewhat safe)	164	23	.16
Stop 5486 Hutt Rd	3 (neither safe nor unsafe)	126	22	.01
Stop 6027 Rongotai Rd	2 (somewhat unsafe)	72.5	20	<.001
Stop 6711 Victoria St B	2 (somewhat unsafe)	96.5	22	.001
Stop 7023 Crawford Rd A	4 (somewhat safe)	162.5	21	.22
Stop 7024 Crawford Rd B	4 (somewhat safe)	195.5	23	.28
Stop 7133 Island Bay	4 (somewhat safe)	261.5	32	.18

Safety Ratings by Cyclists

Cyclists were asked to provide a rating from 1-very unsafe to 5-very safe (or don't know/no opinion) in response to the questions "Thinking about your potential interactions with pedestrians at this bus stop, how would you rate this bus stop in terms of safety?" and "Thinking about your potential interactions with motorised vehicles at this bus stop, how would you rate this bus stop in terms of safety?" Figure 2 shows the proportion of different responses from cyclists at each site.

A two-tailed Mann-Whitney U test (significance level 0.05) was conducted to compare the distribution of cyclists' ratings of safety with respect to potential interactions with pedestrians between each site and the control site, Victoria St A. Tests were carried out using an online calculator[24] and 'don't know/no opinion' responses were removed before testing. The test was also conducted for the mean of cyclists' ratings of safety with respect to potential interactions with motorised vehicles. Results are displayed in Table 2 and 3.

Victoria St A received the highest proportion of safe ratings in terms of interactions with pedestrians (83%) and the lowest proportion of safe ratings in terms of motorised vehicles (28%).

Ratings for safety in terms of potential interactions with pedestrians varied widely across bypass sites. The Crawford Rd sites and Ngauranga were rated the safest of the bypass sites (75% of cyclists at Crawford Rd A rated it safe, 71% at Crawford Rd B and 68% at Ngauranga). When compared to the control site, a statistically significant reduction in cyclists' perceptions of safety with respect to pedestrians was found at four of the seven bypass sites- Hutt Rd, Rongotai Rd, Victoria St B and Island Bay (Table 2). 54% of cyclists rated Hutt Rd safe with respect to pedestrians. Island Bay, Victoria St B and Rongotai Rd all received a low proportion of 'somewhat safe' or 'very safe' ratings (35%, 38% and 39% respectively). Cyclists at each of these three sites were just as likely to rate the stop unsafe as they were to rate it safe. No cyclists considered Rongotai Rd to be 'very safe' with respect to pedestrians.

Most of the bypass sites received a higher proportion of safe ratings for potential interactions with motorised vehicles compared to potential interactions with pedestrians. Hutt Rd was the exception to this, with fewer cyclists rating potential interactions with motorised vehicles safe than potential interactions with pedestrians. At four of the seven bypass sites, over 75% of cyclists rated the stop 'somewhat safe' or 'very safe' for interactions with motorised vehicles (The Crawford Rd sites, Ngauranga and Rongotai Rd). These increases in feelings of safety at these sites when compared to the Victoria St control site are statistically significant, while no significant change was found at the other bypass sites (Table 3). 58% of cyclists rated Victoria St B safe. Hutt Rd and Island Bay were considered the least safe with respect to motorised vehicles, with only 47% and 48% of cyclists rating the sites safe, respectively. Island Bay, Victoria St B and Hutt Rd were considered the least safe as they were the most likely to be rated 'somewhat unsafe' or 'very unsafe' (32%, 33% and 36%) of all the bypass sites, and Victoria St B received the most 'very unsafe' ratings at 14%.

[24] https://www.socscistatistics.com/tests/mannwhitney/default2.aspx

Figure 2: Cyclist perceptions of safety at bus stop bypasses when considering potential interactions with other users

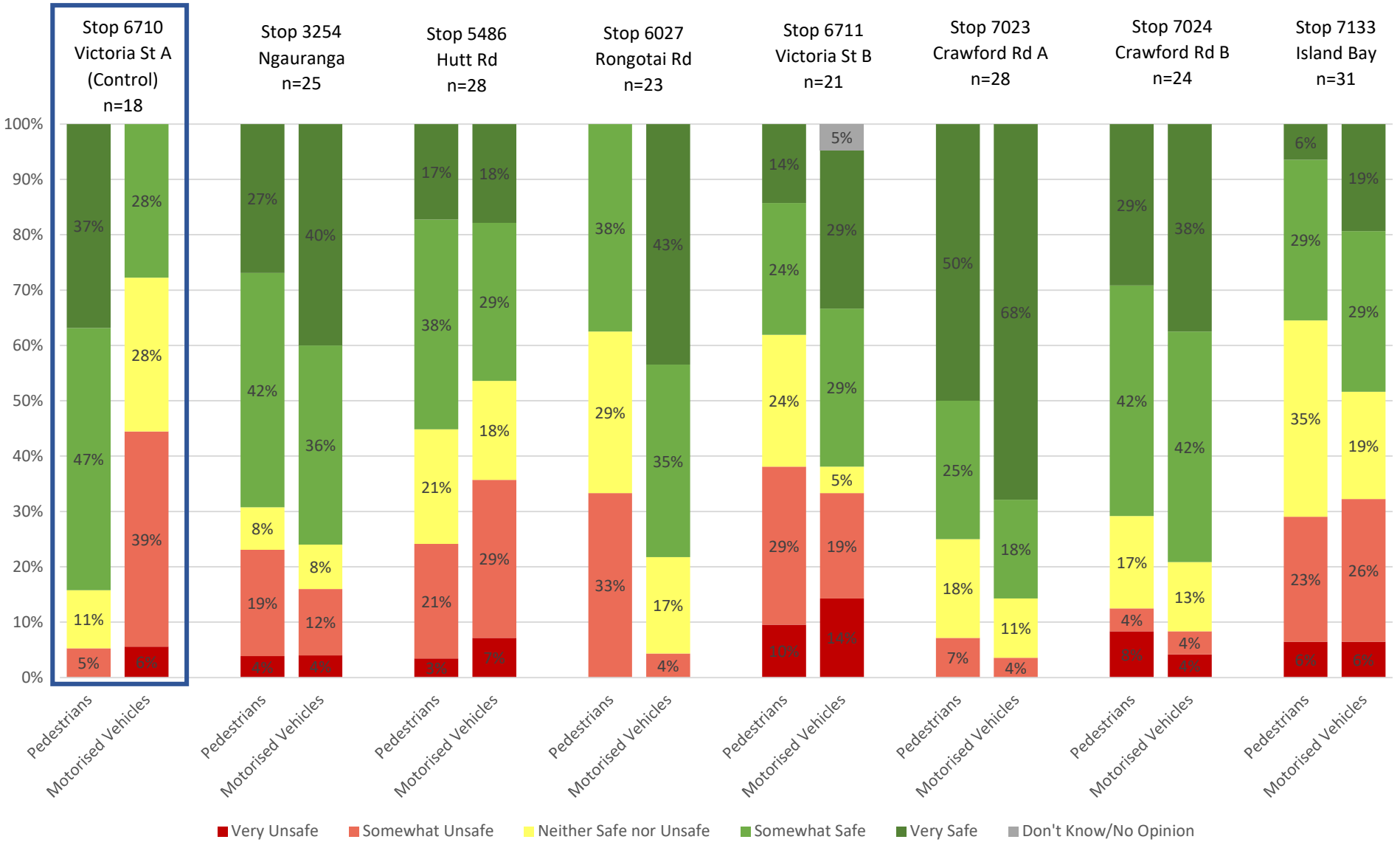


Table 2: Results of two-tailed Mann-Whitney U tests between bypass sites and control for cyclist perceptions of safety when considering interactions with pedestrians ($median_{control}$ = 4 (somewhat safe), $n_{control}$ = 18, α = .05)

Results in red = difference between distributions is not statistically significant
Results in blue = difference between distributions is statistically significant

Site (tested against Victoria St A (control))	Median	U	n_{site}	P
Stop 3254 Ngauranga	4 (somewhat safe)	178	25	.25
Stop 5486 Hutt Rd	4 (somewhat safe)	157.5	28	.03
Stop 6027 Rongotai Rd	3 (neither safe nor unsafe)	79	23	<.001
Stop 6711 Victoria St B	3 (neither safe nor unsafe)	91.5	21	.006
Stop 7023 Crawford Rd A	4.5 (somewhat safe/very safe)	241	28	.81
Stop 7024 Crawford Rd B	4 (somewhat safe)	180	24	.37
Stop 7133 Island Bay	3 (neither safe nor unsafe)	117.5	31	<.001

