

**Facilitators and Barriers to Public Bike Share
Adoption and Success in a City with
Compulsory Helmet Legislation: A Mixed-
Methods Approach**

by

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Abstract

Public bike share (PBS) programs offer a flexible and convenient transport option that may also offer public health benefits from increased physical activity. Emerging evidence suggests several factors as important to bike share use, but little data exists from users where bicycle helmets are required. We completed two surveys, one a randomised telephone survey of Vancouver residents (n=901), and the other an observational survey of helmet use amongst cyclists in downtown Vancouver (n=4126). We also conducted a content analysis of print news articles to identify bike share topics and framing (n=62). We found that infrastructure and weather would be the most important considerations to bike share users. Overall, helmet use was high, but varied by personal and trip characteristics. The news media reported bike share topics in line with new policy developments, but framing depended on the media source. These findings suggest that efforts to increase system uptake should target the cycling infrastructure environment.

Keywords: bike share; cycling; helmets; barriers; facilitators; motivators and deterrents

Life is like riding a bicycle.

*To keep your balance
you must keep moving.*

--Albert Einstein

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B-Cycle docking station in Denver, CO., Summer 2013. Author's photo.

Chapter 1. Introduction

1.1. Background

Cycling is a healthy and environmentally conscious form of urban transportation (Cavill, Kahlmeier, Rutter, Racioppi, Oja, 2008; Davis, Valsecchi, & Fergusson, 2007; Hillman, 1993; Johan de Hartog, Boogaard, Nijland, & Hoek, 2010; Rojas-Rueda D, de Nazelle A, Tainio M, Nieuwenhuijsen MJ., 2011). To help improve environmental sustainability, promote public health, and provide a flexible public travel option, over 500 cities in almost 50 countries have adopted public bicycle sharing systems (Midgley, 2011; Shaheen, Martin, Cohen, & Finson, 2012; Shaheen, Guzman, & Zhang, 2010; Fuller, Gauvin, Kestens, Morency, Drouin, 2013; Larsen, 2013). The public bike share (PBS) system is a fleet of shared sit-up bicycles located at docking stations in a dense network within an urban area. Typically, bicycles are accessible to members and casual users for a subscription fee and additional time charges, with most systems offering the first 30 minutes per trip free. In Canada, medium and large-scale bike share programs already exist in Montreal, Toronto and Ottawa. The City of Vancouver is preparing to launch a 1500 bicycle, 125 docking station system in 2015. The launch will be in two phases: an early field test comprising 250 bicycles and 25 stations in a section of Downtown Vancouver during winter, followed by the remaining fleet throughout the Downtown and in surrounding neighbourhoods by spring (City of Vancouver, 2012; Howell, 2012; Webb, 2012a; City of Vancouver, 2013). The PBS system will be available 24-hours per day, 365 days a year and will be owned and operated by Alta Bicycle Share.

The effectiveness of a PBS system is predicated in large part upon the ease and flexibility to make a trip spontaneously (Fishman et al., 2012). Unlike in most other jurisdictions, users of the PBS system in Vancouver will be required to wear helmets, in compliance with provincial all-ages helmet legislation. Only two of the over 500 PBS systems around the world are actively operating in jurisdictions with compulsory helmet

laws. These are the Melbourne bike share in Melbourne, Australia, which launched in June 2010 with 51 stations and 600 bicycles; and the CityCycle system in Brisbane, Australia, launched in October 2010 with 150 stations and 1800 bicycles (PBSC Urban Solutions, 2010). System use in these two Australian bike share programs is about 0.3 to 0.6 trips per bicycle each day (Brisbane Times, 2011; Fishman et al., 2012; Fyfe, 2010; Fishman et al., 2013), far below internationally reported averages of about 3-8 trips per bicycle per day (Fishman, Washington, & Haworth 2013). Much debate has focused on the helmet requirement as the unique system element responsible for the poorer than expected performance of the Australian PBS systems. If this is the case, Vancouver's system is at risk of not succeeding for the same reason. However, as each PBS system and context is different, it is difficult to generalise the importance of the helmet requirement on system use from Australia to the proposed Vancouver system. In fact, bike share user studies coming out of Australia contend that system use is influenced by a number of factors, including: docking station location and spatial density, system operating hours, ease of registration and cost of membership and rental charges, the bicycle-friendliness of street infrastructure, access to bicycle helmets, and weather and topography (Fishman, Washington, & Haworth, 2012). Predicting the influence of the helmet requirement on system use in Vancouver is further complicated by the integration of bike share with rental helmets.

Vancouver's PBS system will have helmet vending machines and return receptacles at each of the 125 bicycle docking stations (Webb, 2012a; City of Vancouver, 2013). Vending machines will carry up to 30 helmets available in two sizes. Helmets may be rented, with a daily rate set to encourage re-use of a single helmet. Vancouver's helmet and bicycle rental process will be financially seamless, with the opportunity to rent a bicycle and helmet within the same transaction (Webb, 2012b; City of Vancouver, 2013). The option to decline helmet rental (and subsequent helmet rental charges) will also be available. At the end of the day's trips, helmets could be returned to any docking station's helmet receptacle. Used helmets would be held for off-site inspection, sanitation and redistribution (Jackson, 2013; City of Vancouver, 2013). The proposed helmet solution will improve access to helmets by varying degrees for different types of users. Casual users (daily or week access) will benefit most from the proximity and seamless payment for a helmet and bicycle. The same will not be true for bike share

members. Annual users with fob access to the bicycle fleet will still need to rent a helmet using a credit card. Compared to the swipe of a fob to access a bicycle, adding a helmet rental will add time and complexity. In addition, because of the daily rental structure, users who rent a helmet will need to keep their helmet if they expect any additional trips that day. The integrated helmet solution is expected to improve the convenience of helmet use, however, shortcomings remain.

We expect Vancouver residents' perceptions of system factors and actual cycling conditions to have an impact on their expected likelihood of system use, prevalence of helmet use, and attitudes toward the program. We used the Reasoned Action Approach (Fishbein & Ajzen, 2010) as the grounding theoretical framework to model how an individual's attitudes and beliefs affect behaviour. A predecessor of the theory of planned behaviour and theory of reasoned action, Fishbein and Ajzen's (2010) conceptual model accounts for three types of beliefs as important determinants of behaviour. These beliefs include the attitude toward the behaviour, perceived normality of performing the behaviour, and perceived control to perform the behaviour. These beliefs will determine one's intention, and this intention, moderated by actual control, is predictive of behaviour. The role of persuasive communications from the news media may also influence and reinforce attitudes about bike share, or the importance of helmets, and subsequently influence the intention to use PBS.

Our understanding of factors important to the decision to use bike share is still emerging, and the evidence from users where bicycle helmets are required is limited. Our study had three aims. First, we sought to determine the factors considered important to the decision to use Vancouver PBS. In Chapter 2, we assess cyclists' attitudes about bike share, their likelihood of use, and the factors they consider important to the decision to use bike share, from a randomised telephone survey of Vancouver residents. Since the compulsory helmet law would apply to bike share users, we also wanted to capture the motivating and deterring rationale for the use (and non-use) of helmets. Second, we undertook an observational survey of helmet use amongst cyclists in downtown Vancouver to establish baseline helmet prevalence in the proposed bike share zone (Chapter 3). These data will help us understand which personal and trip characteristics are associated with helmet use, and will be repeated after program launch. Third, to complement our telephone survey of Vancouver residents, we conducted a content

analysis of print news articles published about Vancouver PBS. In Chapter 4, we characterise the news media presentation of bike share to gain greater understanding of the newsworthiness and framing of bike share topics. Finally, we discuss crosscutting themes and compare individual chapter findings in Chapter 5.

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Chapter 2. Motivators and Deterrents to Use of Public Bike Share

2.1. Background

Vancouver, B.C., is preparing to launch a public bike share (PBS) system. When the system launches, Vancouver will be joining over 500 cities with existing bike share programs. Emerging evidence suggests that bike share and personal bicycle users regard many of the same factors as important to the decision to cycle, such as the negative impact of adverse weather (Gebhart & Noland, 2013). In Metro Vancouver, Winters, Davidson, Kao, & Teschke (2010) assessed and ranked 73 variables on their importance on influencing the decision to cycle. Their study highlights the importance of perceived traffic safety, attractiveness of the route, segregation from motor vehicle traffic and weather on cycling. Cycling frequency appears to influence the importance of some of these factors on use of the bicycle, and we may observe this variation amongst potential bike share users as well. By segmenting the cycling population, we can gain greater insight into the preferences and needs of each user type. This knowledge can be used to strategically target facility and service improvements to realise the greatest gains in system uptake.

There is also evidence that bike share uptake is related to specific aspects of the PBS system. For example, from focus groups with bike share users, Fishman et al. (2012) reported that usage fees, membership options, system registration process, operating hours, helmet access in jurisdictions that require their use, bicycle or docking space availability, proximity to a docking station, and degree of integration with public transit were elements which could impact bike share system use. Participants also spoke to the issue of visibility and normalcy of public bicycle use as important to their decision to first try the system, not unlike personal bicycle use. The concern of personal bicycle theft was a motivator for some to cycle using public bicycles, as was the avoidance of personal bicycle maintenance (Bachand-Marleau, Lee, & El-Geneidy,

2012; Fishman et al., 2012, 2013; Fuller et al., 2011, 2013; Shaheen, Martin, Cohen, & Finson, 2012).

As Vancouver has all-ages helmet legislation in place that will apply to PBS users, we also sought to determine the motivating and deterring factors to helmet use by personal bicycle riders. Existing studies provide some evidence of personal characteristics associated with helmet use. In many North American jurisdictions, women consistently report wearing helmets more frequently than men, while the opposite is true elsewhere, in European countries in particular (Ritter & Vance, 2011; Richard, Thelot, & Beck, 2013). Cyclist age has also consistently been shown to positively correlate with helmet use, where younger cyclists have a lower prevalence of helmet use compared to middle-aged and older adults (Richard et al., 2013). Certain health risk behaviours like smoking tobacco or cannabis, or excessive alcohol consumption have been negatively associated with helmet use (Richard et al., 2013). This finding may indicate that an individual's proclivity to health and safety may be an important motivator to helmet use.

