The Impact of Regulations on the Usage of e-Scooter Sharing Systems in New Zealand Cities

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ABSTRACT

E-scooter sharing systems (SSS) are a new form of shared micromobility which has quickly gained traction in New Zealand since it was introduced in late 2018, while local governments across the country are introducing regulations that both embrace the technology and protect rider safety. This research paper seeks to initiate a conversation the level of regulations and its impact on ridership, a topic which is not well-researched in New Zealand nor abroad. Current implementations of SSS regulations overseas are presented while acknowledging the ever-changing nature of this innovative mobility mode by including examples of ongoing debates and developments in this area. Lessons are drawn from research into similar bicycle and moped sharing systems. Key regulations and users' demographic data are synthesized to form a framework for analysis.

A nation-wide survey permitted collection of data across a range of demographics and a few SSS companies were approached for a business perspective. The results show that regulations governing user behaviour have a strong negative effect on SSS usage, particularly with respect to frequent users and younger casual users, the two higher-revenue user groups. However, non-users view mandatory safety helmets positively when they are provided with the vehicle, and may broaden the customer base even if overall ridership is reduced. E-scooters being distributed in a way that is convenient and reliable has a strong positive effect on SSS usage, while discount pricing for targeted groups finds support by most people. Local governments may be able to use these two factors to target demographics experiencing transport disadvantage, though the SSS operators may be less enthusiastic about regulation in these areas.

INTRODUCTION

Micromobility is a relatively new collective term for low-powered lightweight utility vehicles designed for short trips. In transport planning circles, it is an idea that has gained popularity due to the suggestion that it may provide an eco-friendly and elegant solution to first- and last-mile challenges with public transportation as well as satisfy an untapped demand for vehicles that are 'right-sized' for various trip lengths. The introduction of electric scooter (or *e-scooter*) sharing systems (SSS) in the past two years and its subsequent popularity worldwide has demonstrated the business potential for new entrants into the micromobility market, paving the way for future innovations to make a mark. (Dediu 2019; Zarif et al. 2019)

With new technology, however, comes new policy challenges. Firstly, there is the question of how to protect rider safety and use of public space while still embracing innovation. For social evolution and advancement to occur, innovative enterprises such as SSS should be allowed to flourish. On the other hand, some members of the public may feel that their way of life is threatened, and look to the government to regulate these companies. The way towards regulation can be difficult – too little regulation and the negative externalities of dockless vehicles such as injuries, poor riding etiquette, careless parking, and visual pollution begin to take over the urban landscape; too much regulation and companies may choose to pack up and leave (see Melbourne's dockless bicycle sharing system, *Obike*). (Deighton-Smith 2018)

Secondly, there is great potential for these new forms of micromobility to create social value, contribute to urban resilience, tackle environmental challenges, and alleviate transport disadvantage. But realising this potential may require government intervention to succeed; similar bicycle sharing systems, when left to their own devices, have not proven to be effective in reducing the number of car trips and often exhibit a bias towards more affluent neighbourhoods. The risk is that, if there are no measurable public benefits, these micromobility services can become just a pathway to privatising public space for corporate profit. (Sun 2018; Médard de Chardon 2019)

Finally, the link between the type of regulation and SSS usage is very unclear. Do mandatory helmets discourage ridership? Does a more consistent distribution of e-scooters have the potential to broaden the appeal of SSS? These questions have major implications both for the companies themselves who must maintain a profitable operation, and for local governments and urban planners looking to create a shift in the way people move. To understand the optimal level of regulation, its relationship to usage first needs to be analysed.

BACKGROUND

Regulations in Overseas Cities

Cities around the world have faced the challenge of regulating a fast-growing industry and rapidly changing transport landscape. Guidelines for micromobility regulations for local governments were published in late 2018 (IMLA 2018). Nonetheless, the differentiating factors between cities, particularly with respect to population density, topography, and existing and competing micromobility modes, means that each city has taken a unique approach to the problem. Table 1 provides an overview of how selected cities have chosen to regulate e-scooter sharing services (SSS). We can see from this table that the forms of regulation can be divided into two broad definitions:

- *Regulating Usage* - such as mandatory safety helmets, maximum operating speeds, bans on footpath-riding, and specified parking areas; and
- *Regulating Operations* - such as business permits and operational fees, maximum fleet sizes, minimum service provision, rebalancing requirements, and transport equity requirements.

In this paper, the focus will be on usage regulations and rebalancing / equity requirements. Other restrictions such as operational fees and maximum fleet sizes relate more to business models and less to ridership, and fall outside the scope of this study.

Studies on Overseas Regulations

This section reviews published research into regulations overseas. Due to the lack of articles available specific to SSS, some conclusions will be drawn from literature on bicycle sharing systems (BSS), both *station-based* (docked) and *free-floating* (dockless).

Mandatory Safety Helmets

Helmets for users of SSS are currently a topic of debate for transport regulators, with public safety and costs to public health a major concern for city officials. A study in Austin, Texas found that, of all reported injuries to scooter riders, nearly half (48%) had some form of head injury, and 15% had traumatic brain injuries (Austin Public Health 2018). This supports a study in at the University of California, Los Angeles (UCLA) which found that around 40% of all injuries from using SSS included some form of head injury (Trivedi et al. 2019). At the current time (May 2019), none of the cities in Table 1 have mandatory helmet requirements for e-scooters, but most have 'recommended' them either through public education campaigns or instructions to riders.

On the other hand, previous studies in BSS suggest that helmet requirements substantially decrease ridership (Médard de Chardon et al. 2017; Fishman et al. 2014). It is unclear if the same relationship applies to SSS.