Table 3: Results of two-tailed Mann-Whitney U tests between bypass sites and control for cyclist perceptions of safety when considering interactions with motorised vehicles ($median_{control}$ = 3, $n_{control}$ = 18, α = .05)

Results in red = difference between distributions is not statistically significant
Results in blue = difference between distributions is statistically significant

Site (tested against Victoria St A (control))	Median	U	n_{site}	P
Stop 3254 Ngauranga	4 (somewhat safe)	95.5	25	.001
Stop 5486 Hutt Rd	3 (neither safe nor unsafe)	200.5	28	.25
Stop 6027 Rongotai Rd	4 (somewhat safe)	63.5	23	<.001
Stop 6711 Victoria St B	4 (somewhat safe)	129	21	.14
Stop 7023 Crawford Rd A	5 (very safe)	48.5	28	<.001
Stop 7024 Crawford Rd B	4 (somewhat safe)	78.5	24	<.001
Stop 7133 Island Bay	3 (neither safe nor unsafe)	210.5	31	.16

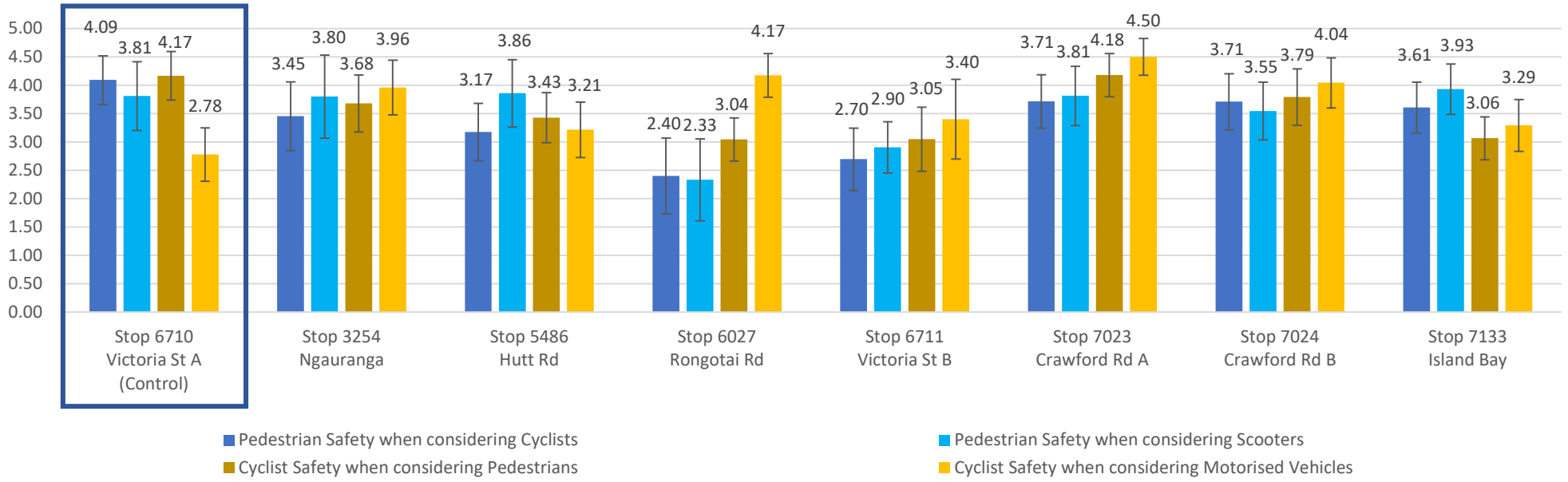
Comparing Safety Ratings of Pedestrians and Cyclists

At six of the seven bypass sites, cyclists were more likely to rate the site 'somewhat safe' or 'very safe' in terms of pedestrian interactions and less likely to rate the site 'somewhat unsafe' or 'very unsafe', suggesting that potential interactions between pedestrians and cyclists have a greater impact on the feelings of safety for pedestrians than for cyclists. The biggest differences in feelings of safety between cyclists and pedestrians were found at Rongotai Rd and Victoria St B. 39% of cyclists at Rongotai Road felt safe, while only 25% of pedestrians felt safe. Further, no cyclists at Rongotai Rd felt very unsafe, whereas 35% of pedestrians felt very unsafe. At Victoria St B, 59% of pedestrians felt that the site was unsafe compared to 39% of cyclists.

At Island Bay, the opposite was the case, with only 35% of cyclists rating the site safe with respect to pedestrian interactions; a much lower proportion than the 66% of pedestrians who rated the site safe with respect to cyclist interactions.

Figure 3 displays weighted averages with 95% confidence intervals for safety ratings at all sites. This allows impacts on both pedestrians and cyclists to be compared at each site and across sites. The weighted averages tell a similar story to the proportional breakdown of safety ratings (Figures 1 and 2): Rongotai Rd and Victoria St B rate the most poorly across interactions between cyclists and pedestrians while the Crawford Rd sites rate the safest.

Figure 3: Weighted means of perceptions of safety at bus stop bypasses in terms of potential interactions with other users

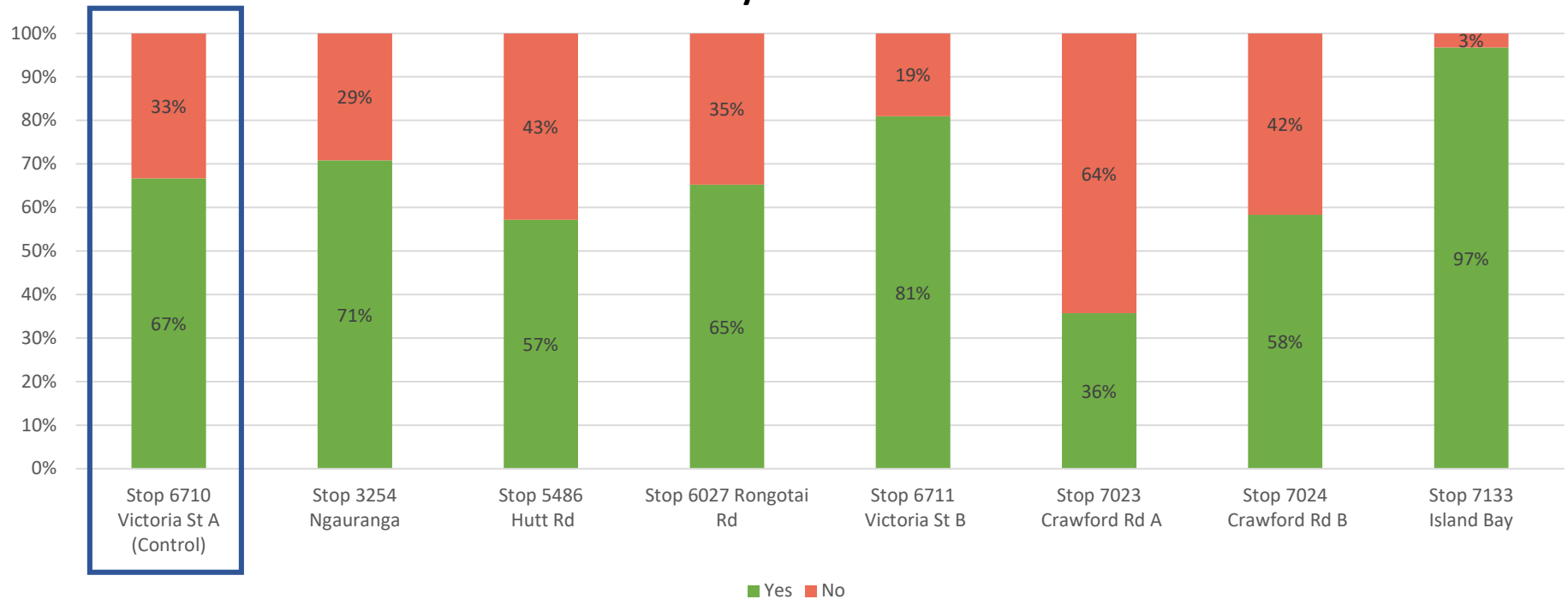


2.2 Impact of bus stop bypass design on the way cyclists ride

Cyclists were asked “does the design of this site affect the way that you ride?” Figure 4 shows the proportion of yes and no responses at each bus stop. If cyclists responded ‘yes’, they were asked the follow-up question “in what ways [does the design affect the way that you ride]?” Frequency of comment types across sites are displayed in Table 4. There is some overlap between answers to this question and to the subsequent survey question which asks cyclists to comment more generally on the design of the bus stop in terms of safety (such as when a cyclist indicates a preference to avoid the bus bypass). These comment type frequencies are recorded separately, based on which question the respondent was providing an answer for.