Bike share attracts users from a diversity of travel modes. We sought to understand which factors are important influences on the decision to use bike share. We analysed data from a population-based survey of Vancouver residents to better understand the motivators and deterrents to use of the proposed PBS system in Vancouver, B.C. We also looked at motivators and barriers to helmet use to identify factors that could be relevant to bike share system use.

2.1.1. Research Questions

1. Which factors are considered important to the decision to use a future PBS system by Vancouver residents, and how does the importance of these factors differ between cyclist types?
2. What are the motivators and deterrents to helmet use for current cyclists?

2.1.2. Hypothesis

Null: There is no difference in the importance of factors on the decision to use PBS amongst cyclist types.

Alt: The importance of selected factors on the decision to use PBS will rank differently amongst cyclist types.

2.2. Methods

2.2.1. Data Source and Survey Administration

Our analysis is based on the Vancouver PBS pre-implementation telephone survey. This was a population-based, cross-sectional and randomised telephone survey of Vancouver residents aged ≥ 16 years. The marketing firm Sentis conducted the 41-question survey in September and October 2012. The survey used both land-line (90.2%, $n=810$) and mobile phone (9.8%, $n=88$) random-digit dialling to recruit study participants until sex and age quotas were met. Nine hundred and one Vancouverites completed the survey. Those who indicated cycling in the past 12 months ($n=472/901$) were asked a series of 5-point Likert questions about their attitude toward bike share and likelihood of system use. A score of '3' was considered neutral. Scores of '1' or '2' were considered a negative response, while scores of '4' or '5' were considered positive responses. Respondents who were cyclists and who were not 'very unlikely' to use PBS ($n=298/901$) were asked questions about factors that would influence their decision to use PBS and helmets. Interviewers coded reasons for helmet use into one of seven categories and helmet non-use into one of ten response categories (Appendix II). Responses were weighted to match the sex and age distribution of the Vancouver population.

2.2.2. Definition of Cyclist Types

The survey asked about cycling frequency in the past 12 months, using three annual sub-divisions to better capture the seasonal variability in cycling frequency. The three seasons were: summer (May, June, July and August), winter (November, December, January and February), and spring or fall (March, April, September, and October). We took the mid-point of the frequency response for each season and calculated the annual cycling frequency. We categorised respondents by their frequency of cycling into three cyclist types. We defined regular cyclists as those making 52 or more cycle trips per year (on average cycled at least once weekly). Frequent cyclists

were those individuals making between 12 and 51 cycle trips per year (on average cycled at least once monthly), and occasional cyclists made between 1 and 11 cycle trips per year (on average cycled less than once a month). We considered those who made no cycle trips in the previous 12 months as non-cyclists.

2.2.3. Outcomes

We looked at two analyses; influences on the use of a PBS, and influences on helmet use. All cyclists, aside from those who said they were 'very unlikely' to use the PBS, were asked questions about 6 factors that might influence their use of bike share (Appendix II). Responses to the importance of these six factors ranged from 1- 'not at all important', to 5- 'very important'. We calculated the mean score and p-values by cyclist type. For the analysis of determinants of helmet use, cyclists who indicated 'very unlikely' expected use of Vancouver PBS (n=173) were not included in the analysis. We asked cyclists who were not 'very unlikely' to use PBS if they wore a helmet on the last bicycle trip. Responses to helmet use on the last cycle trip were dichotomous (Yes/No), and we used multivariable logistic regression to calculate odds ratios. Two questions assessed the reasons for helmet use or non-use (Appendix II). Respondents were asked to cite their primary reason for wearing a helmet when they cycle helmeted, with the option to say "I never wear a helmet" if they did not use one. Respondents were then asked to cite the primary reason for cycling unhelmeted, with the option to say "I always wear a helmet" if they always cycle helmeted. We reported helmet use motivators and deterrents as the proportion of respondents citing each reason.

2.2.4. Statistical Analysis

We calculated the mean responses for all cyclists and by cyclist type, and performed a one-way analysis of variance (ANOVA) test to determine statistical significance of between group differences. Finally, we used multivariable logistic regression analysis to assess personal and trip characteristics as predictors of helmet use.

2.3. Results

2.3.1. Influences of Use of PBS

Of a total of 901 participants who completed the study, 52.4% (n=472/901) reported cycling in the past year. Table 2.1 displays demographic characteristics for all respondents and for cyclists. Compared to all respondents, cyclists tended to be male (53% versus 49%), have a post-secondary education (66% versus 60%) and have an annual income of \$50 000 or more (58% versus 52%).

Table 2.1. Demographic Characteristics of all Survey Respondents and Those Indicating Cycling in the Past 12 Months.

	All Respondents	Cyclists
Total Respondents	901 (100)	472 (52.4)
Sex		
Male	437 (48.5)	249 (52.8)
Age (years)		
16-34	309 (34.3)	116 (24.6)
35-54	324 (36.0)	203 (42.9)
55+	268 (29.7)	125 (26.5)
Education		
Primary School	31 (3.5)	14 (3.0)
Secondary School	115 (12.7)	49 (10.4)
Completed University	258 (28.7)	150 (31.9)
Graduate Degree	277 (30.8)	159 (33.7)
Occupational Status		
Student	122 (13.0)	72 (15.2)
Employed	585 (62.3)	340 (72.0)
Retired	105 (11.2)	31 (6.5)
Income		
\$20,000 or less	59 (6.5)	25 (5.2)
\$20,001-\$50,000	168 (18.7)	70 (14.8)
\$50,001-\$100,000	255 (28.3)	138 (29.2)
\$100,001+	213 (23.6)	135 (28.7)

Overall, about two-thirds (62.9%, n=567/901) of respondents were aware of PBS programs. Cycling respondents had higher awareness of bike share (75.1%), with regular riders (85.9%) demonstrating greater awareness of program existence compared to their frequent (70.4%) or occasionally (70.5%) cycling counterparts (p-value=0.015). Overall, respondents felt that a public share program “is a good or very good idea for Vancouver” (mean=3.9). As a group, cyclists were very supportive of the idea of bike share in Vancouver (Figure 2.1), with regular cyclists finding the idea the most

favourable. Differences in the mean score between cyclist types were significant (p -value= 0.004). Also in Figure 2.1 is the proportion of respondents who expected 'likely' or 'very likely' use of the Vancouver bike share program. Only about a quarter of cyclists (28.0%) expected to use the program, and the variation between cyclist types was not significant (p -value=0.201).

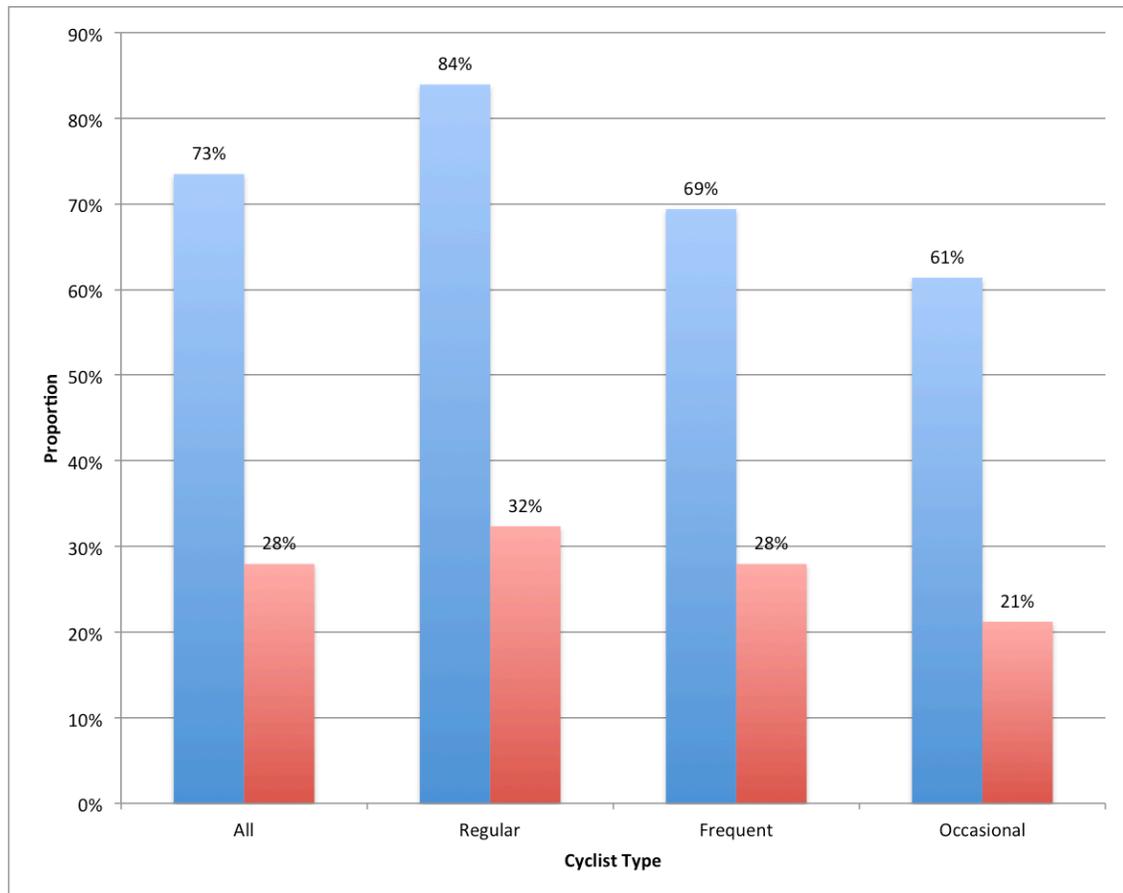


Figure 2.1. Proportion of Respondents Reporting Support for Public Bike Share, in Terms of Attitude Toward and Likelihood of Use

Note: Blue bars represent the proportion of respondents thinking bike share is a 'good' or 'very good' idea for Vancouver. Red bars represent the proportion of respondents 'likely' or 'very likely' to use the Vancouver bike share program.