Table 1. Regulation of shared e-scooter services overseas

City	Fleet Size	Regulations
Los Angeles	31,500 (Mar 2019)	No riding on footpaths, speed limit of 15 mph. 16,000 e-scooters to be located in disadvantaged communities. (City of Los Angeles 2019a; City of Los Angeles 2019c; City of Los Angeles 2019b)
Paris	15,000 (Apr 2019)	Prohibited on footpaths (riding and parking), specified parking spaces, operators must sign up to a charter of best practice. (Mairie de Paris 2019)
Austin	13,600 (May 2019)	None currently, although proposed regulations are currently in discussion (Thornton 2019). For now, a 'scooter etiquette' flyer gives guidelines on usage (City of Austin 2019).
Madrid	8,600 (Apr 2019)	Prohibited on footpaths (riding and parking) and bus lanes. Equitable distribution at the beginning and end of each day. (Ayuntamiento de Madrid 2019)
San Francisco	1,600 (Apr 2019)	No riding on footpaths. 70% of fleet must be available at all times, and rebalancing is required for underserved areas. Each operator must have 150 riders that provides half-price ridership for low-income people. (SFMTA 2019)
Singapore	No data available	No riding on roads or 'pedestrian-only' paths (different from footpaths). Speed limit of 25 kph on shared paths and 10 kph on footpaths. Operating licensing for SSS companies yet to be determined. (Singapore Legal Advice 2019)

Speed Limits and Riding Locations

Neither speed limits nor footpath bans have been studied extensively, even though both are commonly proposed regulations for SSS; of the 7 cities in Table 1, two have imposed speed limits and four have banned e-scooters from footpaths. Furthermore, these are unique to SSS – BSS does not provide any point of comparison, as most cities expect bicycles to be ridden in bicycle lanes and usually without an imposed speed limit. Thus any research into the relationship between these regulations and SSS usage will be new.

Parking Locations

A boom in free-floating BSS created problems with unused vehicles and disorderly parking in Beijing, with bicycles encroaching on footpaths and public spaces (Sun

2018). Similar incidents have been reported with SSS in various cities and though it appears to polarize public opinion, it is unclear what effect this has on e-scooter usage.

Studies in China have shown that station-based BSS are preferred over free-floating BSS for regular trips (such as commuting to work) and that free-floating BSS do not replace regular car usage (Li et al. 2019; Sun 2018). Additionally, with station-based BSS, variation in station sizes reduce usage while station density increases usage (Médard de Chardon et al. 2017). This suggests that reliability is a key component of making BSS a viable alternative for commuting, which may explain why station-based BSS tend to target affluent areas even though docking stations in disadvantaged communities can produce substantial accessibility improvements (Qian and Niemeier 2019). It is likely that these conclusions can be applied to the usage of SSS as a regular commuting mode, by applying geofenced parking locations for SSS in order to imitate docking stations.

This may, however, decrease usage among recreational or irregular riders, as it has been shown that longer-distance and flexible (non-commuting) travelers prefer free-floating BSS over station-based ones (Li et al. 2019).

Rebalancing and Transport Equity

Data from Washington, D.C. shows that even without regulation, free-floating sharing systems (BSS and SSS) are better distributed across the city than station-based BSS, including in areas that are traditionally underserved (Populus 2018). This compares well with the findings from Kunming where young, lower-income, and student groups prefer free-floating BSS (Li et al. 2019).

At present (May 2019), Los Angeles and San Francisco both have licensing restrictions that require SSS companies to provide a certain level of service to disadvantaged communities either through rebalancing requirements (Los Angeles) or through ridership requirements (San Francisco). It is unclear whether these restrictions have been successful in reducing transport disadvantage; the experiment, however, is at risk of being terminated prematurely by state legislation seeking to preempt local powers, likely due to lobbying by micromobility companies (Zipper 2019).

Customer Segmentation

The impact of regulations may vary across demographics. A German study demonstrated how users of dockless *'medium-weight' electric scooter* (i.e. moped) sharing systems can be clustered according to their usage patterns, with key segmentation factors being average rentals per customer and average age. Notably, a small segment (4.4%) of the customer base who can be considered regular users, or *power users*, generates 41% of total revenue, while younger casual users form a large section of users (58%) and make up another 41% of revenue. Older casual users form 24% of the customer base and 16% of revenue, while the remaining 14% of users constitute 1% of revenue. The proportion of users to non-users in the population is unclear. (Degele et al. 2018)

Regulations in New Zealand

In New Zealand, the speed and location of vehicles are governed by the NZ Transport Agency (NZTA), while local government controls local transport planning (such as creation of cycleways) and issues business permits. The road code states that e-scooters are not permitted to be ridden in cycle lanes, but they are permitted on the footpath, on the road, and on separated cycleways. On the footpath, they must be operated *"in a careful and considerate manner"* and *"at a speed that does not put other footpath users at risk"*. There are no regulations with respect to a speed limit nor to the use of safety helmets (NZ Transport Agency 2019). Additionally, local governments have introduced various regulations as detailed in Table 2.

Table 2. Regulation of shared e-scooter services in New Zealand

City	Fleet Size	Regulations
Auckland	1,875 (May 2019)	Slow speed zones, redistribution requirements. Maintenance targets. Code of Practice, trial permits required. (Auckland Council 2019a; Auckland Council 2019b)
Hutt City	600 (Apr 2019)	Working bells, redistribution requirements. Operations, parking, safety and maintenance targets. Trading permit required. (Hutt City Council 2019)
Wellington	800 (Mar 2019)	Will be available sometime in June. Code of Practice likely to be implemented - regulations currently in discussion. (Wellington City Council 2019; Newstalk ZB 2019)
Christchurch	1,600 (May 2019)	No specific regulations. Trading permit required. (Christchurch City Council 2019a; Christchurch City Council 2019b)
Dunedin	300 (Jan 2019)	No specific regulations, but classified as vehicles. Memorandum of Understanding - no permit. (Dunedin City Council 2019; Block 2019)
New Plymouth	50 (Feb 2019)	15kph maximum speed, removed from public places by midnight. Incident reporting. Memorandum of Understanding - no permit. (Persico 2019)

The distribution of legislative power in New Zealand may be different to that of other countries, which may impact the nature of local government regulation. There is also little consistency between city councils. For example, the Dunedin City Council website states that SSS operators do not require a permit as they are classed as vehicles on the footpath (i.e. falls under NZTA road rules), while other councils treat them as a business trading in public places and impose operating conditions on the permit.