Across all but one site, most cyclists responded that the way that they ride was affected by the design of the bus stop. Nearly all cyclists at Island Bay reported an impact on the way that they ride, while cyclists at Crawford Rd A were least likely to report an effect on their riding.

Figure 4: Cyclist responses to “Does the design of this bus stop affect the way that you ride?”



By far, the most frequent comments from cyclists across all sites regarding the impact of bypass design on their riding was that they slowed down. The main reason was because of pedestrians at the stop, although a few cyclists also mentioned that the behaviour of vehicles near the stop caused them to slow down. The second most frequent type of comment was that cyclists were more aware or more careful at the bus stop bypass. **At Victoria St A (no bus stop bypass) the comments about being more aware or taking more care all related to being aware of busses or other moving vehicles as opposed to pedestrians.**

At Island Bay**, where cyclists' riding behaviour was most impacted, cyclists were most likely to comment on their decision about where to ride at the site.** Their comments either indicated that they prefer to stay on the road even when a bus is present; that they prefer to stay on the road except when a bus is present; or that they prefer to use the bypass, even when a bus is not present. Most cyclists who commented on this said that they preferred to stay straight on the road but to use the bypass when a bus is present.

Cyclists at Crawford Rd A were least likely to respond that their riding was affected by the site. There are several factors that may be related to this finding. The physical layout of the site naturally allows cyclists to ride in a straight trajectory onto the bypass/shared zone (therefore removing a decision between staying on the road and taking the bypass); cyclists are likely to already be travelling slowly because it is uphill (and therefore less likely to comment that they slow down); and it is a site with low pedestrian frequency (which therefore means cyclists do not need to be as cautious of pedestrians).

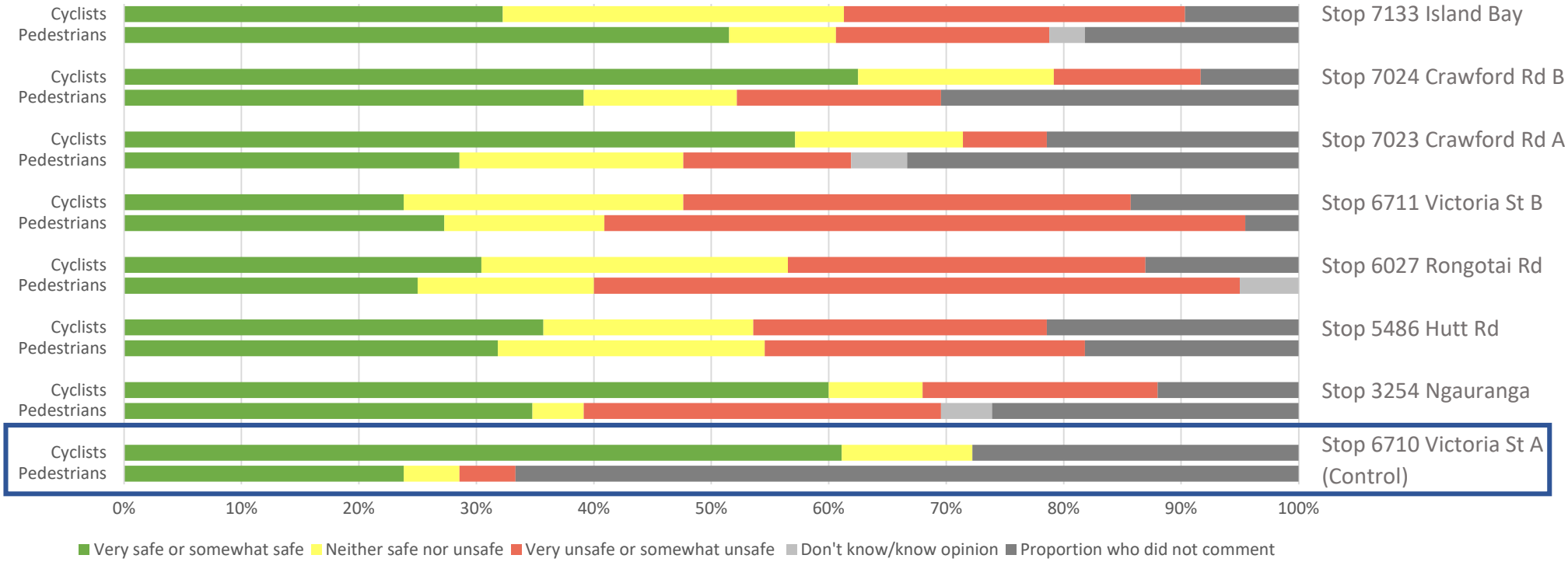
It is important to note **that these responses do not provide any strong indication of whether these impacts on cycling behaviour are perceived as positive or negative impacts on cyclists' experience**. Only a few of the miscellaneous comments explicitly described how cyclists felt and included comments such as "it is uncomfortable" and "it is a lot to think about" as well as "I feel safer" and "I am a careful cyclist anyway."

Table 4: Cyclist commentary regarding impact of bus stop design on the way they ride.

Comment type	*Stop 6710 Victoria St A (Control)*	*Stop 3254 Ngauranga*	*Stop 5486 Hutt Rd*	*Stop 6027 Rongotai Rd*	*Stop 6711 Victoria St B*	*Stop 7023 Crawford Rd A*	*Stop 7024 Crawford Rd B*	*Stop 7133 Island Bay*
I prefer to stay on the road – even when a bus is there	0	2	0	1	0	1	2	3
I tend to stay on the road – but will use the bypass if there is a bus or traffic	0	0	0	0	1	1	2	11
I tend to use the bypass	0	0	0	0	0	0	3	2
I slow down	0	6	11	8	11	3	2	12
I stop when there is a bus	1	0	0	0	4	0	0	1
I am more aware/take more care	6	3	6	4	6	3	3	4
Misc unclassified	3	5	4	4	1	5	3	3

2.3 Comments on Bus Stop Bypass Design in Terms of Safety: Overview

Figure 5: Proportion of cyclists and pedestrians who commented on the design of the bus stop bypass (in terms of safety with pedestrians and cyclists, respectively)



The proportion of respondents who chose to comment compared to those who chose not to comment is displayed in Figure 5 and provides some indication of "level of feeling".[25] In most cases, cyclists chose to comment more frequently when compared to pedestrians and did so both whether they found the site safe or unsafe. Pedestrians had very few comments on Victoria St A which does not require them to interact with cyclists. Conversely, a much higher proportion of pedestrians commented at Victoria St B and Rongotai Rd when compared to cyclists. These sites were rated worst on average for pedestrian safety with respect to cyclists. Tables 5 and 6 display frequent comment types made at each site, as well as totals across all sites. Frequent comments and comment types at each site are summarised in Section 2.4. Analysis of these comments is contained within Section 3: Discussion.

[25] Greenshields and Davidson, *Bus Stop Bypasses: Surveys,* 24

Table 5: Pedestrian commentary regarding design of the bus stop bypass in terms of safety

	Stop 6710 Victoria St A	Stop 3254 Ngaurang a	Stop 5486 Hutt Rd	Stop 6027 Rongotai Rd	Stop 6711 Victoria St B	Stop 7023 Crawford Rd A	Stop 7024 Crawford Rd B	Stop 7133 Island Bay	Total across all sites
Total number of respondents who commented:	7	17	18	20	21	14	16	27	148
Comment Type	**Number of respondents who made a similar comment**								
There are general/uncategorised design elements that I dislike or that make the stop unsafe	1	4	9	5	8	4	5	7	43
There are design elements I like or that make it safe	4	4	2	2	4	5	7	5	33
Safety depends on me and other road users being aware/considerate at the stop	0	0	4	3	7	4	1	5	24
I have concerns with the surrounding area	0	3	0	4	1	2	3	9	22
Cyclists are dangerous/too fast	0	3	1	3	2	0	0	4	13
The signage/marking needs to improve	0	2	3	2	1	1	3	0	12
Pedestrians are often unaware of the cycle lane	0	0	0	1	1	2	0	5	9
Motorised vehicles make it unsafe to access the stop	0	6	0	3	0	0	0	0	9
There is ambiguity/confusion at the bus stop	0	0	0	1	2	3	2	0	8
Exiting the bus is unsafe	0	0	0	6	0	0	0	0	6
The design is unsafe because it is unexpected	0	0	0	0	5	0	0	0	5
I have seen or experienced near misses/collisions	0	0	2	0	1	2	0	2	5
Cyclists ride through here safely/at a good speed	0	0	0	0	0	1	1	0	2
Misc other comments	3	4	7	5	3	3	4	10	39