Respondents were asked to indicate the importance of six factors on their decision to use public bike-share (Table 2.2). Cycling respondents who expected 'very unlikely' future use of the system were not asked these questions. Overall, the three most important factors to influence the decision to use bike share were having a connected network of bicycle routes (mean=4.2), rain or adverse weather (mean=3.7),

and the presence of separated cycle routes (mean=3.7). Three of these six factors varied in importance between the different types of cyclist, with the difference in mean scores largest between regular and occasional cyclists. The fear of injury from crashes and falls, the importance of rain and adverse weather, and the presence of steep hills were less important to regular cyclists (p-values: <0.01, <0.01, and <0.001). B.C.'s law requiring helmet use when riding a bicycle did not rate as highly important, however, the distribution of responses to this question was bi-modal, with peak responses of '1' and '5'.

Table 2.2. Strength of Potential Motivators and Deterrents to use of a Public Bike Share Program, According to Current Cycling Behaviour

Rank	Factors	Cyclist Type (mean response and standard deviation)				p-values
		All (n=298; 100.0%)	Regular (n=132; 44.3%)	Frequent (n=81; 27.2%)	Occasional (n=85; 28.5%)	
1	A connected network of bicycle routes through the city	4.16 (1.13)	4.26 (1.12)	3.92 (1.16)	4.07 (1.10)	0.917
2	Rain and adverse weather	3.73 (1.38)	3.34 (1.44)	3.79 (1.36)	4.10 (1.12)	0.003
3	The presence of separated bicycle lanes along your route	3.65 (1.34)	3.53 (1.41)	3.40 (1.25)	3.90 (1.27)	0.086
4	The law in BC requiring you to wear a helmet when riding a bicycle	3.24 (1.75)	2.99 (1.79)	2.89 (1.74)	3.30 (1.69)	0.265
5	Steep hills along your route	2.91 (1.40)	2.48 (1.39)	2.92 (1.30)	3.34 (1.28)	<0.001
6	The fear of injury from crashes or falls	2.59 (1.50)	2.15 (1.40)	2.25 (1.53)	3.08 (1.48)	0.001

Note: Question: "How important are the following factors to your decision to use public bikeshare."
Weighted mean scores, where 1 = not at all important, 2 = not important, 3 = neutral, 4 = important, and 5 = very important.

2.3.2. Influence on Helmet Use

Respondents were also asked about their helmet use behaviour. Cyclists who indicated 'very unlikely' future use of the system were not asked these questions. On

their last bicycle trip, 79.9% (n=238/298) of respondents reported using a helmet. In multivariable analysis (Table 2.3), helmet use was significantly associated with rider age and cyclist type. Middle aged (35-54 years) and older adults (55 years) were more likely to wear a helmet on their last trip (OR 1.99; CI 1.05-3.88 and OR 3.22; CI 1.12-12.32, respectively), as compared to those aged 16-34. Compared to regular cyclists, frequent and occasional cyclists had lower odds of helmet use (OR 0.56; CI 0.27-1.20 and OR 0.43; CI 0.21-0.87, respectively).

Table 2.3. Results of Multivariable Regression for Reported Cycle Helmet Use

Characteristic	Helmeted/Total (%)	Unadjusted OR (95% C.I.)	Adjusted* OR (95% C.I.)
All Cyclists	238/298 (79.9)		
Sex			
Male	117/153 (76.5)	Ref	Ref
Female	124/145 (85.5)	1.10 (0.62, 1.96)	1.03 (0.57, 1.87)
Age (years)			
16-34	106/143 (74.1)	Ref	Ref
35-54	101/119 (84.9)	2.04 (1.10, 3.92)	1.99 (1.05, 3.88)
55+	32/35 (91.4)	3.07 (1.08, 11.64)	3.22 (1.12, 12.32)
Cyclist Type			
Regular (52+ trips/yr.)	113/131 (86.3)	Ref	Ref
Frequent (12-51 trips/yr.)	65/81 (80.2)	0.63 (0.30, 1.32)	0.56 (0.27, 1.20)
Occasional (1-11 trips/yr.)	62/85 (72.9)	0.42 (0.21, 0.84)	0.43 (0.21, 0.87)

*Note: C.I. = Confidence Interval; OR= odds ratio. Adjusted odds ratios are controlled for sex, age and cyclist type.

Respondents provided open-ended responses as to why they did and did not wear a helmet. The vast majority of respondents wore a helmet because “It protects my head” (78.5%, n=235/298). One in nine were motivated to helmet use because “It’s the law” and “I fear a ticket” (11.0%, n=33/298). Only two per cent (n=6/298) reported they never use a helmet. Despite the high prevalence of helmet use on the last trip, a majority of respondents did not always use a helmet when they cycled (57.0%, n=170/298). For these respondents, the most frequent reason for not wearing a helmet was a lack of “convenience” or “I didn’t have a helmet with me at the time” (31.2%, n=63/170). There

was also dislike of wearing helmets because they were “uncomfortable” or they “make my head sweaty” or “I enjoy the feeling of sun or wind in my hair” (23.5%, n=40/170). Helmets were also not regarded as necessary for certain cycle trips because “I ride my bike safely and slowly” or “the risk of getting involved in an accident is so low” (17.6%, n=30/170).

2.4. Discussion

2.4.1. Summary and Support of Findings

Public bike share is not currently in place in Vancouver, BC. Using data from a random telephone survey of Vancouver residents, we investigated awareness of and attitudes toward bike share, likelihood of intended use, and the factors important to prospective users, stratified by their frequency of cycling. We also queried cyclists on their motivations for wearing a helmet and the barriers that prevented helmet use. This study contributes to the literature by capturing motivators and deterrents to use of PBS for a population subjected to compulsory helmet legislation.

A previous analysis of this survey reported that almost two-thirds of respondents were aware of bike share systems, and nearly seven in ten were supportive of a system in Vancouver (Vander Wekken, 2013). We found that respondents who were cyclists demonstrated an even higher awareness and support for introducing bike share in Vancouver. System awareness and support were positively correlated to cycling frequency. While support was strong, cyclists did not anticipate a high likelihood of system use, and there was no significant difference amongst cyclist types. The favourable support for bike share and low expected personal use may be due to regarding bike share as a positive civic amenity, but not of direct individual benefit, particularly for those who already use a personal bicycle. Since expected likelihood of use was low, understanding the factors important to bike share use may offer a way to reduce perceived barriers and increase system uptake.

The most important influence on the likelihood of using bike share was the presence of a connected network of cycle paths and separated facilities on higher motor traffic corridors. The importance of this factor on the public bicycle trip was steady

across cyclist types. This result is consistent with the literature on personal bicycle riders, which highlight the importance of high quality cycling infrastructure that provides direct, comfortable and safe routes of travel (Winters & Teschke, 2010). Rain and adverse weather was also a highly rated consideration on whether bike share would be used, especially for individuals who cycle less frequently. The importance of rain or adverse weather is well documented, and appears consistent for personal or public bicycle use (Winters et al., 2010). Rain may be a less important consideration for regular riders because of the ownership of rain gear, a necessity for long-term regular cycling (Teschke et al., 2012). The presence of steep hills along one's route showed the same pattern of increasing importance for cyclists who make fewer annual trips, but overall, this cycling condition did not rate as important as the other factors.

Vancouver has an all-ages helmet law, and 4 out of 5 cyclists in this study reported that they wore a helmet on their last trip. This prevalence of reported helmet use is consistent with other Canadian cities with compulsory helmet legislation (Macpherson & Spinks, 2008; Karkhaneh, Rowe, Saunders, Voaklander, Hagel, 2011). The helmet requirement was the fourth-highest ranked consideration on using bike share (out of six factors), after a coherent network of bicycle routes, separated facilities, and rain or bad weather. The polarised responses to the helmet law question resulted in a near neutral mean score, where about equal proportions found the helmet requirement to be 'not at all important' and 'very important'. The most cited reason for cycling unhelmeted was not having a helmet at the time of the trip. In terms of implications for PBS, for bike share users to have a prevalence of helmet use similar to personal bicycle riders, helmets will need to be a convenient option.

2.4.2. Strengths and Limitations

A strength of this study is the use of a dual frame (landline and mobile telephone) random digit dialling design and large sample size. A limitation of this and other public opinion research that uses telephone surveys is the trend away from household landlines and toward mobile phone use, particularly amongst youth, males, those living in smaller households, and lower income individuals (Phoenix Strategic Perspectives Inc., 2012). The proportion of mobile phone respondents was just under 10%, which may have underestimated the actual population of mobile phone only users in Vancouver.

Weighting was not applied to correct for the underrepresentation; however, weighting by demographics may have helped to improve representativeness by limiting the extent of non-coverage bias. It remains unclear how the attitudes, opinions and behaviours of mobile phone only respondents differ from landline respondents in ways relevant to bike share.

To minimise respondent burden and increase participation rates, the survey collected only minimal data from those who reported being 'very unlikely' to use a bike share system. Unfortunately, this meant that 173 cyclists were not asked questions about helmet motivators, deterrents, and use. Compared to all cyclists who were asked these questions, the excluded cyclists were older (39.3% compared with 26.3% aged 55+ years). Given that age is associated with helmet use, the exclusion of these older cyclists may have resulted in an underestimate of helmet use. The use of questions with closed ended response categories may have limited factors that could otherwise be captured in alternative methods, such as the interview or focus group. Questions pertaining to helmet use motivators and deterrents were semi-open (Appendix II), which allowed us to capture reasons not developed a priori. Despite these limitations, our findings reflect the opinions of different groups of Vancouverites who cycle, including some typically underrepresented in cycling research, such as women and older adults.