METHODOLOGY

The relationship between e-scooter regulations and SSS ridership is currently not well-understood. From the previous section, it seems that the primary reasons for introducing regulations tend to be safeguarding public health and public space (particularly footpaths). Regulations specifically for the purpose of increasing ridership for social or environmental outcomes appear to be a secondary concern.

This study intends to clarify this relationship such that the balance between safety / space and SSS usage can begin to be quantified. To do so, a survey on the public opinion of e-scooter regulation was conducted and selected SSS companies were contacted with some questions.

Survey

The survey was created on the website *SurveyHero* using a free account. The questions were proposed (see below) and were given ethics approval by the Department of Geography at the University of Canterbury. The survey would use opt-in sampling, meaning that consent would be freely given. It was distributed online using a link posted on a number of *Facebook* groups which either expressed a particular interest in e-scooters, or were geographically based in one of the major cities which has (or will have in the near future) access to SSS, as well as some of the location-based *Reddit* subreddits. The nature of the sampling method meant that responses would most likely be received from those who were passionate about e-scooters, micromobility, or transportation modes in general, and young people who use social media platforms.

The questions posed could be grouped as follows:

1. *Demographics*
    - Which New Zealand e-scooter city do you live in?
    - What suburb do you live in?
    - How old are you?
    - What is your gender?
    - How often do you use an e-scooter sharing service?
    - Which of these travel modes do you use to commute to and from work, study, or other daily activities?
2. *How regulations would affect usage of e-scooters*
    - If safety helmets were mandatory, how would this affect your use of e-scooters?
    - If safety helmets were mandatory and provided, how would this affect your use of e-scooters?
    - If a speed limit of 15 kph was imposed and enforced on e-scooters, how would this affect your use of e-scooters?
    - If e-scooters were not permitted to be ridden on footpaths, how would this affect your use of e-scooters?

- If e-scooters had to park in restricted locations (one or two locations per street), how would this affect your use of e-scooters?
- If e-scooters were consistently distributed each morning a short distance from your home, how would this affect your use of e-scooters?

3. *Comparing different regulations*

    - Would you prefer to wear a helmet and be able to go at faster speeds, not wear a helmet and go no faster than 15km per hour or wear a helmet and go no faster than 20km per hour?
    - If one single safety restriction had to be imposed, would you prefer for a speed limit of 15 kph but you could ride anywhere, or no speed limit but E-Scooters cannot be ridden on footpaths?

4. *Opinion on discount schemes*

    - Some e-scooter sharing service companies overseas have discounted pricing for students, those on lower incomes and/or those who receive benefits from the government. They do this by collecting personal details such as name, official identification, and proof of low-income status. The next two questions relate to similar schemes in NZ.
    - How do you feel about a similar scheme operating in NZ?
    - How do you feel about e-scooter sharing service companies sharing more usage data with the government in order to implement this scheme? (Note: currently some usage data is already being shared.)

The main suite of questions (group 2) link regulation to usage. The expectation is that any added restrictions would decrease usage, whereas the last question on increased reliability would positively correlate with usage. The comparison between different regulations (group 3) could give insight into public preferences, while the final questions on discount schemes (group 4) aim to gauge public approval of differential pricing and willingness to share more data in return for some benefits. The initial collection of demographic data (group 1) permits notable outlying grouped opinions to be detected.

Questions for Companies

Selected SSS companies were also approached with a few questions on their attitude towards equity and safety goals. Table 3 shows the e-scooter companies that are operating in New Zealand in May 2019, of which the first three (Lime, Flamingo, and Wave) were approached. The questions posed to these companies were:

"We were just wanting to know a couple of opinions you have on regulation in regards to:

1. The redistribution of E-scooters around the city after they are charged to encourage usage in areas that don't have as much use as places like the city centre, and do you think it would be beneficial to increase usage in these areas?
2. A discounting scheme for either students or low income users.
3. Enforcing regulations around wearing helmets, reducing the speed, and the use on footpaths."

The purpose of these questions were to identify differences in opinions between companies and the public, which may highlight the areas of tension between regulators and operators. The expectation is that SSS companies would be against increased regulation, though they may be inclined to offer discount schemes for low income brackets, something which is currently occurring overseas (Lime 2019).

Table 3. Companies Operating in New Zealand in May 2019

Company	**Company Headquarters**	**NZ Cities of Operation**	**NZ National Fleet Size**
Lime	San Francisco	Auckland, Hutt City, Christchurch, Dunedin	2850
Flamingo	Wellington	Auckland, Wellington, Christchurch	1225
Wave	Auckland	Auckland	400
Jump	New York	Wellington	400
Beam	Singapore	Christchurch	300
Blip	New Plymouth	New Plymouth	50

RESULTS

Survey

230 people responded to the survey. The results of the survey are presented in Table 4 and use the following clustering groups based on concepts from a segmentation study by Degele et al. (2018):

- *Frequent Users* - uses SSS 3+ times per week.
- *Casual Users* - have used SSS at least once, but no more than 2 times per week.
- *Non-Users* - have never used an SSS.

Casual Users are further classified as *older* (36 years or older) and *younger* (35 years or younger). In this table, orange highlights represents a negative impact on SSS use and green a positive impact, while yellow is used for the two preference questions. The depth of colour relates the the proportion. Note also that the *'would ride less/more'* questions also have a *'no effect'* option, which is not included here (thus the responses will not add to 100%).