Table 6: Cyclist commentary regarding design of the bus stop bypass in terms of safety

	Stop 6710 Victoria St A	Stop 3254 Ngauranga	Stop 5486 Hutt Rd	Stop 6027 Rongotai Rd	Stop 6711 Victoria St B	Stop 7023 Crawford Rd A	Stop 7024 Crawford Rd B	Stop 7133 Island Bay	Total across all sites
Number of respondents who commented:	13	22	22	20	18	22	22	28	174
Comment Type	**Number of respondents who made a similar comment**								
There are general/uncategorised design elements that I dislike or that make this stop unsafe	3	2	4	8	8	5	8	7	45
There are design elements I like or that make it safe	4	5	4	4	6	9	4	7	43
I have concerns with the surrounding area	4	13	13	3	9	5	3	7	57
Pedestrians are often unaware of the cycle lane	0	2	1	2	0	2	5	8	20
I like separation between cyclists and busses/cars	1	6	0	0	3	1	2	2	17
Safety depends on me and other road users being aware/considerate at the stop	1	1	1	0	4	4	3	3	17
There is ambiguity/confusion at the bus stop	0	1	1	5	2	0	7	1	17
The signage/marking needs to improve	0	1	4	4	3	0	2	2	16
There is impaired visibility at the stop	0	2	7	0	1	1	1	3	15
Pedestrian levels are low here	0	4	1	2	0	5	1	0	13
I prefer to avoid the bus stop bypass	0	2	0	0	0	0	4	6	12
Pedestrians take care around the stop	0	0	0	1	1	0	1	1	4
Misc other comments	6	2	4	2	4	5	10	8	41

2.4 Comments on Bus Stop Bypass Design in Terms of Safety: Site-by-Site Summaries

This section provides a summary of comments specific to each site. Some comments, particularly by cyclists, noted concerns about surroundings areas that are not specific to the design of bus stop bypasses. For a summary of these comments, see Appendix C.

Stop 6710 Victoria St at Ghuznee St (Victoria St A (Control))

Key points

There were mixed responses to the design of this site from cyclists. While some thought that cyclists and buses crossing paths created problems, others explicitly commented that they preferred this design when compared to Victoria St B. Perhaps unsurprisingly, pedestrians provided very little comment about this stop, as they do not need to interact with cyclists.

Pedestrian comments [7 commenters out of 21 respondents]

Positive aspects

- This design is good [4]

Cyclist comments [13 commenters out of 18 respondents]

Positive aspects

- This is a superior design to Victoria St B in terms of safety [3]

Concerns/areas for improvement

- The bus crossing the cycle lane is a problem [3]
- The trees prevent the bus from being able to pull over far enough [1]

Other

- Safety at the bus stop depends on the driver [1]
- I would not want a design like Island Bay as the alternative [2]

Stop 3254 Centennial Highway at Glover St, Ngauranga

Key points

The most frequent comment type from cyclists was regarding concerns about the area surrounding Stop 3254 (See Appendix C). Pedestrians were most concerned with accessing the bus stop from the carparks over the road due to speed and quantity of traffic, and suggested a pedestrian crossing in the area. Several cyclists mentioned that they liked having the cycle lane separate from the bus stop and road, and a few pedestrians and cyclists commented positively on the cycle lane passing behind the bus stop.

Pedestrian comments [17 commenters out of 23 respondents]:

Positive aspects

- Cycle lane behind the stop [2]

Concerns/areas for improvement

- Exiting the car and crossing the road to the stop from the carpark is unsafe because of the speed and quantity of traffic coming past [6]
- Cyclists come through at speed [3]
- A pedestrian crossing to access the stop would be useful [2]

Cyclist comments [22 commenters out of 25 respondents]:

Positive aspects

- Good separation between cyclists and busses/cars [6]
- Reduced interaction with waiting passengers because of cycle lane placement [2]
- Clear view on approach [2]

Concerns/areas for improvement

- Have experienced issues with pedestrians on the cycle lane [2]

Other

- Low pedestrian numbers at this site [4]

Stop 5486 Hutt Road at School Road

Key points

Dangerous cyclist-motor vehicle interactions in the surrounding area were the most frequently mentioned concern for cyclists (see Appendix C). At the bus stop itself, the most frequent comments from cyclists were regarding the impaired visibility at the stop. 29% of cyclists who commented either mentioned that the shelter blocked sightlines or suggested making the shelter see-through. The advertising signage that forms the South side of the shelter creates a blind corner and blocks the view of cyclists coming in the opposite direction. It also prevents cyclists from being able to see pedestrians inside or just past the shelter. Pedestrian comments focussed on the potential for clashes with cyclists, particularly when accessing the stop (as well as along the footpath), as well as the need to be alert to get to the stop. Suggestions to improve the bypass included increased separation between the two modes, a marked pedestrian crossing, and more signage to alert cyclists to pedestrians.

Pedestrian comments [18 commenters out of 22 respondents]:

Concerns/areas for improvement

- I have to be aware and look for everything [4]
- Increase separation between cyclists and pedestrians [2]
- Needs a clearly marked pedestrian crossing [2]
- Needs better/clearer signage to alert cyclists to pedestrians [2]
- I have had near misses at this site [2]
- Cyclists get annoyed at pedestrians crossing the cycle lane [2]

Cyclist comments [22 commenters out of 28 respondents]:

Positive aspects

- Good separation between cycle lane and pedestrians at the stop [3]

Concerns/areas for improvement

- The shelter blocks sightlines/make the shelter see-through [7]
- Include a pedestrian crossing, like the one at the stop further up Hutt Rd (outside the childcare centre) [2]

Stop 6027 near 119 Rongotai Rd

Key points

The most pressing concern for pedestrians at Stop 6027 was the danger of alighting at the stop. Pedestrians mentioned that "they can't see cyclists" when getting off the bus, especially as cyclists come through quickly, and that even if they try to look, they cannot really "hover" in the bus steps to do this. Accessing the bus stop is also challenging for some pedestrians because there is no nearby marked pedestrian crossing to the other side of Rongotai road.

Several cyclists said that the markings at the stop are ambiguous and that it is unclear what users should do and who should give way at the site. Specific comments included the unclear meaning of the red markings and the painted pedestrian and cycle symbols on the shared path, as well as a suggestion for increased signage that clarifies who has right of way and to remind pedestrians and cyclists to watch out for each other.

Pedestrian comments [20 commenters out of 20 respondents]

Positive aspects

- Good separation between cyclists and buses [1]
- Spacious and clear [1]

Concerns/areas for improvement

- Exiting the bus directly onto the cycle lane is dangerous [6]
- It is difficult to cross the road to access the stop [3]
- Cyclists come through at speed [3]

Other

- It is safe, you just have to pay attention [2]

Cyclist comments [20 commenters out of 23 respondents]

Positive aspects

- Good separation between cyclists and the road/buses [2]

Concerns/areas for improvement

- The painted red markings and symbols are ambiguous, and it is unclear who has right of way [5]

Other

- Pedestrian levels are low here [2]

Stop 6711 Victoria St at Abel Smith St (Victoria St B)

Key points

Both pedestrians and cyclists commented that the unexpectedness of the design for alighting passengers or for cyclists made it dangerous, especially for new people to Wellington or to the stop. The most frequent comment by both commuter types was that they had be alert and that safety at the site relied on cyclists stopping and on passengers being aware, but that this did not always happen.

Cyclists also had significant concerns with the general section of the cycle way, encompassing the Liquorland exit and the intersection at Abel Smith St (See Appendix C).

Pedestrian comments [21 commenters out of 22 respondents]

Positive aspects

- This design is good [4]

Concerns/areas for improvement

- Safety depends on me and other road users being aware/considerate at the stop [7]
- The design is unexpected [5]

Other

- A wider footpath would let prams and wheelchairs get past [1]

Cyclist comments [18 commenters out of 21 respondents]

Positive aspects

- The signage/markings are clear/obvious [4]
- Good separation between cyclists and busses/cars [3]

Concerns/areas for improvement

- Safety depends on me and other road users being aware/considerate at the stop [4]
- The signage/markings need to improve (to indicate the shared lane and to indicate when either pedestrians or cyclists should give way) [3]

Stop 7023 Crawford Road at Wellington Road roundabout

Key points

Cyclists commented positively on the design or mentioned that the stop had low pedestrian traffic which made it easy to use. Both cyclists and pedestrians noted that the design was suitable because it was on an uphill section, which meant that cyclists travelled slower and were able to slow down and be aware of pedestrians. Several pedestrians also gave positive comments about the stop. Pedestrians and cyclists both mentioned that they needed to be aware at the stop and that it should be ok “if people share responsibly” and “are paying attention”. While several pedestrians felt that the markings at the site were not clear enough, a few cyclists commented favourably on the markings and none of the cyclist respondents in this survey described the stop as ambiguous or unclear.