2.4.3. Conclusions and Policy Implications

Cyclists are largely aware of bike share and supportive of its adoption in Vancouver. The most important influence on PBS use will be having a connected network of separate cycling routes. This finding is consistent with studies from personal bicycle riders. Fortunately, the provision of quality bicycle infrastructure is a factor amenable to intervention and improvement that will support all types of cyclists.

Reported helmet use is high, and increases with regular cycling. A small majority of respondents forgo helmet use for at least some of their trips, with convenience and lack of helmet availability the primary reasons. These findings highlight the importance of having helmets readily available at the point of bicycle rental if a high prevalence of helmet use amongst bike share users is desired.

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Chapter 3. Helmet Observations

3.1. Background

The global rise of bike sharing systems in Europe, North America, and Asia has increased urban bicycle use (Parks et al., 2013). Emerging evidence from cities with bike share programs demonstrates that public bicycle users wear helmets less frequently than riders of personal bicycles. Studies conducted in Toronto, Boston, New York, and Washington report the prevalence of helmet use was about 20% of public bicycle riders, compared to closer to 50% of personal bicycle riders (Bonyun, Camden, Macarthur, & Howard, 2012; Fischer et al., 2012; Kraemer, Roffenbender, & Anderko, 2012; Basch et al., 2014). In Montreal, the prevalence of helmet use amongst BIXI users (the public bike share [PBS] system) was even lower, at 12% (Grenier et al., 2013). The emerging evidence to date suggests that low prevalence of helmet use amongst PBS users arises from the spontaneous nature of public bicycle use, and the fact that few bike share systems have readily available helmet rental options (Bonyun, Camden, Macarthur, & Howard, 2012; Fischer et al., 2012; Kraemer, Roffenbender, & Anderko, 2012; Fishman, Washington, & Haworth, 2012, 2013; Page, Macpherson, Middaugh-Bonney, & Tator, 2012; Grenier et al., 2013; Basch et al., 2014).

Helmet use prevalence also varies by personal and trip characteristics. Page et al. (2012) conducted helmet observations in Toronto during weekday mornings and found that commuter travel was associated with higher helmet use, while weekend recreational trips had lower helmet use. Grenier et al. (2013) recorded cycling location as an independent predictor of helmet use. Compared to commuter routes, cyclists on residential routes, isolated bike paths and park paths had higher odds of helmet use. A fifth area labelled “tourist area” had significantly lower odds of helmet use, but the authors did not describe the infrastructure at this site. The studies also collected data on cyclist sex. Helmet prevalence by cyclist sex had conflicting findings across jurisdictions. Helmet use was more prevalent for males versus females in New York (Basch et al.,

2014), but less prevalent in Washington, Toronto, Montreal, and Vancouver (Bonyun et al., 2012; Fischer et al., 2012; Kraemer et al., Teschke et al., 2012a; Grenier et al., 2013).

Helmet use prevalence is high for personal bicycle riders in cities with compulsory helmet legislation (Macpherson & Spinks, 2008; Karkhaneh et al., 2006, 2011). British Columbia introduced helmet legislation in 1996, and three years later, an observational survey of cyclists across the province reported adult helmet use prevalence was 70% (Foss & Beriness, 2000). Similarly, Nova Scotia introduced all-ages legislation in 1997, and an observational study found that pre-legislation helmet use prevalence (38%) in Halifax doubled to 75% in the year the law was introduced. In Australia, cyclists' helmet use has been compulsory for the country since 1991. The prevalence of helmet use amongst adult bicycle riders in metropolitan Melbourne the year after the law was introduced was 92% for commuters and 80% for recreational riders (Cameron, Vulcan, Finch, et al., 1994).

Helmet use prevalence for personal bicycle riders in cities without legislation is lower. In Toronto, about half of cyclists were observed wearing helmets (Bonyun et al., 2012; Page, Macpherson, Middaugh-Bonney, & Tator, 2012); similar results were seen in Boston (Fischer et al., 2012) and New York (Basch et al., 2014). Findings are very site dependent though; for example, two studies from Washington, D.C. report differing results: 39.4% and 69.9% (Fischer et al., 2012; Kraemer et al., 2012). Both studies observed a large number of cyclists in September and October of 2011, so the difference may be related to observation sites, suggesting substantial variability across the city.

Vancouver, B.C. is preparing to launch a PBS system. There have been no recent observational surveys of helmet use in the Vancouver area. This field survey provides baseline data of helmet use prevalence for personal bicycle riders in the bike share system zone, and determines which personal and trip characteristics are associated with helmet use.

3.1.1. Research Question

1. What is the prevalence of helmet use while cycling, and how does this vary across personal and trip characteristics?

3.1.2. Hypothesis

Null: There is no difference in helmet use prevalence between men and women, those travelling during the mid-day or PM peak (afternoon rush hour), weekday or weekend riders, or riders along different cycling infrastructure.

Alt: There is a statistically significant difference in helmet use prevalence between rider sexes, time of day of travel, day of week of travel, and bicycle infrastructure type.

3.2. Methods

3.2.1. Measuring Helmet Use Prevalence

Cycle helmet prevalence can be determined using surveys of self-reported helmet use or from observations in the field. Self-reported helmet use data, such as that available in the Use of Protective Equipment module of the Canadian Community Health Survey (CCHS), enquires about frequency of helmet use. Response categories are 'Always', 'Most of the time', 'Rarely', and 'Never'. A population based helmet prevalence rate is calculated using a respondent's reported frequency of helmet and bicycle use (Dennis, Potter, Ramsay, & Zarychanski, 2010). An alternative method is field observations. Observers collect data on helmet use at different sites and times using a standardised observation protocol (Bonyun et al., 2012; Fischer et al., 2012; Kraemer et al., 2012; Page et al., 2012). Using an observational study method to measure helmet use limits the potential for desirability or recall bias that can be present in self-reported data, although observed helmet use may vary substantially based on observation location and timing.

3.2.2. Observation Protocol

This study assessed the prevalence of helmet use amongst Downtown Vancouver adult cyclists (estimated at 16+ years) by bicycle infrastructure type, between

June and September of 2012. We conducted observations on fair weather weekdays and weekends during the mid-day (11.00-13.00) and PM peak (16.00-18.00) periods. Observers recorded the gender (male or female) and helmet use (yes/no) for all adult cyclists crossing the screen line (screen line runs perpendicular to the street segment). Individuals walking with a bicycle were not counted. Where two or more people were on a single bicycle, such as with tandem bicycles or the addition of a child seat on a single seat bike, only the primary operator was counted. Cyclists who crossed the screen line but were not on the designated infrastructure (such as sidewalk riding) were not counted. Counts were taken for a 30-minute period at each location. A total of 48 observation periods were made, totalling 24 hours of observation.

Cycle Traffic Screening Sites

We selected sites based on two criteria: infrastructure type and cycle traffic volume. We chose three infrastructure types found in Downtown Vancouver: cycle tracks, bicycle lanes, and off-street paths (Table 3.1). This required observations at three separate sites. We selected street or path segments along the most popular cycling routes to capture the highest traffic volumes. The locations used in the study were:

1. Cycle track: The Dunsmuir Viaduct, 15 metres East of Citadel Parade
2. Bicycle Lane: Burrard St., 5 metres South of Helmcken St.; Richards St. at W Pender St.; Pacific St. at Homer St.
3. Off-Street path: Seaside off-street path, 10 metres East of Carrall St.

Table 3.1. Description of Cycle Infrastructure Route Types

Cycle Track



An on-street bicycle only lane physically separated from motor and pedestrian traffic.

Bicycle Lane



An on-street travel lane reserved for bicycles. Demarcated by a painted line and located next to a car lane and the curb or car parking.

Off-Street Path



An off-street bicycle only or multi-use path. May be separated from or shared with pedestrians, in-line skaters, skateboarders, runners and other active travel modes.

3.2.3. Data Analysis

We calculated the proportion helmeted for the entire sample and across personal and trip factors: sex, infrastructure type, month, day of week, and time of day. We used multivariable logistic regression to calculate odds ratios of helmet use. We conducted data analyses using R version 2.14.1.

3.3. Results

3.3.1. Population Description

The demographic and trip characteristics for the 4146 observed cyclists are presented in Table 3.2. The overall ratio of male to female riders was 1.66:1 or 37.6% female, and this figure varied by infrastructure type.

Table 3.2. Characteristics of Bicycle Riders in Downtown Vancouver, B.C. Observed in 2012

Characteristic	Number (%)
Total Observations	4146
Gender	
Male	2586 (62.4)
Female	1560 (37.6)
Infrastructure Type	
Off-street path	2708 (65.3)
Bicycle Lane	424 (10.2)
Cycle Track	1014 (24.5)
Month	
June	953 (23.0)
July	1164 (28.1)
August	1103 (26.6)
September	926 (22.3)
Day of Week	
Weekday	2097 (50.6)
Weekend	2049 (49.4)
Time of Day	
Mid-Day (11-13.00)	1469 (35.4)
PM-Peak (16-18.00)	2677 (64.6)

3.3.2. Predictors of Helmet Use

Overall, the prevalence of helmet use was 74.9% (n=3105/4146). Table 3.3 shows the unadjusted and adjusted odds ratios for helmet use by personal and trip characteristics. Helmet use was significantly associated with rider sex, infrastructure type, month of travel, and time of day. Women were found to have higher odds of wearing a helmet than men (odds ratio [OR] 1.42; 95% confidence interval [CI] 1.22-1.66). Compared to off-street paths, riders using bicycle lanes or cycle tracks demonstrated higher odds of helmet use (OR 2.07; CI 1.59-2.71 and OR 2.36; CI 1.95-2.87). Riders in August and in the PM-Peak period had lower odds of helmet use

compared to travel in June or mid-day riders (OR 0.78; CI 0.63-0.95 and OR 0.64; CI 0.55-0.75). In the bivariate analysis, travel during the weekend was associated with lower odds of helmet use, however, after accounting for the infrastructure type covariate, the association between helmet use and day of week was no longer significant.