Table 4. Survey Results

	Frequent Users	**Casual Users (Older)**	**Casual Users (Younger)**	**Non-Users**
Demographics				
(# of respondents)	12	12	139	67
(% of respondents)	5.2%	5.2%	60.4%	29.1%
Mandatory Helmets			*(average score w/ range -100 to 100)*	
	-72	-45	-62	-15
Mandatory Helmets - provided			*(average score w/ range -100 to 100)*	
	-48	-31	-7	17
Mandatory Helmets - provided			*(grouped into ride less / no effect / ride more)*	
(would ride less)	75%	50%	38%	13%
(would ride more)	16%	8%	25%	48%
Speed Limit				
(would ride less)	66%	25%	48%	16%
(would ride more)	0%	0%	2%	21%

	Frequent Users	Casual Users (Older)	Casual Users (Younger)	Non-Users
Ban on Riding on Footpaths				
(would ride less)	83%	50%	60%	48%
(would ride more)	0%	8%	1%	9%
Specified Parking Locations				
(would ride less)	75%	50%	57%	24%
(would ride more)	0%	0%	1%	9%
Better Distribution near you each day				
(would ride less)	16%	0%	0%	6%
(would ride more)	67%	67%	68%	45%
Mandatory Helmets vs Speed Limit				
(prefer helmet)	42%	33%	54%	31%
(prefer limit)	50%	50%	37%	30%
(both)	0% *	17%	8%	39%
* Note that 8% of Frequent Users opted not to provide a response to this question.				
Ban on Riding on Footpaths vs Speed Limit				
(prefer ban)	42%	25%	40%	43%
(prefer limit)	58%	75%	60%	57%
Opinion of Discount Scheme				
(in support)	75%	42%	86%	70%
Providing More Trip Data			*(average score w/ range 0 to 100)*	
	49	48	65	61

The following figures provide a visual representation of the results from all respondents where the answers were given on a scale. Figure 1 shows the distribution of responses to the two questions related to mandatory safety helmet requirements. Additionally, a number of comments covering a number of regulatory issues were received from respondents. A selection of these are presented in Appendix I.

Responses from Companies

Of the companies which were approached, only Lime and Flamingo responded. Their full written responses can be found in Appendix II.

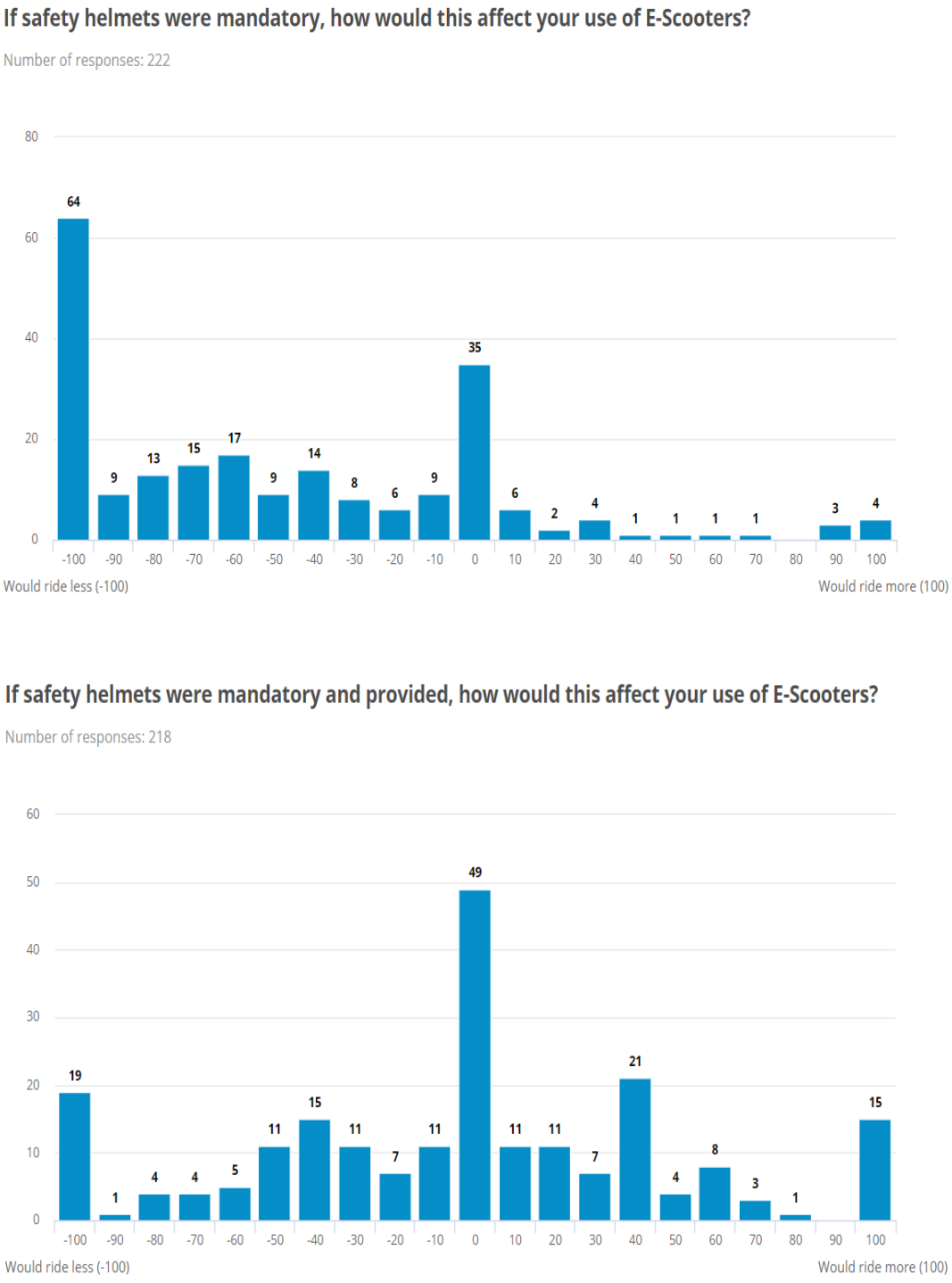

Fig. 1. Histogram of responses to questions regarding mandatory safety helmets.