Pedestrian comments [14 commenters out of 21 respondents]

Positive aspects

- Visible, spacious, good design [5]

Concerns/areas for improvement

- Safety depends on me and other road users being aware/considerate at the stop [5]
- The signage/markings are confusing [3]

Cyclist comments [22 commenters out of 28 respondents]

Positive aspects

- This is a good design [6]
- It is a good design for an uphill site [3]
- The markings are good [2]

Concerns/areas for improvement

- Safety depends on me and other road users being aware/considerate at the stop [4]

Other

- Pedestrian levels are low here [5]

Stop 7024 Crawford Road at Kilbirnie Tennis Club

Key Points

Confusion about where to ride, and who has right of way at the site was the most frequent concern for cyclists and was also a concern raised by several pedestrians. Respondents were confused by the red, and some were unsure if the red markings meant they were not allowed to cycle on it. The white concrete strip was also a confusing aspect of the design, as some cyclists thought it might have been intended for cyclists to ride on. Several cyclists also commented that they would prefer less interaction between cyclist and pedestrians or would like a way to "totally separate pedestrians from cyclists" such as more clearly designated areas or signage. Cyclists also reported that the Duncan Terrace junction created a hazard (See Appendix C). 44% of pedestrians who commented said that they liked the design or mentioned specific elements of the design that they liked. On the other hand, a quarter of pedestrians who commented felt that interactions between cyclists and pedestrians create an unsafe stop.

Pedestrian comments [16 commenters out of 23 respondents]

Positive aspects

- This is a good design [4]
- The markings are good [2]

Concerns/areas for improvement

- It is unsafe having cyclists coming onto footpath [4]
- The signage/markings are confusing [2]

Cyclist comments [22 commenters out of 24 respondents]

Positive aspects

- There is plenty of space [2]
- Good separation between cyclists and the busses/cars [2]

Concerns/areas for improvement

- The signage/markings are confusing/it is not clear who has right of way [7]
- I would prefer less interaction/increased separation between cyclists and pedestrians [6]
- Pedestrians are often unaware of the cycle lane/stand on the red part [5]
- When the bus is there, I actively to avoid the bypass [2]

Stop 7133 near 206 The Parade, Island Bay

Key Points

The most common concern from cyclists at this site was that pedestrians were unaware of the cycle lane. While some cyclists thought that pedestrians needed to pay more attention, others commented that pedestrians "don't know it's a cycle lane" and "it's not their fault." On the other hand, several cyclists felt that the design was a positive change and thought it was a good design for less confident cyclists and children. Pedestrians were concerned about the speed that cyclists come through the site and felt that safety depended on them being alert to cyclists. However, two respondents also commented to the effect that the need for them to be alert was not problematic as they had "no issues" or got "used to it".

Pedestrian comments [27 commenters out of 33 respondents]

Positive aspects

- This is a good design [5]

Concerns/areas for improvement

- Cyclists come through at speed [4]
- Pedestrians stand on or walk across the cycle lane [5]
- Pedestrians need to be alert to cyclists (but this not necessarily a bad thing) [5]

Cyclist comments [28 commenters out of 31 respondents]

Positive aspects

- There is good visibility [2]
- I like being separated from busses/cars [2]
- It is good for less confident riders or children [2]

Concerns/areas for improvement

- Pedestrians stand on or walk across the cycle lane (but it is not necessarily their fault) [8]
- I prefer to avoid the bus stop bypass/would prefer it if cyclists could continue straight through and busses were careful [6]
- The shelter blocks visibility past the stop and people could step out from behind the stop [3]
- There is a lot going on at this stop [2]

3 Discussion

3.1 Influence of Bus Stop Bypass Design and Other Factors on Safety Perceptions for Pedestrians

- **Considering potential interactions with cyclists**

At sites with high perceptions of safety

***Road gradient**:* At the Crawford Rd sites, which had a high proportion of 'somewhat safe' or 'very safe' ratings, the cycle lane is on a reasonably steep uphill gradient. No pedestrians commented that cyclists were too fast past these stops, and several cyclists commented that the hill meant that they were already travelling slowly past the stops which allowed them to be more aware. Cyclists at all bypass sites reported that they slowed down at the bus stop. The Crawford Rd sites have high perceptions of safety, despite having the lowest proportion of cyclists reporting that they slowed down (18% and 9%) compared to the other sites (26% to 50%). **This may indicate that cyclists are already travelling significantly slower due to the uphill gradient, or that pedestrians are better able to perceive the lower speeds of approaching cyclists, therefore increasing perceived safety for pedestrians**. As mentioned by a few cyclists, e-bikes on the hills may begin to cause more problems in terms of interactions at speed, especially if their popularity as a commuter option increases.

Shared zone on footpath rather than in-line with dedicated cycle lane: At the Crawford Rd sites and at Island Bay, the layout requires cyclists to enter a shared zone that is part of the footpath (in front of the stops on Crawford Rd, but behind the stop at Island Bay). By comparison, at the other stops, where perceptions of safety were lower, pedestrians are required to cross a cycle path (even where the crossing is marked out as a shared zone, as it is at Rongotai Rd, it is in line with the dedicated cycle lane). **Requiring cyclists to transition onto footpaths, rather than requiring pedestrians to navigate cycle lanes may increase perceptions of safety for pedestrians.** However, no sites were surveyed which have a shared zone on a footpath in front of the shelter (ie. a layout like the Crawford rd sites) but on a flat gradient. Therefore, the gradient of the road could be the more important factor influencing feelings of safety at Crawford Rd.

At sites with low perceptions of safety

The lowest feelings of safety were reported at Rongotai Rd and Victoria St B. Both stop layouts route cyclists between the shelter and the bus bay, rather than behind it. However, the high ratings of safety at the Crawford rd sites indicate that the placement of cyclists alone is not the key factor that makes pedestrians feel unsafe. Based on comments and specific aspects of the Rongotai Rd and Victoria St sites, important factors may include:

Dedicated cycle lane between shelter and bus bay: The designs at Rongotai Rd and Victoria St B situate a dedicated cycle lane between the shelter and the bus bay. This layout requires pedestrians to cross the lane at the time that the bus arrives, as well as to alight the bus directly onto the cycle lane. Pedestrians frequently commented either that the site was unsafe because the layout was unexpected (Victoria St B) or that alighting the bus was unsafe (Rongotai Rd). **Therefore, being required to (unexpectedly) cross a dedicated cycle lane to board or alight the bus is likely to contribute to pedestrians feeling unsafe at bus stops.** This also suggests that some alighting passengers at Rongotai Rd may not notice the small buffer area of kerb between bus bay and cycle lane, as they perceive themselves as alighting directly into the cycle lane.

Unclear right of way: One possible explanation for the high proportion of 'very unsafe' responses at Rongotai Rd, especially when compared to Victoria St B is that the design at Victoria St requires cyclists to stop for pedestrians when a bus is present (whether or not they actually do), while the Rongotai Rd shared space creates an ambiguous area where cyclists may continue through even when pedestrians are using the space. However, pedestrians did not explicitly comment on the ambiguity of the Rongotai Rd site, and commented at both sites that cyclists are too fast. Therefore, it is not necessarily the case that a clearer indication of right of way would significantly increase perceptions of safety for pedestrians.

Boarding passengers vs Alighting passengers: Snapper card data from May 2019 indicates a higher proportion of boarding passengers at Victoria St compared to alighting passengers, while the opposite was true at Rongotai Rd. Very few passengers boarding at Rongotai Rd were seen during the afternoon survey periods at Rongotai Rd, whereas both boarding and alighting passengers were surveyed at Victoria St (However, this survey did not capture whether each individual survey participant was an alighting or boarding passenger.) The most frequent comment from pedestrians at the Rongotai Rd site was that exiting the bus felt unsafe. Comments made at Island Bay also highlighted concerns with exiting the bus directly onto the cycle lane at the stop on the opposite (Outbound) side of the road. **This suggests that passengers boarding and alighting the bus will experience bypass designs differently and may indicate that the current designs are more suitable when passengers are boarding, possibly because they have a clearer view of the cycle lane and more time to react, but less suitable for alighting passengers.**

➢ Considering potential interactions with scooters

Currently low e-scooter traffic: Scooters typically received a similar proportion to cyclists of 'safe' ratings at each site. The exceptions to this were Ngauranga and Crawford Road A where a higher proportion of pedestrians responded 'don't know/no opinion' or 3-'neither safe nor unsafe'. At three of the sites, more than 20% of respondents answered 'don't know/no opinion' when considering potential interactions with scooters. Therefore, scooters are not more of a concern than cyclists, at least at the bus stops themselves. Several pedestrians commented that they had rarely or never seen scooters at the bus stop. These findings may suggest that current safety perceptions of scooters around bypass sites are largely related to low frequency of e-scooters travelling past the sites.