Table 3.3. Odds Ratios for Observed Cycle Helmet Use Amongst Cyclists at Locations in Downtown Vancouver, Summer 2012

Characteristic	Helmeted/Total (%)	Unadjusted OR (95% C.I.)	Adjusted* OR (95% C.I.)
Total Observations	3105/4146 (74.9)	--	--
Sex			
Male	1877/2586 (72.6)	Ref	
Female	1228/1560 (78.7)	1.40 (1.20, 1.61)	1.42 (1.22, 1.66)
Infrastructure Type			
Off-street Path	1899/2708 (70.1)	Ref	Ref
Bicycle Lane	349/424 (82.3)	1.98 (1.52, 2.58)	2.07 (1.59, 2.71)
Cycle Track	857/1014 (84.5)	2.33 (1.92, 2.81)	2.36 (1.95, 2.87)
Month			
June	717/953 (75.2)	Ref	Ref
July	888/1164 (76.3)	1.06 (0.87, 1.29)	0.98 (0.80, 1.21)
August	793/1103 (71.9)	0.84 (0.69, 1.03)	0.78 (0.63, 0.95)
September	707/926 (76.3)	1.06 (0.86, 1.31)	0.90 (0.73, 1.12)
Day of Week			
Weekday	1616/2097 (77.1)	Ref	Ref
Weekend	1489/2049 (72.7)	0.79 (0.69, 0.91)	0.88 (0.76, 1.02)
Time of Day			
Mid-Day (11-13.00)	1167/1469 (79.4)	Ref	Ref
PM-Peak (16-18.00)	1938/2677 (72.4)	0.68 (0.58, 0.79)	0.64 (0.55, 0.75)

Note: C.I. = Confidence Interval; OR= odds ratio. *Adjusted odds ratios are controlled for sex, infrastructure type, month, day of week, and time of day

3.4. Discussion

3.4.1. Summary and Support of Findings

We observed downtown Vancouver cyclists in the summer of 2012 to establish a baseline prevalence of helmet use and basic demographic characteristics of the cycling population before the introduction of a PBS program. We found that helmet use prevalence varied by personal and trip characteristics.

Women had 42% higher odds of helmet use compared to men. The higher helmet use by women cyclists may be due to a greater traffic risk aversion than men (Byrnes, Miller, & Schafer, 1999). The explanation of women's traffic risk aversion causing higher helmet use is consistent with our observation of fewer female cyclists on infrastructure with closer proximity to motor traffic. Our study finding support the conclusion by Garrard, Rose and Lo (2008) that women cyclists prefer routes with greater separation from motor traffic.

Helmet prevalence varied substantially in cyclists across the different infrastructure types. Helmet use was over twice as likely for cyclists travelling along on-street facilities, either in bicycle lanes or along cycle tracks, as compared to cyclists travelling along an off-street multi-use path, away from motor traffic. The similar rates of helmet use between the bicycle lane and cycle track may result from similar perceptions of traffic risk, despite evidence that cycle tracks are the safest facility type (Lusk, Morency, Miranda-Moreno, Willett, & Dennerlein, 2013; Teschke et al., 2012b; Winters et al., 2012). Regular cyclists (those who cycle at least weekly) may also be more likely to cycle on-street (Winters & Teschke, 2010) and are more likely to wear helmets compared to occasional cyclists who prefer to use separated facilities and wear helmets less frequently.

Helmet use does not appear to vary between weekday and weekend travel. We ran stratified models to verify that the association between day and helmet use were consistent across infrastructure types. This was true, except for the bicycle lane that showed a statistically significant lower prevalence of helmet use on weekends (72% compared to 88% on weekdays, p -value <0.001). While significant, the bicycle lane

accounts for about seven per cent of weekend observations, so the impact is not substantial to the overall weekend helmet prevalence. We also observed a 35% higher volume of bicycle traffic on the off-street path on weekend days, which accounted for 76% of all weekend observations. This upshift in off-street path use during the weekend made the bivariate odds ratio between day of week and helmet use appear significantly lower, but the adjusted odds analysis accounts for this shift in infrastructure preference during the weekend. Therefore, weekend travel appears to confound the association between helmet use and infrastructure type, which itself may be a marker for trip type (i.e., utilitarian, recreational, commute). This finding is in contrast to the observational survey of helmet use in Boston that did find a lower odds of helmet use for weekend travel (Fischer et al., 2012), however, the investigators did not include infrastructure or trip type in the regression analysis.

We observed lower odds of helmet use during the PM-peak travel period. We expected higher helmet use during this time as it might include more commuter trips, and higher helmet use during commuting times was observed elsewhere (Basch et al., 2014). This may result from Vancouver commuter cyclists having a lower helmet use prevalence. We also noted decreased helmet use in August, relative to other months. Additional recreational and tourist trips resulting from end of summer holiday travel could be responsible for this finding, as was seen in Montreal (Grenier et al., 2013). Riders may also forgo helmet use in August in response to the discomfort from higher average temperature.

The highest bicycle volumes were seen at the off-street and separated infrastructure locations. Cycle infrastructure separated from motor traffic is more appealing to a broader demographic of travellers (Winters & Teschke, 2010) and can induce a shift in travel from parallel corridors that lack physical separation from motor traffic (Winters, Teschke, Grant, Setton, & Brauer, 2010).

3.4.2. Strengths and Limitations

We were able to look at helmet use by sex, but for a very few cyclists, we had difficulty assigning a gender using the physical markers of hair length and style, facial features, body morphology, and clothing. Since helmet use was less ambiguous, these

observations may present as a gender misclassification. We did not include variables such as ethnicity and age, which were difficult to assign to a moving person at a distance.

We chose to restrict observations to fair-weather days for two reasons. First, our aim was to observe the greatest number of cyclists during each observation session and cycle volumes are higher on days without rain. Second, rain tends to dissuade novice and low frequency riders from cycling more so than regular riders (Winters, Davidson, Kao, Teschke, 2010); restricting observations to fair weather days limited sampling bias.

Observational studies in other cities demonstrate that the location of screen sites is an important factor on helmet use prevalence because of changes to the observed sample or trip type. We aimed to be consistent with screen sites, however, the bicycle lane observation site changed twice, due to very low bicycle volumes (≤ 20 cyclists per hour). The two trial sites were downtown and in close proximity to the final site, so we do not expect helmet use to be systematically different between the three sites. In addition, counts from the alternate trial sites contributed less than ten per cent of the bicycle lane observations. The consistency of screening sites is a key feature of this study design that will allow us to observe helmet use prevalence and cycling population demographic changes over time and after the introduction of a public bicycle sharing program. Our future work will include a sub-study to look at multiple sites for each infrastructure type, but with only one observation period per site.

3.4.3. Conclusions and Policy Implications

We observed the highest helmet use prevalence in female cyclists and for those travelling in on-street cycling facilities (either a bicycle lane or cycle track). The provision of an integrated and connected arterial street network of cycle tracks may help to increase the proportion of female cyclists, the safety of cycling, and the prevalence of helmet use whilst cycling.

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Chapter 4. News Media Content Analysis

4.1. Background

The news media have a long-standing role as both a conduit for information and as an actor that shapes public opinion and policies (Wallack & Dorfman, 1996; Dorfman, 2003; Gebbie, Rosenstock, Hernandez, & Institute of Medicine, 2003). The media's role in shaping health is twofold (Gebbie et al., 2003). The more direct but less influential role is on *individual behaviour* from information delivery. The second and more influential role is its ability to change public policies that alter the *conditions* in which people make decisions that affect their health (Dorfman & Gonzalez, 2011). The news media exert this influence on public policy through agenda setting (making issues visible and a public priority for action), shaping debate (framing how we think about issues), political pressure, and policy advancement (Dorfman & Gonzalez, 2011). An example of a potential health supportive structural change is the introduction of a public bicycle sharing system. As a novel approach to promote active transportation, news reports of potential bike share issues can have a substantial influence on public support and policy maker decisions.

Content analysis is a social research method used to describe and analyse texts to represent their content (Miller & Brewer, 2003). In health sciences, content analysis can be used to understand the media's portrayal of public health issues. In light of the news media's role in influencing public opinion and political behaviour, we conducted a review of print news article content related to the proposed Vancouver public bike share (PBS) system. We sought to identify the media source of bike share reports (who is saying it), and the nature of the report (the 'what' and 'to what extent') (Neuendorf, 2002). The systematic analysis of article frequency, framing (slant or tone that gives salience to a particular interpretation (Entman, 1993), and content (i.e., article topics) should provide a rich description of message content and highlight messaging patterns.

The Vancouver news media's presentation of bike share may feature either internal system factors or external operating conditions. Internal factors may include the number of bicycles, subscription and user costs, or the novel helmet integration strategy, among others. External operating conditions include the physical and social environment in which the system operates. These factors may include the bicycle friendliness of street infrastructure, driving culture, and local weather and topography. The portrayal of bike share may have implications for system approval and later uptake (Chapman, Maher, Savvaidis, 2011). In the pre-approval and community engagement process, news articles can shape public opinion. A public opinion shift away from bike share program support may influence the likelihood of system approval. After system adoption, the frequency and framing of news articles may over or under-represent the influence of a system factor on future success. Ultimately, this has the capacity to negatively impact system use.