DISCUSSION

Impact of User Regulations on SSS Usage

Firstly, a note on the provision of helmets in conjunction with helmet regulation. Figure 1 demonstrates how the spread of opinion changes from strongly negative to relative balance when operators provide users with helmets. Clearly, for helmet regulation to succeed, operator-provided helmets must be included. The remainder of this discussion will therefore focus on this version of the helmet regulation.

Regulations about vehicle use are likely to have a negative impact on ridership. Figure 2 shows the overall distribution of responses to the four user-related regulations - that is, mandatory helmet, speed limit, ban on riding on footpaths, and restricted parking locations. Note that the footpath-riding ban was seen to be the most detrimental to SSS usage, while mandatory helmets generated relatively balanced responses.

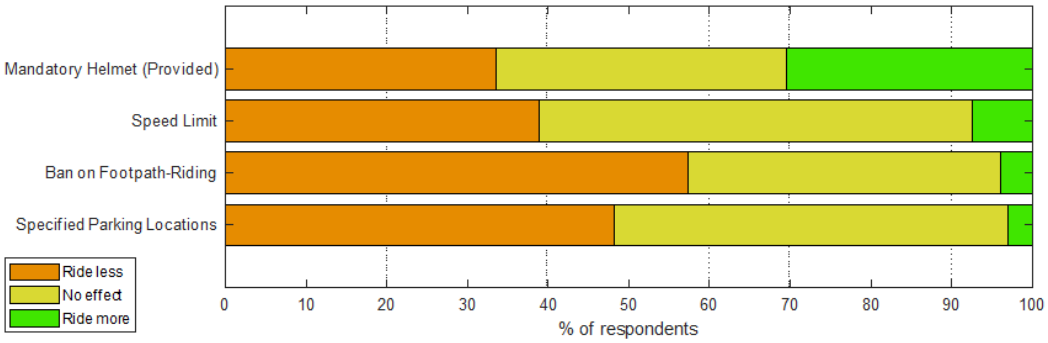

Fig. 2. Effect of general safety regulations on SSS ridership.

To understand the differences in responses to the proposed regulations, user demographics, laid out in Table 4, should be considered. From the table it can be seen that a footpath-riding ban is consistently viewed negatively across all user groups. Furthermore, Frequent Users consistently indicate that any regulation would have a negative effect on their usage of SSS, though this may be a result of the small sample size.

Specified, or restricted, parking locations are unpopular among Frequent Users, which may be surprising as reliability should be a key factor in commuting or regular trips (Li et al. 2019). This observation may relate to Marchetti's constant, where individuals have a transit time 'budget' and any delay from having to park the e-scooter some distance away from the intended destination will tip the balance towards alternative travel modes (Marchetti 1994). Restricted parking is also negatively viewed by Casual Users, reflecting BSS research showing that docked stations restrict choice for longer distances and flexible trips (Castillo-Manzano et al. 2016; Li et al. 2019).

The demographic breakdown of helmet regulation is shown in Figure 3. Frequent Users are strongly against helmet regulation, while Older Casual Users also mostly view them

negatively. Interestingly, the split among Younger Casual Users are much more even, and many of Non-Users' responses suggest that they are willing to try out SSS if helmets were made available.

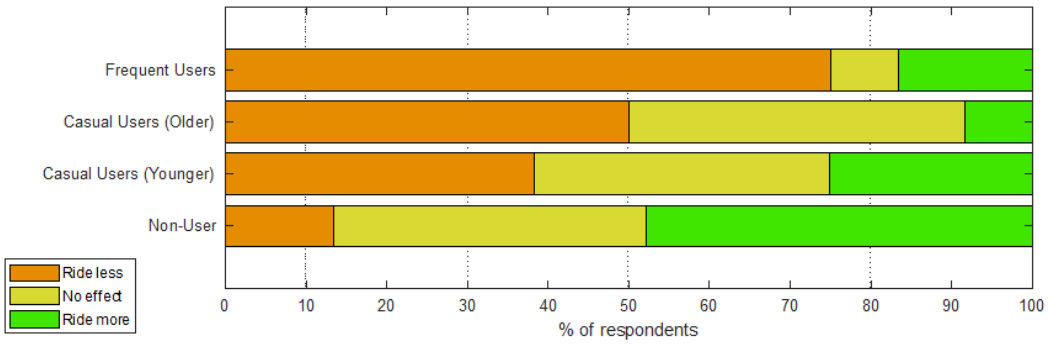

Fig. 3. Effect of helmet regulation on different user groups.

The survey questions setting different regulations against each other produced results that corroborate our initial observations. A choice of a footpath-riding ban versus a speed limit clearly favours the latter, as seen in Figure 4. Notably, among Older Casual Users there is a very strong preference for a speed limit to be imposed over a footpath-riding ban. This may be due to the feeling of relative safety of riding on footpaths instead of next to cars, less reliance on speed (e.g. use for recreational rather than transit), and less thrill-seeking behaviour (more common among the younger population), compared to other groups where top speeds may be more of a concern.