3.2 Influence of Bus Stop Bypass Design and Other Factors on Safety Perceptions for Cyclists

- **Considering potential interactions with pedestrians**

Ambiguous markings/unclear right of way: **One key factor that may contribute to a decreased sense of safety for cyclists with respect to potential interactions with pedestrians is a lack of clarity around right of way in shared zones**. In particular, the survey found that **red stripes at shared zones are confusing for some cyclists**. Rongotai Rd had the second highest proportion of 'somewhat unsafe' or 'very unsafe' ratings with respect to potential interactions with pedestrians (35%). Cyclists at this site commented most frequently that the markings were ambiguous because they did not make it clear who had the right of way. Other comments included that it is unclear what the red stripes mean, and what the painted pedestrian and cycle symbols are intended to indicate.

The addition of the white strip of concrete in the Crawford Rd B design, intended to create a buffer zone for pedestrians to stand on while boarding or alighting, appears to have unintentionally contributed to confusion for some users about use of shared zones. Crawford Rd A was much more likely to be considered 'very safe' than Crawford Rd B in terms of interactions with pedestrians. The most frequent comment by cyclists at Crawford Rd A was that the layout of the markings is ambiguous and confusing, and cyclists commented that they were unclear on who was meant to be on the red stripes and on the white concrete. However, cyclists still rated Crawford Rd B safe, so other factors at this site appear to be more important for perceived safety.

Pedestrian behaviour and awareness of the cycle lane*:* At Island Bay, the most common concern was that pedestrians often cross the cycle lane without looking or stand on the cycle lane. A few cyclists commented that "it's not [pedestrians'] fault" and that more needed to be done to make pedestrians aware that there was a cycle lane, such as signage or green paint. Several cyclists at Crawford Rd B also commented that pedestrians on the cycle lane were a problem. The issue with unaware pedestrians in the cycle lane may be most mentioned at these two sites because both have a similar design which routes cyclists off the road onto a shared zone on the footpath. However, cyclists at Crawford Rd B were less likely to rate the site as unsafe, which may be related to the far lower pedestrian density at this site in peak times. **Therefore, at stops with high pedestrian use, designing the bypass to manage pedestrian behaviour and awareness of the cycle lane is likely to be an important factor for improving perception of safety on the bypass and encouraging cyclists to use the bypass.**

Visibility: **Poor visibility is a concern for cyclists and may have an impact on their feelings of safety.** At Hutt Rd, nearly a third of cyclists who commented were concerned that there was impaired visibility at the stop. While a few of these comments were about the blind spot at the driveway adjacent to the stop, most were about the blind spot created by the advertising signage in the shelter. Cyclists at other sites, such as the Crawford Rd sites and Ngauranga commented positively on good visibility and a clear view on the approach to the sites because this allowed them to react to pedestrian behaviour.

Marked pedestrian crossing: A zebra crossing may be a design option that increases the perception of safety not only for pedestrians, but also for cyclists. A few cyclists mentioned that they would like a crossing at the Hutt Rd stop like the one at another site along Hutt Rd. A TRL study of pedestrian crossings at bus stop bypasses found that more pedestrians used a zebra crossing compared to an uncontrolled crossing when accessing a bus stop island.[26] This could help manage where pedestrians choose to cross and reduce the likelihood that they will cross at the blind corner.

➢ Considering potential interactions with motorised vehicles

Navigating moving traffic: At Victoria St A, where cyclists are required to pass between the bus and moving traffic, cyclists were least likely to rate the stop as safe. Cyclists commented that they needed to be aware of moving traffic and the bus, and sometimes had to move out of the cycle lane into traffic because of the incorrect positioning of the bus.

Concerns with the wider cycle network: At bypass sites where over 30% of cyclists rated the stop unsafe (Hutt Rd, Island Bay and Victoria St B) most concerns focussed on cycle lane design and driver behaviour in the surrounding area, particularly in relation to interactions at driveways and intersections just before and past the bus stop (eg. the Liquorland and Abel Smith St intersection at Victoria St A); along the whole cycle way (eg. blind spots at business entrances along the Hutt Road Cycle Path); and illegal parking over the cycle lane (eg. at Island Bay). Similar concerns were also mentioned at the other sites. **Comments by cyclists, even at the least safe sites, do not indicate that a low perception of safety from motorised vehicles comes about because of elements of the bypass designs.** Further, 10% (17) of cyclists who commented mentioned that they liked having the separation between cycles and cars/busses.

These findings suggest that cyclists are more likely to feel safe with respect to motorised vehicles where they can bypass the stop. However, the findings also show that there are still pressing safety concerns and conflict points along key cycle routes in Wellington City that may hinder an increased uptake of cycling. See Appendix C for a summary of these other concerns.

[26] Greenshields and Davidson, *Bus Stop Bypasses: Surveys, v*

3.3 Implications for Bus Stop Design

The potential interactions between cyclists and pedestrians may decrease feelings of safety for both users at bus stop bypasses. Based on ratings of safety and comments from survey respondents, aspects of bypass design and layout that may influence feelings of safety can be determined. Some of these aspects, as well as recommendations for increasing feelings of safety at these potential zones of cyclist-pedestrian interaction, are outlined below:

- Clearer indications of right of way at shared zones may reduce ambiguity and confusion, and increase feelings of safety, particularly for cyclists.
    - The additional white concrete strip at Crawford Rd B which is intended to act as a buffer zone for passengers may have unintentionally increased confusion at this shared zone.
    - Several cyclists did not understand the meaning of the red-striped painted markings at Crawford Rd and Rongotai Rd.
- Increasing the visibility of the bypass behind the stop at Island Bay, for example, with markings on the cycle lane, could help manage pedestrian behaviour and increase feelings of safety for cyclists.
- A zebra crossing at Hutt Rd may increase feelings of safety for both pedestrians and cyclists.
- Removing ad signage in bus shelters, for example at Hutt Rd, may improve visibility for cyclists and increase feelings of safety because it allows them to react to pedestrians.
- Pedestrians tend to feel less safe at sites where they are required to cross dedicated cycle lanes.
- Alighting passengers will experience bus stop bypass designs differently to boarding passengers and may find it more unsafe to exit directly onto a cycle lane due to being unaware of, or having a limited view of, any approaching cyclists.
- Slow, uphill bypass sites with good visibility were considered safe by both pedestrians and cyclists.
- Cyclists have other pressing concerns along the cycle way that impact their general feelings of safety, particularly relating to motorist behaviour at driveways and intersections.

4 Demographics

Survey respondents were asked demographics questions. These questions were not required to be answered for a survey to be considered valid, as some respondents needed to leave due to their bus arriving or because of other time pressures.

4.1 Age

Figures 6 and 7 show the age distributions of survey respondents. Pedestrian respondents were typically in the younger age ranges (in the 20-29 or 30-39 age groups), while cyclists were predominantly aged between 40 and 59. Few respondents in the older age groups were surveyed.