There are multiple streams of news media, including newspaper, television, radio, and numerous social media outlets like Youtube, Twitter, and Facebook. The influence of these social media outlets on public opinion has grown in prominence in the last several years, however, social media, by and large, still takes its direction from the mainstream media. Lead stories on blogs are particularly tied to legacy media outlets for content (Pew Research Centre, 2010; Maier, 2010), which suggests that a review of traditional print news media content will provide a highly comprehensive sample of all print news media on bike share. We chose not to use photos or photo captions that accompany news articles, as "visuals in newspapers are not the primary defining feature of what is selected as newsworthy: photos are taken to document, illustrate, and support a news story" (Altheide & Schneider, 2013, p.87).

In preparation for the expected launch of the Vancouver PBS system in summer 2015, this print news article content analysis captures the media's portrayal of bike share during the approval process and before program launch.

4.1.1. Research Questions

1. What system features or operating conditions are reported as bike share facilitators and barriers?

2. In what ways does the media portrayal of facilitators and barriers differ over time, topic, or by media source?

4.1.2. Hypothesis

Q2 Null: The media's portrayal of facilitators and barriers to bike share is consistent across time, topic or media source.

Q2 Alt: The media's portrayal of bike share changes over time, topic or by media source.

4.1.3. Outcomes

The identification and descriptive analysis of the news article sample's general attributes, topics, barriers and facilitators, and overall (author) slant.

4.2. Methods

4.2.1. Timeframe

Articles about Vancouver PBS appear in the database beginning in 2007 until the present day. During this timeframe, we discovered that articles were clustered into three reporting waves, one in each of mid-2012 and 2013, and early 2014. Related civic events and policy developments during each period are discussed below.

June 2012

June is Bike Month in Metro Vancouver. An increase in news related to bicycles was expected during this period. Specific to bike share in Vancouver, May 2012 marked the end period of evaluating the potential proponents (operators) of Vancouver's future system. In June, Vancouver city council received an update on the preferred operator (Alta Bicycle Share), the business model, and procurement process for the future system. In August, Alta agreed to meet conditions of operations and financing before the city would award them the contract to operate the system.

July 2013

In April, a partnership agreement between the City of Vancouver and Alta was negotiated. In May, the second (and final) round of external stakeholder meetings were held. In July, Vancouver city council approved a contract with Alta pending its fulfilment of sponsorship requirements.

January 2014

After ongoing financial troubles and accumulating debt, Bixi, the operator of Montreal's Bixi bike share system, was required to repay its loans to the City of Montreal. Unable to pay its debt, Bixi sought bankruptcy protection. Bixi is Alta's supplier of equipment (bicycles and docking stations), so the financial collapse of Bixi led to a flurry of reports speculating on the implication for the rollout of PBS in Vancouver.

On February 23, 2014, we conducted the search for articles published during these three reporting waves by sampling articles between January 1, 2012 and January 31, 2014. We found no articles about Vancouver PBS published in February 2014.

4.2.2. Database

The article sample was taken from the SFU database of print newspapers, *Canadian Newsstand*. Legacy newspaper publication titles in the database with a distribution in Vancouver include: The Vancouver Sun, The Province, The Globe and Mail, The Vancouver Courier, The National Post, and The West End.

4.2.3. Article Selection (Inclusion & Exclusion Criteria)

An overview of the article selection process is provided in Figure 4.1. We conducted a full text search of English language articles using the following search terms and variants:

1. Vancouver, AND
2. "bike shar*" OR "bike-shar*" OR "bikeshar*" OR "public bike system" OR "public bike?share system" OR "pubic bicycle system"

Our search identified 246 news articles. Publication titles without a distribution in the City of Vancouver were excluded (n=85 articles). The titles excluded were: The Toronto Star, The News, The Richmond News, The Gazette, The Calgary Herald, The North Shore News, The Times Colonist, The Burnaby News Leader, The Edmonton Journal, The North Shore Outlook, The Ottawa Citizen, The Tri City News, The Burnaby Now, The Coquitlam Now, The Golden Star, The Kelowna Capital News, The Kingston Whig-Standard, The Leader Post, The Leader, The Nanaimo News Bulletin, The Record, The Review, The South Delta Leader, The Star Phoenix, The Terrace Standard, The Trail Times, and The Victoria News.

Document types included hard news articles, columns, opinion pieces and editorials. Correspondences (letters to the editor) were excluded (n=18). We restricted articles to the publication years of 2012-2014 (n=46), capturing the three reporting waves discussed in section 4.2.1, and consistent with the announcement of key milestones in Vancouver's bike share program development. We conducted a review of the remaining 97 articles to identify and remove duplicates (same date, author and publication title, but separate entry in the database), and articles that contained the search terms but did not discuss Vancouver PBS (n=35). The final sample comprised 62 articles discussing Vancouver PBS.

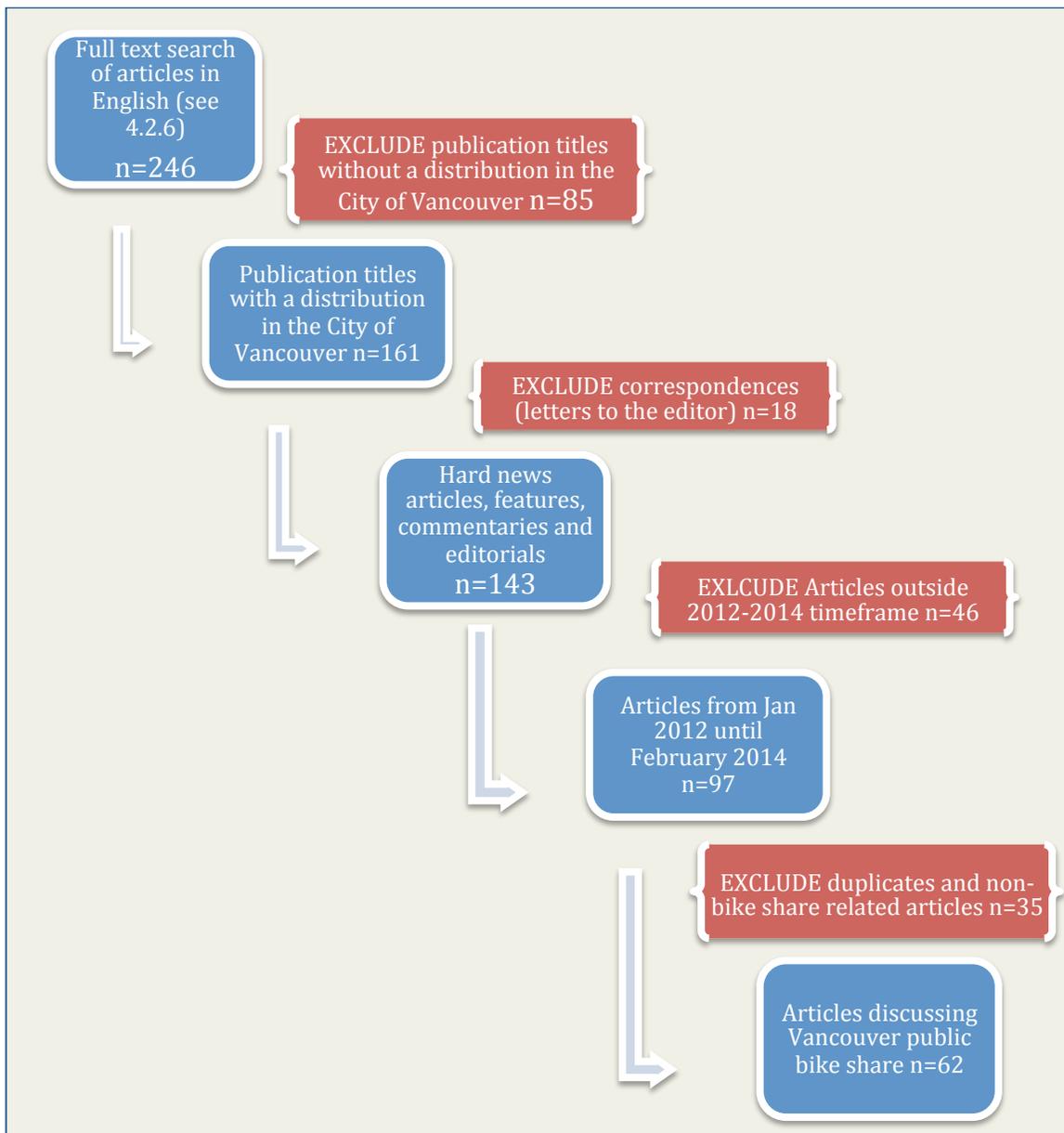


Figure 4.1. Flowchart of Article Inclusion and Exclusion Criteria

4.2.4. Validation of Coding Framework

The coding framework (Appendix IV) was refined using two training sets of articles (n=3 each) taken from media on Montreal’s Bixi bike share program. Two coders independently evaluated the articles of each set, and then met to refine the coding framework and instructions guide. Changes included: two additional article topic categories of social factors and technology; the addition of a ‘neutral or no effect’ barrier

or facilitator code; and a variable for including examples of words or phrases quoted from the article to support the slant coding. Agreement improved between training datasets. The coders analysed a final training set of preliminary articles from the Vancouver PBS dataset (n=5). Definitions of variables and coding guidelines were finalised before the Vancouver PBS sample was analysed.

4.2.5. Article Coding

Two coders evaluated all articles independently. The coders compared the values applied to the attributes of *article topic*, *barrier/facilitator*, *management strategy*, and *opinion slant*. The coders identified discordant values for each variable, and in cases where this occurred, they reviewed the article and agreed upon a single value for each variable. The original codes were preserved for later calculation of an inter-coder reliability coefficient (discussed in section 4.2.6). Each coding variable is discussed below.