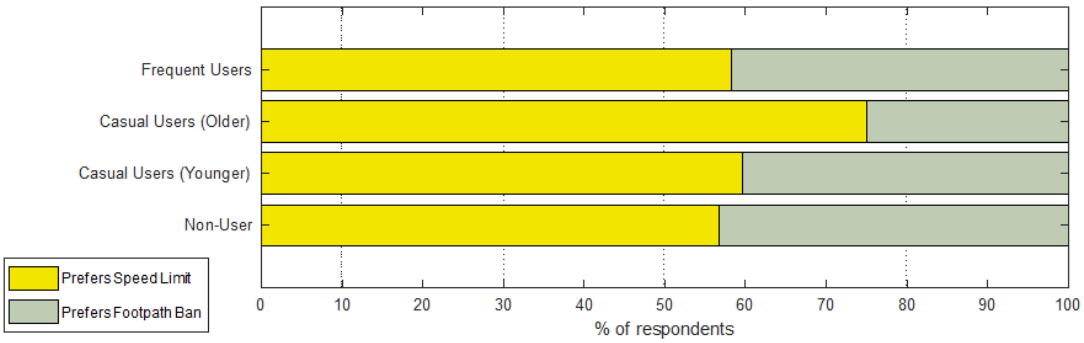

Fig. 4. Choice of speed limit or footpath-riding ban.

The comparison between speed and helmets shown in Figure 5 is a bit more divisive and offers some insight in how the clusters use SSS. Frequent Users are seen to prefer speed limits over helmets, suggesting that top speeds are not as important as the convenience of not carrying a helmet for their daily commute (and also of note is the 8% who were not willing to select any option). In contrast, Younger Casual Users prefer helmets, suggesting that speed is more important to them. This could also be indicative of a cultural shift whereby younger people have grown up around mandatory bicycle

helmets and thus are generally more accepting of helmet use. Also of note is the substantial number of Older Casual Users and Non-Users who prefer both regulations to be implemented simultaneously, once again suggesting that a larger proportion of them view SSS as a recreational activity where neither speed nor inconvenience has a strong effect.

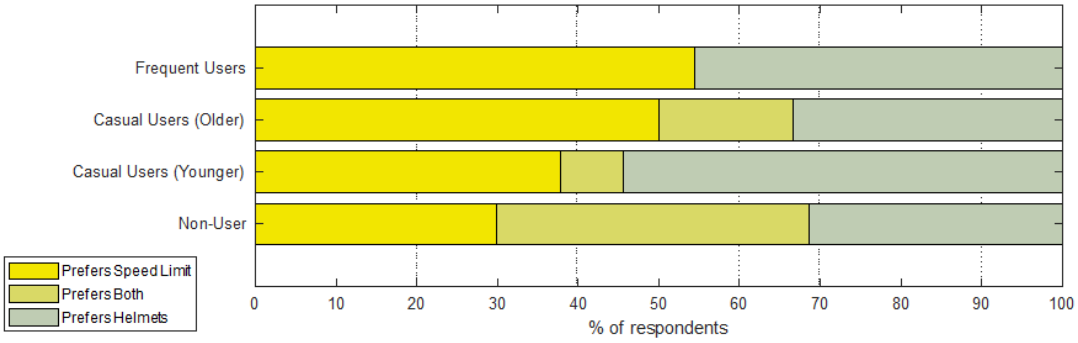

Fig. 5. Choice of mandatory helmet vs speed limit.

Overall, user regulations will have a negative impact on trips by Frequent Users and Younger Casual Users. If SSS revenue is at all similar to that of moped sharing systems, then these are likely to be the two main revenue-generating clusters (Degele et al. 2018). While neither Flamingo nor Lime spoke out against user regulations (see Appendix II), they are likely to lobby against them should they be proposed. National and local governments should also be mindful that imposing such regulations may cause these businesses to collapse or withdraw from the market. Additionally, these regulations will be difficult and expensive to police and enforce.

Impact of Operator Regulations on SSS Usage

A 'better' distribution of e-scooters (i.e. that is more convenient and reliable for users) is unsurprisingly well-supported and likely to increase usage across the board, as shown in Figure 6. While both SSS companies who provided responses (see Appendix II) were clear that they preferred demand-driven rebalancing, it is noteworthy that Non-Users also indicated an inclination to try out SSS if they were more readily available, though they are noticeably less convinced than the other groups. This indicates two things: (a) there is some potential for a widening of the customer base if e-scooters are strategically located, and (b) there may yet be an underlying reason why Non-Users are not predisposed to e-scooters. One possibility would be that Non-Users may reside in areas where e-scooters are not a good replacement for cars, due to the fact that e-scooters tend to be used for shorter trips (Schellong et al. 2019).

Figure 7 shows that discount schemes for lower-income groups are also well supported by respondents, except those in the Older Casuals group. Flamingo is already on board with a student discount, whereas Lime's representative preferred demand-driven discounts (which may not have the social benefits discussed above).

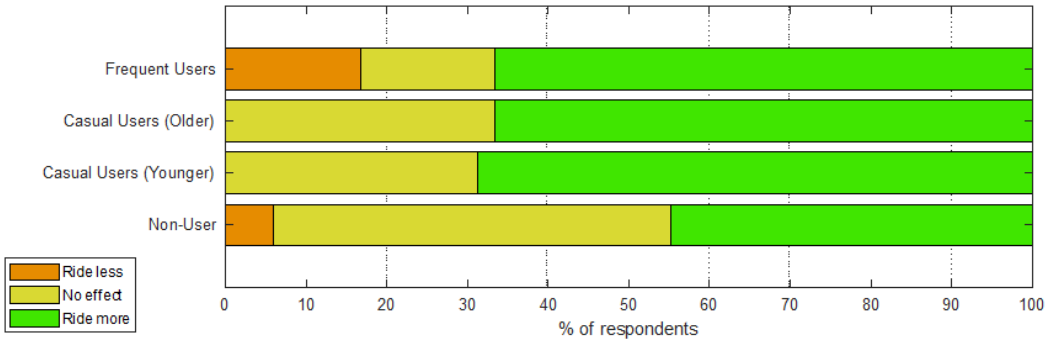

Fig. 6. Effect of better e-scooter distribution on different user groups.