Figure 6: Respondent Age: Cyclists

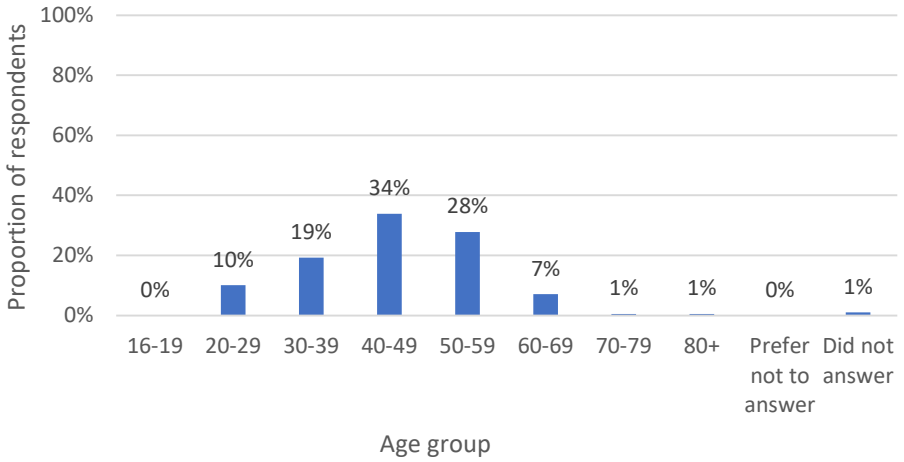
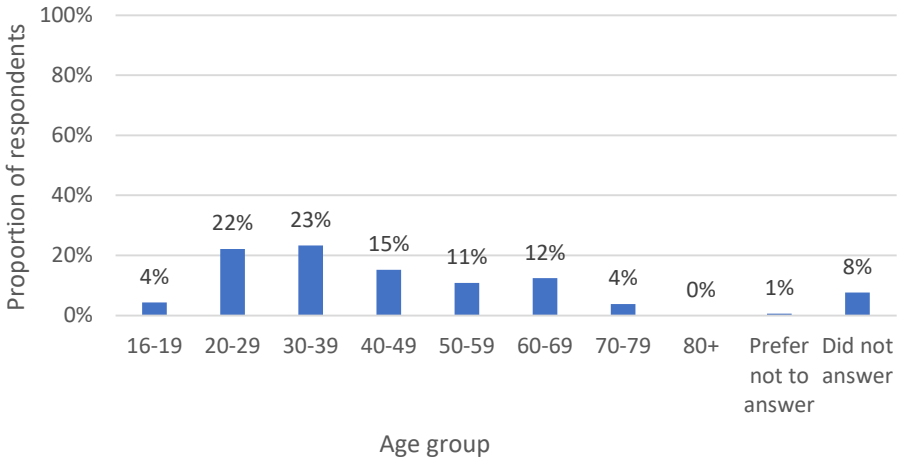


Figure 7: Respondent Age: Pedestrians



4.2 Gender

Figures 8 and 9 show the distribution of gender identities of survey respondents. Cyclists were predominantly male, while pedestrians were more balanced, but skewed towards female.

Figure 8: Respondent Gender Identity: Cyclists

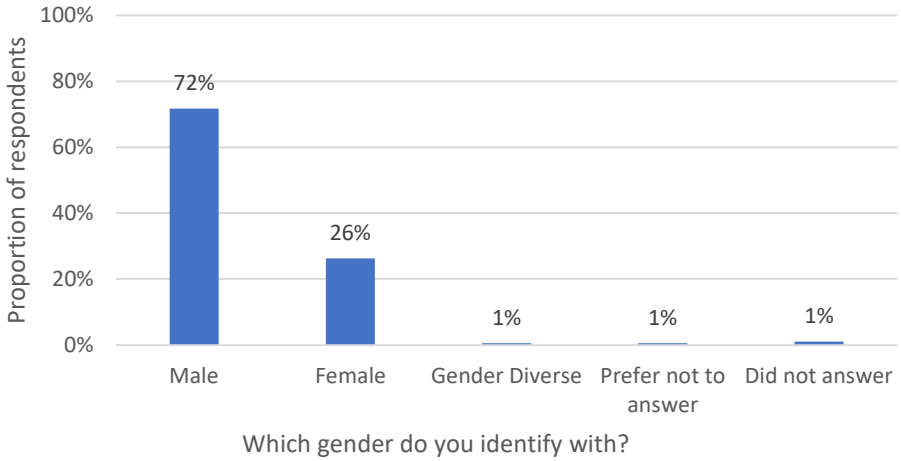
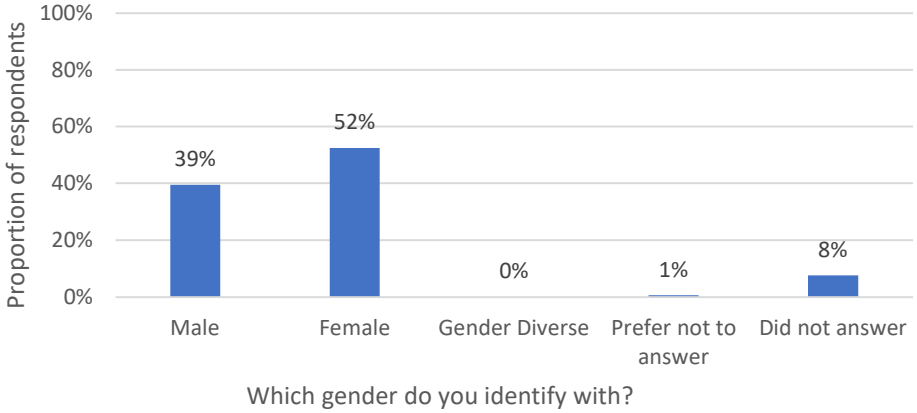


Figure 9: Respondent Gender Identity: Pedestrians



4.3 Disability

Figures 10 and 11 showed the proportion of survey respondents who self-reported a disability or accessibility concern that could impact their safety at the bus stop.

Amongst cyclists, one reported a vision disability, and one reported the trailer that they use to transport their children. This was likely reported here as there was no question in this survey to capture other encumberments such as trailer loads for cyclists, or small children, prams or shopping bags for pedestrians.

Amongst pedestrians, reported disabilities included impaired vision [2]; impaired hearing [1]; impaired mobility [5] (specified mobility disabilities were partial paralysis of the leg, cerebral palsy, and rheumatoid arthritis); chronic obstructive pulmonary disease (emphysema) [1]; and fibromyalgia [1].

Figure 10: Respondent Self-Reported Disability: Cyclists

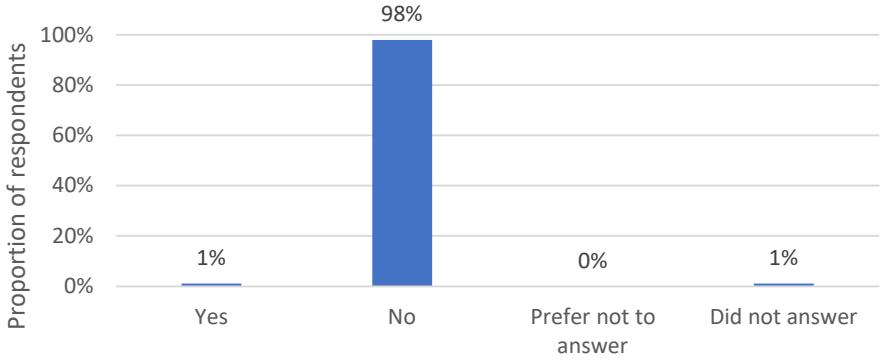
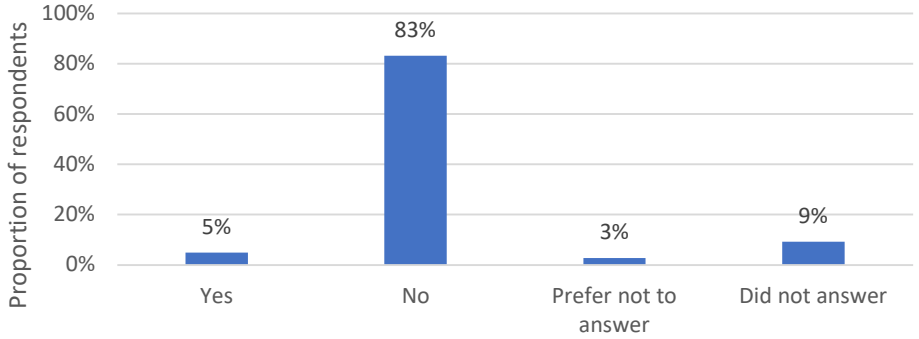


Figure 11: Respondent Self-Reported Disability: Pedestrians



5 Conclusion

➢ Limitations and Future Research

This research provides insights into how bus stop bypass design impacts user experience, and some recommendations for how to improve future design. However, user feedback from intercept surveys cannot tell the whole story of how design elements influence the behaviour of cyclists and pedestrians or capture the frequency and level of interactions occurring at these sites. Therefore, additional research into how users behave at shared zones, or respond to different design elements, such as through video observations, would provide a more thorough understanding of whether bypass designs are significantly increasing the frequency of problematic interactions between cyclists and pedestrians, and which design elements may reduce this conflict.

The demographic data also indicates that few people in the older age brackets and few people with disabilities were surveyed. Specific engagement with these groups will also be important to gain feedback on the accessibility of these designs for all users.

➢ Conclusions

This research aimed to increase understanding of how bus stop bypass designs impact perceptions of safety for pedestrians and cyclists, as well as how bus stop bypass designs impact the way cyclists ride. The findings suggest that bypasses at bus stops are achieving their aim of increasing feelings of safety for cyclists with respect to potential interactions with motorised vehicles. However, because of the increase in potential interactions between cyclists and pedestrians at these bypass sites, cyclists felt significantly less safe with respect to potential interactions with pedestrians at four of the seven bypass sites, compared to the control site. Perceived safety for pedestrians with respect to cyclists also significantly decreased at three of the bypass sites. At most sites (including the control site), the majority of cyclists reported that the design influenced the way that they ride. Cyclists most frequently reported either slowing down for pedestrians or being more aware of pedestrians (or motor vehicles).