Bike Share Focus

We assigned articles into one of two categories based on the proportion of the article devoted to discussion of Vancouver bike share. Articles that contained at least 50% bike share content were categorised as having a *primary* bike share focus. Articles with less than half of content devoted to bike share were regarded as having a *secondary* bike share focus.

Article Topic(s)

The twelve topic codes presented in Table 4.1 were chosen based on the bike share literature, Bixi article tests, and training datasets. These 12 topic codes were developed to represent the variability in media article subjects. Topic codes were assigned to articles by answering the question, “What makes the issue news today?” An article could receive more than one topic code if it presented and discussed more than one topic.

Table 4.1. Article Topics and Descriptions

Topic 1	Docking station location, number or density, and integration with other modes	Placement of docking stations, number of bicycles and stations, density of stations, transit integration
Topic 2	System registration and hours of operation	System sign up process and system operating hours/days per year or seasonal availability characterising system accessibility
Topic 3	Bicycle access charges and user fees	Access and hourly charges, membership options, fobs, credit card/debit payment options
Topic 4	Integrated helmet rental	Helmet rentals, return receptacles, and all related issues of costs and logistics to users and the operator
Topic 5	Provincial compulsory helmet law	Provincial requirement to wear helmets while cycling
Topic 6	Cycling conditions [non-weather, non-topography]	Road conditions, safety, infrastructure (road/bicycle), influence of other road users
Topic 7	Weather	Rain, wind, snow, temperature, sun, heat
Topic 8	Topography	Hills, elevation
Topic 9	Individual socio-demographics	Factors relating to the population of potential riders
Topic 10	Finances and operations	Monetary costs of the system, business plan, debt, who pays, and system operators/financers/sponsors
Topic 11	Technology	Changes to system access and user information: websites, smartphones, mobile apps, docking station user interfaces, social media
Topic 12	Social Factors	State of progressivity in thinking and city planning, trendsetting, green image/vision (environmentalism), public popularity

Barrier or Facilitator

We coded each article topic into one of three categories based on our interpretation of the topic's impact to bike share adoption or future success in Vancouver (Appendix IV):

Facilitators were topics that conveyed positive system attributes or effects that would arise from implementing a bike share system. Topics that were viewed as supporting system use, viability, and continued operations were classified as facilitators.

Barriers were topics that conveyed negative system attributes or effects that would arise from implementing a bike share system, and were seen as reasons against system

adoption. Topics that were presented as likely to lead to poor system uptake, viability or sustainable operations were categorised as barriers.

Negligible/unclear topics did not present as having a supportive or deterrent role to bike share adoption or future success, or had an impact on system adoption or operations that could not be predicted.

Management Strategy

The management strategy variable was used to indicate if the author included a barrier management strategy when a topic was presented as a barrier. The reported management strategy would directly redress the barrier and includes systemic or short-term changes that either serve to maintain system operations or aid system adoption. Articles assigned a 'negligible/unclear' barrier or 'facilitator' code are distinct from articles that the author presented as a 'barrier' to system adoption or operations and were accompanied by a management strategy (Appendix IV).

Opinion Slant

The opinion slant code was assigned to each article based on the author's presentation of information or use of language, figures of speech, and tone of writing. The code represents the reader's overall impression of the author's opinion toward Vancouver PBS. One of three codes was used to denote article slant: *positive*, *balanced*, or *negative* (Table 4.2). In addition, coders quoted key positive or negative words and phrases that supported the slant code assignment.

Table 4.2 Definition of Author Opinion Slant Codes

1-Positive (for bike share adoption or success)	Language and tone are consistently supportive of the future system and/or its users. Emotionally based arguments may dominate over fact based statements that are designed to contextualize/minimize system problems or challenges, while promoting system features, benefits to users, or the merits of the system. Quotes may present opinions in support of the system or hopeful in overcoming barriers and challenges. There is a sense of optimism of the positive impacts of introducing bike share, even if challenges or questions about system viability remain.
2-Balanced (impact on bike share adoption or success)	Article presents benefits, challenges, and impacts of the future system that are fact based. Author's criticisms are contextualized and measured using non-inflammatory language. Presentation of facts, quotes and opinions are mostly balanced and does not favour one side in prominence (length of discussion or placement in article).
3-Negative (for bike share adoption or success)	Article presents event(s) as major system barriers that threaten the approval, launch or success of system operation or continued viability. Language and tone are consistently critical, mocking, unsupportive or dismissive of the future system or its users. Emotionally based arguments that are designed to incite anger, frustration, or contempt dominate over fact based statements.

Vignette

Vignettes are brief descriptions or stories that are illustrative of themes or highlight key issues. Coders recorded examples of illustrative article vignettes as part of the article coding process.

4.2.6. Measuring Inter-rater Reliability

To assess the concordance of variable assignments between coders during their first, independent pass at coding, we calculated a Cohen's kappa statistic. Cohen's kappa is an appropriate measure of concordance for two raters and nominal data (data without a natural order) (Cohen & Jacob, 1960). Krippendorff's alpha is also a suitable statistic, however, the alpha coefficient reduces to a form resembling Cohen's kappa in cases of nominal data with two coders (Cohen, Jacob, 1960). The added statistical complexity that benefits cases of ordinal, interval or other level of data measurement, and multiple coders (more than two), are not required here. Kappa values fall between zero and one. Complete disagreement between coders would receive a zero score, and perfect agreement would achieve a value of one. We calculated coefficients by compiling a matrix of possible values for a variable, using a separate axis for each coder. The

frequency of code response pairs (i.e., opinion slant codes of 1,1=13; 1,2=7; 1,3=0) was used to populate the matrix.

We assessed inter-rater reliability (IRR) using the variable of *author opinion slant*. There was a high degree of agreement between the coders, where 85.5% of variable code assignments were in concordance. We calculated a Cohen's Kappa coefficient of 0.74. The statistic's magnitude guidelines suggest that a coefficient of 0.74 indicates substantial or excellent agreement and a high degree of inter-rater reliability (Viera & Garrett, 2005). Regardless, the two coders discussed and reconciled all cases with discrepancies.

4.3. Results

The final sample consisted of 85 topics in 62 articles. The articles were published in 5 newspapers: The Vancouver Sun, The Province, The Vancouver Courier, The Globe and Mail, and the National Post.

Topics ranged from one to three per article, where 3 articles had three topics (4.8%), 17 articles had two topics (27.4%), and 42 articles had a single topic (67.7%). The topics covered 7 of the original 12 topic categories, and included: PBS infrastructure, registration and operation, access charges and fees, the helmet rental strategy, the helmet law, system finances and operations, and social factors. Article topics were primarily about system finances and operation (n=31, 36.5%), the helmet law (n=16, 18.8%), social factors (n=13, 15.3%), and the helmet rental strategy (n=11, 12.9%). The 5 topics of cycling conditions, weather, topography, individual socio-demographics, and technology were not discussed sufficiently to qualify as topics in any Vancouver PBS article.

The sample consisted of a mixture of articles that were written primarily about Vancouver bike share, or mentioned Vancouver bike share as part of another, usually related, story. For articles written primarily about bike share, article size was between 500-600 words for three of the five publications, while the Province's articles averaged about 100 words less (443), and the Globe and Mail's articles averaged about 150 words more (694). The proportion of articles that were on the front page varied widely, with the

Province having no front-page articles, and the Globe and Mail with a third (a single article). The Vancouver Courier had the most front-page articles, with three (20%).

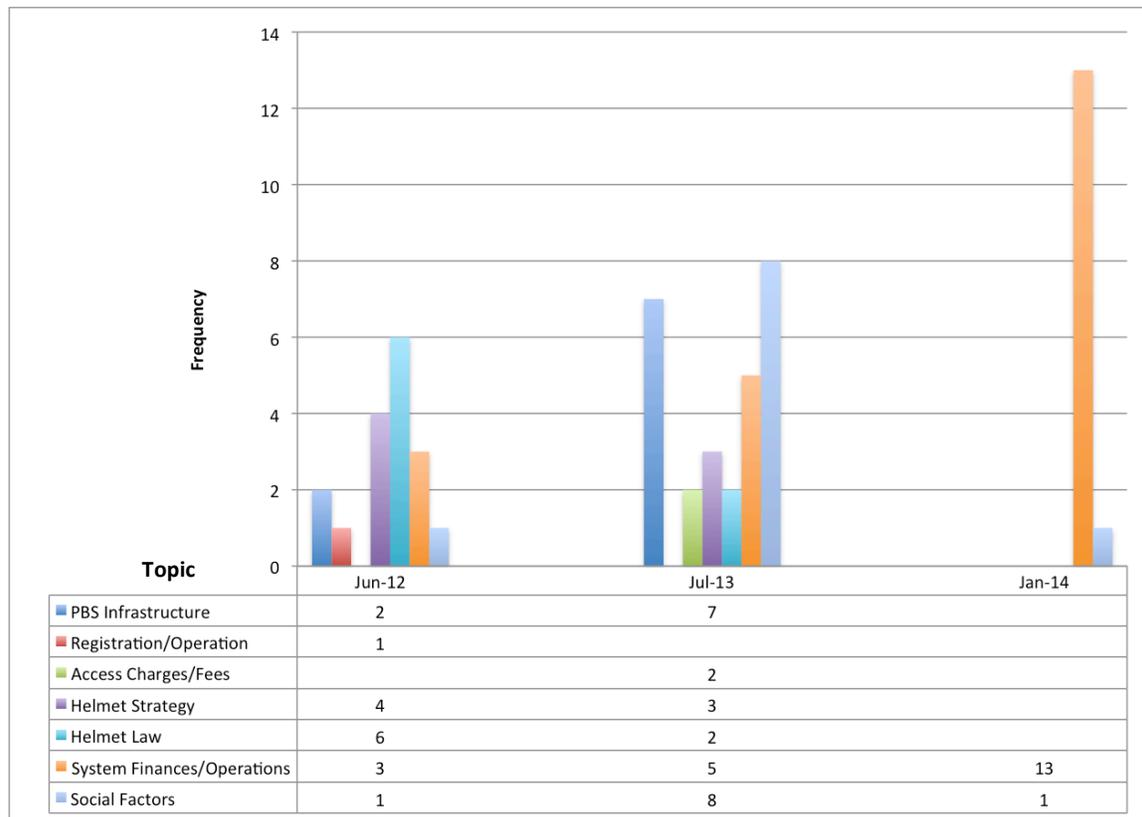


Figure 4.2. Frequency of Article Topics During the Three Publication Waves, 2012-2014