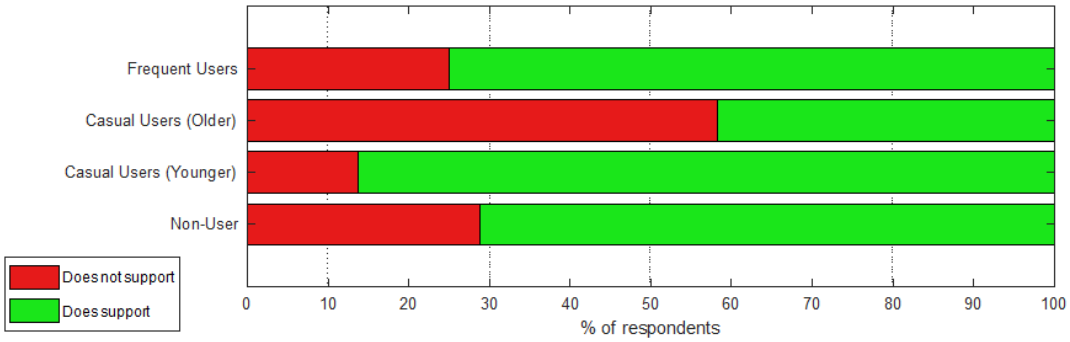

Fig. 7. Support of discount scheme by different user groups.

A 'better' distribution and an income-based discount scheme would likely be welcomed by all groups. The difficulty lies in the fact that an equitable distribution of vehicles desired by local governments may not be equivalent to current business practice. Areas where alternative transport modes are needed (i.e. *transport disadvantaged*) are perhaps areas with mostly Non-Users, which are would fall outside operators' preference for demand-driven levels of service.

So why regulate at all? From survey comments (see Appendix I), it would appear that Non-Users have strong opinions against certain aspects of SSS: footpath riding (the key issue for other groups) and a general lack of safety regulations. They are likely to be underrepresented in this study and are likely to be a large proportion of the general population, and at some point in the future there may be political pressure to implement some sort of regulatory framework. In this instance, survey data suggests that if any regulation had to be imposed, then operator-provided mandatory helmets may be the most widely accepted by the general public.

The concern of SSS companies about regulation requiring equitable distribution is understandable, as over-provision of vehicles in low-demand areas will clearly lead to under-utilisation. Nonetheless, governments should consider the potential for social and

transport equity outcomes that innovative micromobility modes may provide and invest accordingly. Partly because the uniqueness of SSS may open up previously unobtainable goals, but also because the positive aspects of SSS are unlikely to be realised without government intervention. Without benefits to the public and the community, SSS may become just a way for corporations to increase urban penetration and privatisation of public space (Médard de Chardon 2019).

Along with income-bracket discounts, it may be worthwhile also considering transfer discounts as a way to encourage SSS use, particularly in areas experiencing transport disadvantage (Li et al. 2019). E-scooters are great for first- and last- mile considerations, and while they may not be an optimal choice for a single-mode journey in transport-disadvantaged areas, they may be more attractive in a multi-mode journey in conjunction with public transport hubs. Together with a more even distribution across underserved areas, there is a lot of potential for environmental benefits to be realised.

There are some non-regulatory options. Both companies indicated their preference for education and awareness campaigns, though neither explicitly spoke out against safety regulations. Finally, the best determinant of BSS success is infrastructure spending and the same is likely to be true for SSS (Médard de Chardon et al. 2017; Médard de Chardon 2019).

Limitations of Study

One of the main drawbacks of a study on SSS has been the lack of published data to reference and compare these results to. The assumption that BSS and moped sharing systems have enough similarity to SSS in terms of public experience, public opinion, and customer segmentation, was useful but it must be acknowledged that this assumption has not been tested or proven.

Regulation of SSS has been acknowledged as a future problem for city councils and local governments, but there is no systematic approach and thus the scope of this study was limited to commonly-accepted regulations. It is possible for a more innovative regulatory framework to exist which is not covered in this paper.

The survey was conducted using opt-in sampling, meaning that the respondents of the survey may not accurately represent the population. It is likely that Non-Users as a group are underrepresented in this survey (i.e. the idea of a *silent majority* who tend not to respond to surveys). Also, using a headcount for overall numbers means that Frequent Users are underrepresented in terms of revenue impact. An attempt has been made to separate these clusters based on responses but more work needs to be done in this area.

It is notable that the survey and company responses capture current opinions, while SSS are still new and may have some teething problems. Opinions may change over time as the general public becomes more familiar with the technology.

Finally, opinion surveys based on hypothetical scenarios have a tendency towards response bias (i.e. the responses are idealistic and do not reflect real changes in usage). An attempt has been made to provide both 'positive' and 'negative' regulations to reduce this bias, but particularly with non-users with little to no experience with scooters, it is likely to still be present.

CONCLUSION

E-scooter sharing systems (SSS) have spread across New Zealand's major cities and a survey of public opinion was conducted on how various regulations may affect their usage. Respondents were grouped according to usage and age. Frequent users and casual users responded very negatively to a mandatory helmets, speed limits, footpath-riding bans, and specified parking locations. Non-users responded negatively to footpath-riding bans and specified parking locations, but considered speed limits neutral and mandatory helmets positively. Overall it suggests that a ban on riding on footpaths will reduce SSS usage significantly, while mandatory safety helmets (if provided by operators) may reduce usage by existing customers but may encourage non-users to try them out, hence expanding the customer base.