Based on the ratings of safety at different sites, as well as comments from survey respondents, there are several factors which may influence the perceptions of safety for bypass users, and some recommendations can be made that may improve cyclists' and pedestrians' experiences at the bus stop. Design elements that manage pedestrian behaviour or enable cyclists to pre-empt it may increase perceptions of safety for cyclists. Specific examples include:

- Markings (such as zebra crossings or painted symbols) or signs that indicate expected user behaviour and right of way, particularly in shared zones.
- Clearly marked cycle lanes, particularly where the cycle lane passes through predominantly pedestrian space, for example, at Island Bay.
- Good visibility of potential conflict areas around the bypass. This may require advertising boards to be removed from the sides of shelters.

For pedestrians, crossing dedicated cycle lanes that pass between the shelter and the bus bay created the most concern. This was especially the case for alighting passengers. Requiring cyclists to give way to pedestrians at these sites when a bus is present may increase pedestrians' feelings of safety. However, pedestrians still reported feeling unsafe even when crossing a controlled dedicated cycle lane where cyclists are required to give way. Therefore, further research into this specific type of design may be required to understand how to improve user behaviour and experience.

Bus stop bypasses will continue to be an important part of the growing cycle networks in New Zealand cities. While some of the trialled designs in Wellington city are proving successful, others are raising safety concerns for cyclists and pedestrians. The experiences of all users at the bus stop, and this report's recommendations, should be considered in the design of bus stop bypasses as part of the wider goal to improve the attractiveness and uptake of both active and public transport modes in New Zealand.

Supplementary Material

Appendix A: Pedestrian Survey

Intro and opt in/out

Hi there, my name is _____ and I am conducting a survey on behalf of Wellington City Council to help them better understand the safety and convenience of bus stop designs. Your answers will be used to improve the design of bus stops going forward. It will take about 5 minutes – would you like to participate?

- Yes – continue to question 1.
- Yes but don't have time – offer paper with link to online survey.
- No – End and thank them for their time.

Thank you – here is an information sheet describing the study. Would you like a moment to read it?

1. **What brings you to this location today?**
   [Read out most likely response to check with respondent]

   a) Bus passenger
   b) Traveling through on manual bicycle
   c) Traveling through on electric bicycle
   d) Traveling through on manual scooter
   e) Traveling through on electric scooter
   f) Walking through
   g) Other – write in response

2. **Thinking about your potential interaction with cyclists at this bus stop, how would you rate this bus stop in terms of safety?**

   - 1 – very unsafe
   - 2 – somewhat unsafe
   - 3 – neither safe nor unsafe
   - 4 – somewhat safe
   - 5 – very safe
   - Don't know/no opinion

3. **Thinking about your potential interaction with scooters at this bus stop, how would you rate this bus stop in terms of safety?**

   - 1 – very unsafe

- 2 – somewhat unsafe
- 3 – neither safe nor unsafe
- 4 – somewhat safe
- 5 – very safe
- Don’t know/no opinion

4. Do you have any comments on the design of this bus stop in terms of safety?

5. What is your age?

a) 16-18
b) 19-29
c) 30-39
d) 40-49
e) 50-59
f) 60-69
g) 70-79
h) 80+
i) Prefer not to answer

6. Which gender do you identify with?

a) Male
b) Female
c) Gender diverse
d) Prefer not to answer

7. Do you live with a disability or accessibility issues that could impact your safety at this stop?

a) Yes
b) No
c) Prefer not to answer

If yes, could you briefly describe the disability or accessibility issue (for example, relating to mobility, hearing, vision)? Or you can choose not to answer.

Appendix B: Cyclist Survey

Intro and opt in/out

Hi there, my name is ____ and I am conducting a survey on behalf of Wellington City Council to help them better understand the safety and convenience of bus stop designs. Your answers will be used to improve the design of bus stops going forward. It will take about 5 minutes – would you like to participate?

- Yes – continue to question 1.
- Yes - but don't have time – offer slip of paper with link to online survey.
- No – End and thank them for their time.

Thank you – here is an information sheet describing the study. Would you like a moment to read it?

8. What brings you to this location today?
[Read out most likely response to check with respondent]

h) Bus passenger
i) Traveling through on manual bicycle
j) Traveling through on electric bicycle
k) Traveling through on manual scooter
l) Traveling through on electric scooter
m) Walking through
n) Other – write in response

9. Thinking about your potential interactions with pedestrians at this bus stop, how would you rate this bus stop in terms of safety?

- 1 – very unsafe
- 2 – somewhat unsafe
- 3 – neither safe nor unsafe
- 4 – somewhat safe
- 5 – very safe
- Don't know/no opinion

10. Thinking about your potential interaction with motorised vehicles at this bus stop, how would you rate this bus stop in terms of safety?

- 1 – very unsafe
- 2 – somewhat unsafe
- 3 – neither safe nor unsafe
- 4 – somewhat safe
- 5 – very safe

- Don’t know/no opinion

11. Does the design of this bus stop affect the way you ride?

a) Yes
b) No

If yes …In what ways?

12. Do you have any comments on the design of this bus stop in terms of safety?

13. What is your age?

j) 16-18
k) 19-29
l) 30-39
m) 40-49
n) 50-59
o) 60-69
p) 70-79
q) 80+
r) Prefer not to answer

14. Which gender do you identify with?

e) Male
f) Female
g) Gender diverse
h) Prefer not to answer

15. Do you live with a disability or accessibility issue that could impact your safety at this stop?

d) Yes
e) No
f) Prefer not to answer

If yes, could you briefly describe the disability or accessibility issue (for example, relating to mobility, hearing, vision)? Or you may choose not to answer.

Appendix C: Concerns with the Surrounding Area

Several respondents reported concerns about the wider cycle network or the area near the survey site. These concerns are not directly relevant to the bus stop bypasses in this survey but may provide useful general feedback on safety concerns facing cyclists and pedestrians. Concerns pertaining to safety are summarised below:

Stop 3254, Centennial Highway at Glover St, Ngauranga

Cyclists at this site had issues with motor vehicles not giving way when exiting Glover St. The angle parking also caused problems because of motor vehicles reversing directly into the cycle lane.

Stop 5486, Hutt Road at School Road

Cyclists were concerned about safety at business driveways along the Hutt Rd Cycle Path. Specific driveways of note included the Spotlight entrance, which was reported to be a bad blind spot, and at the petrol station. Several cyclists reported near misses and collisions along this route. Other cyclists felt unsafe at the area where the Hutt Rd Cycle Path ends, and they are required to merge back into general traffic. One cyclist requested a “Riders please slow down sign” outside the childcare centre on Hutt Rd, as they were concerned about potential interactions between small children and cyclists.

Stop 6027, near 119 Rongotai Rd

Cyclists and pedestrians reported challenges with the general kerbside cycle path design. Parked cars blocked sightlines making it more challenging for cars to spot cyclists when turning left into side streets off Rongotai Rd, and power poles were reported to block sightlines for cars exiting driveways. Pedestrians noted that it is challenging to cross Rongotai Rd to access the bus stop because there are no nearby pedestrian crossings. One pedestrian commented that “the berm is the same width as walkers for elderly people” making it challenging for them to exit their cars at the kerb. There may be other general accessibility issues at these separated kerbs for people with limited mobility that were not captured in this survey.

Stop 6710, Victoria St at Ghuznee St

Cyclists were concerned about cars parking across the cycle lane as far back as the bus stop as they waited to turn left at Vivian St.

Stop 6711, Victoria St at Abel Smith St

Cyclists reported “terrible safety” at the Liquorland exit due to cars exiting without looking, or parking in the cycle lane to exit onto the busy street. Other cyclists felt that the Abel Smith intersection was still unsafe, as motor vehicles turning left fail to check for cyclists.

Stop 7024, Crawford Road at Kilbirnie Tennis Club

The Duncan Tce intersection may create an additional hazard for cyclists where they transition from the footpath onto the cycle lane, as there is ambiguity about whether cars must give way.

Stop 7133, near 206 The Parade, Island Bay

Both pedestrians and cyclists mentioned safety concerns with the bus stop on the opposite side of the road because it required passengers to alight directly onto the cycle lane. Cyclists also reported vans and cars parked illegally across the cycle lane just past the bus shelter.