All respondents were felt positively about having e-scooters located nearby more consistently, though SSS companies recommended sticking to demand-driven rebalancing. Frequent users, younger casual users, and non-users all supported a discount scheme for those on lower incomes, whereas older casual users did not. Together these suggest that there is potential to increase usage if rebalancing/pricing were better suited to an individual's circumstances. However, companies appear generally reluctant for these factors to be regulated.

To achieve stated social, environmental, and transport equity goals, rebalancing requirements and discount schemes may need to be implemented which may not be directly profitable for the company, but cities like Los Angeles has built these policies into their licensing arrangements. There is currently no data which shows how successful such regulations are, and this would be a strong candidate for future research.

There are some indications that first- and last-mile transit discounts (when used in conjunction with a paid public transport trip) are worth testing.

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APPENDIX I. COMMENTS SUBMITTED BY SURVEY RESPONDENTS

Regulation	Cluster	City	Comment
General	Frequent User	Auckland	E-scooters need minimal regulation and councils and public agencies should enable more routes amenable to e-Scooters. Cities that don't cater to e-scooters will become backwaters.
General	Frequent User	Auckland	E-scooter regulations are ludicrous when cars kill 400 people a year.
General	Frequent User	Auckland	As someone who is disabled, these help me in my day to day life, as there's no guaranteed car parking in the city (and expensive) and buses don't get close enough to where you want to go most times.
General	Non-User	Wellington	Personally, I'd probably be too embarrassed and old to be seen riding one in public, but I would love to see regulations hugely favouring riders - the more e-scooters out there, the better!
General	Non-User	Christchurch	I don't currently use them, but I would still like to see more safety regulations implemented. I would be more likely to use them if the companies paid fairer rates and there were stricter regulations surrounding safe usage. I currently boycott them due to concerns about lack of regulation and enforcement.
Helmet	Casual User (Younger)	Christchurch	100% helmets should be mandatory and provided.
Helmet, Speed Limit	Casual User (Younger)	Auckland	I would agree to slow down the speed of e-scooters on busy sections is the right thing to do but having mandatory helmets would be cumbersome to the user.
Helmet, Speed Limit	Casual User (Younger)	Wellington	Definitely think a lower speed limit and supplied helmet is the way to go.
Speed Limit	Casual User (Younger)	Auckland	Reducing the speeds would make them much less attractive and I would barely ever use them.
Speed Limit, Where to Ride	Casual User (Older)	Wellington	They should be allowed in cycle lanes. Special speed limit should only apply on footpath.
Helmet, Where to Ride	Casual User (Younger)	Auckland	Wearing a helmet should be mandatory like on bicycles, and they should be allowed on the footpaths. They would be too dangerous on roads.
Where to Ride	Casual User (Younger)	Auckland	I think they're dangerous on the footpaths and should only be used in bike lanes or roads.
Where to Ride	Casual User (Younger)	Christchurch	They shouldn't be on the roads. It's hard enough watching for cyclists whilst driving.

Where to Ride	Non-User	Auckland	I will never use them, but they need to get off the footpaths entirely, have stronger restrictions keeping children off of them, and increase in tickets given out to dangerous riders
Where to Ride	Non-User	Wellington	Walkers have right of way over e-scooters on footpaths.
Where to Ride	Non-User	Christchurch	Pedestrians in particular would benefit from scooters not being allowed on footpaths.
Personal Data	Casual User (Younger)	Auckland	I would be okay with giving personal details in order to get discounts for using e-scooters if the e-scooter services were publicly owned.
Upkeep	Non-User	Auckland	More penalties for malfunctioning and unsafe scooters.
Infrastructure	Non-User	Auckland	If councils and the government invested more in building proper "cycle" lanes there would be no issues with the use of e-scooters as an excellent form of transport.

Note: Comments in favour of more regulation are highlighted in orange, while those against are highlighted in green. Mixed or neutral comments are in yellow.

APPENDIX II. WRITTEN RESPONSES FROM LIME AND FLAMINGO

Lime:

1. While I agree that widespread supply is good for everyone - in short, I don't think regulation is the best way to achieve this. I believe it should be economically driven through supply and demand. This involves analysis of rider patterns and understanding how we can better meet the needs of the customer at different times of the day. This would see more varied patterns of deployment depending on when the scooter was charged. Regulation in this area would likely lead to poor utilization, which has significant opportunity cost for business.
2. I think there is merit in a discounting scheme, and this is something that we currently do in some markets (and something we continue to experiment with). Again, it would come down to time of day (utilization) rather than general discount. I believe there is scope to utilize riders to "re-balance" scooters around the city. I would prefer "incentive riding" rather than generic discount by demographic as this solves both a social need and a business need.
3. Safety is very important, and there are three things I would encourage from any regulation discussion:

    1. Relativity - Comparison of like data.
    2. A whole of health approach - considering the positive health benefits of riding.
    3. Practicality - A lot of "good ideas" can be very difficult to implement, enforce and mantain.

    I personally think safety is best achieved through education, infrastructure and awareness. Govt led e-scooter campaigns (like we do for roading) would be a great start.

Flamingo:

1. Throughout the day we relocate scooters in low demand areas back into high demand areas. This allows us to create a more reliable service and increase the efficiency of our vehicles.
2. We are constantly reviewing our pricing to ensure our service is affordable for everyone in the community. Flamingo currently offers a Student Plan, which waives the unlock fee on rides taken by students.
3. Safety is Flamingo's top priority. We make a proactive and concerted effort to educate and promote compliance with applicable laws through multiple channels. These channels include our app, our website, our scooter, marketing schemes and information events. We strongly encourage all riders to wear a helmet while riding an electric scooter. We work with local councils and businesses to create low speed and no riding zones. Riding on the footpath comes down to local legislation set out by each council. We encourage riders to use their common sense when making a judgement on where to ride, whether this be on the road or on the footpath.