The distribution of article topics for the three publication waves in 2012, 2013, and 2014 is presented in Figure 4.2. Articles written in June 2012 (n=10 articles) were dominated by discussions of the provincial compulsory helmet law (35.3%), the integrated helmet rental strategy (23.5%), and system finances and operations (17.6%). Together, these topics comprised 13 of the 17 topics covered in bike share articles published in June (76.5%). In July 2013 (n=16 articles), there were 60% more articles on Vancouver bike share, relative to the previous year. We found a shift in the article focus toward the social factors of introducing a bike share system (29.6%), and the location and details of PBS infrastructure (25.9%), which together accounted for 55.6% of the month's topics (n=15). The helmet law and integrated helmet rental strategy were discussed in about one in five articles during this month (18.5%). In July 2013, new

topics arose related to user access charges and fees (7.4%). The final publication wave took place in January 2014 (n=13 articles). The primary topic during this phase was system finances and operations (92.9%). PBS infrastructure, registration and operations, access charges and fees, the compulsory helmet law or accompanying rental strategy were not article topics in January 2014.

We looked at whether topics were presented as a barrier or facilitator to Vancouver bike share adoption or success (Figure 4.3). In June 2012 (n=17 topics), 64.7% of topics were presented as a barrier, 11.8% as a facilitator to bike share adoption, and 23.5% were interpreted as having a negligible or unclear impact. The media in July 2013 (n=27 topics) were more positive: 44.4% of articles were presented as barriers, 33.3% as facilitators, and 22.2% as having a negligible or unclear impact. In January 2014 the media were very negative: with the focus on finances, of the month's 14 topics, 71.5% were barriers, and 28.5% had an unclear or negligible impact – none were positive.

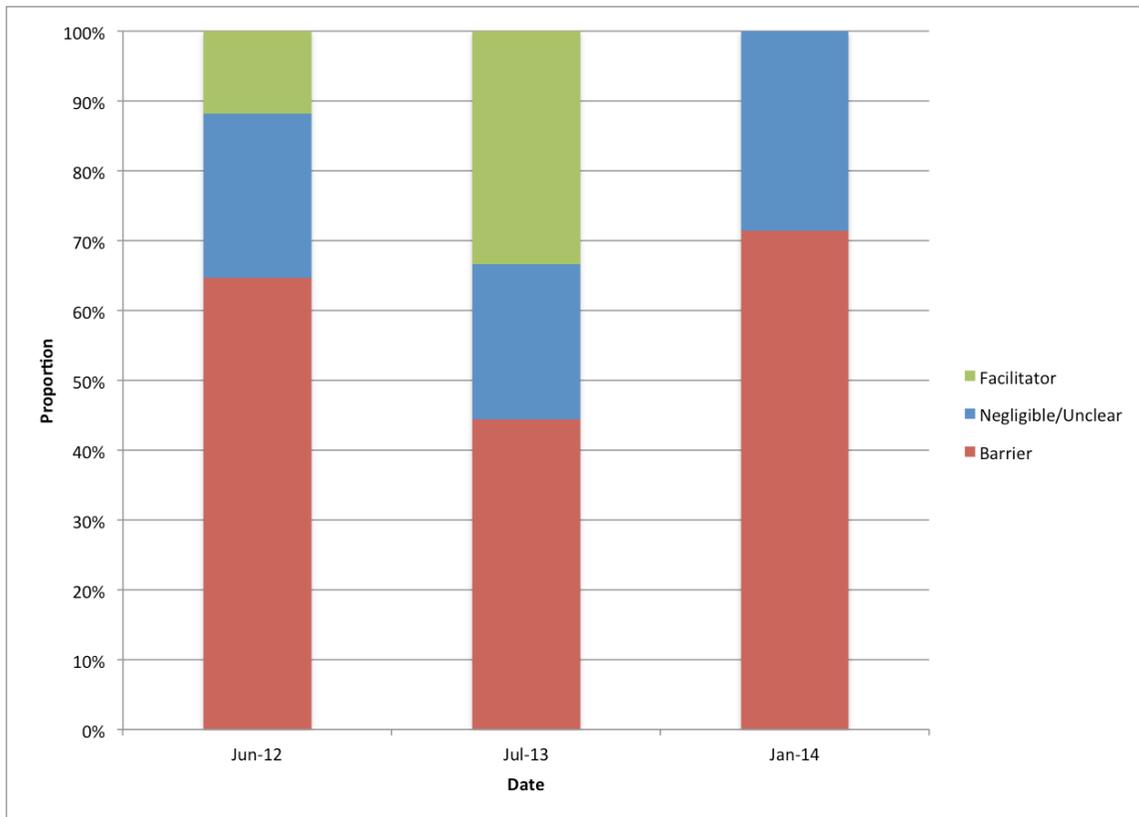


Figure 4.3. Proportion of Article Topics Presenting as a Barrier or Facilitator to Vancouver Bike Share, 2012-2014

When presenting a topic as a barrier, it was also important to look at whether the author included discussion of a barrier management strategy as a way to overcome the barrier. To the reader, this would have the effect of mitigating the perceived negative impact of the barrier. The distribution of barriers or facilitators and barrier management strategies by topic category is presented in Table 4.3. The top barrier topic presented by the media was the helmet law (93.8%, n=15/16). A barrier management strategy was presented for 60% (n=9/15) of these topics. These strategies were centred on the integrated helmet rental strategy. System financing and operations was the next leading barrier topic (67.7%, n=21/31). Only a quarter of these topics included a management strategy (23.8%, n=5/21). When a management strategy was included, it often featured the City’s contractual protection from operating debts should the system not prove financially viable. The City’s contract functions as a management strategy by mitigating the barrier effect to system adoption from poor financial performance. The top three facilitators to bike share adoption were the system’s expected positive impact to civic

social factors (53.8%, n=7/13), the density and location of PBS infrastructure (45.5%, n=5/11), and the integrated helmet rental strategy (36.4%, n=4/11).

Table 4.3. Barrier and Facilitator Distribution by Article Topic

	Barrier and Facilitator Distribution			
	Barrier; Percent (N)	Management Strategy; Percent (N)	Negligible/Unclear; Percent (N)	Facilitator; Percent (N)
PBS Infrastructure	36.4 (4/11)	50.0 (2/4)	18.2 (2/11)	45.5 (5/11)
Registration/Operation	0.0 (0/1)	0.0 (0)	100 (1/1)	0 (0/1)
Access Charges/Fees	50 (1/2)	100 (1/1)	50 (1/2)	0 (0/2)
Helmet Rental Strategy	45.5 (5/11)	20.0 (1/5)	18.2 (2/11)	36.4 (4/11)
Helmet Law	93.8 (15/16)	60.0 (9/15)	6.3 (1/16)	0 (0/16)
System Finances and Operations	67.7 (21/31)	23.8 (5/21)	32.3 (10/31)	0 (0/31)
Social Factors	38.5 (5/13)	0.0 (0/5)	7.7 (1/13)	53.8 (7/13)

The distribution of barrier and facilitator topics by media source is presented in Table 4.4. When reporting on bike share, all publications presented the majority of bike share topics as a barrier to adoption or future success (52.0% to 77.8%), with The Province reporting the highest number and proportion of topics as a barrier to bike share (n=14, 77.8%). The Vancouver Sun had the lowest proportion of topics presented as a barrier to bike share (52.0%), however, with the largest number of topics (and published articles), this yielded the second highest number of barrier topics (n=13). The inclusion of a barrier management strategy varied between zero and 46.2% of a publication's barrier topics. The National Post included no barrier management strategy for its three barrier topics, while the Province included a management strategy for a fifth (21.4%) of its barrier topics. The Vancouver Courier, the Globe and Mail, and the Vancouver Sun

included an approximately equivalent proportion of barrier topics with an accompanying management strategy (40.0%, 45.5%, and 46.2%). The proportion of topics as a facilitator to bike share varied between 10.5% and 25.0%. The National Post had the highest proportion of facilitator topics (25.0%), while the Vancouver Sun had the largest number of facilitator topics, at 6 (24.0%).

Table 4.4. Article Characteristics Distributed by Media Source

Publication	Bike Share Focus		Article Size Mean Word Count	Front Page N (%)	Barrier/Facilitator Distribution			Author Opinion Slant Distribution			
	Primary; N (%)	Secondary; N (%)			Barrier; N (%)	Mgt Strategy; N (%)	Negligible or Unclear; N (%)	Facilitator; N (%)	Positive; N (%)	Balanced; N (%)	Negative; N (%)
The Vancouver Sun	13/17 (76.5)	4/17 (23.5)	538	1/17 (5.9)	13/25 (52.0)	6/13 (46.2)	6/25 (24.0)	6/25 (24.0)	1 (5.9)	12 (70.6)	4 (23.5)
The Province	10/13 (76.9)	3/13 (23.1)	443	0/13 (0.0)	14/18 (77.8)	3/14 (21.4)	1/18 (5.6)	3/18 (16.7)	2 (15.4)	6 (46.2)	5 (38.5)
The Vancouver Courier	7/15 (46.7)	8/15 (53.3)	566	3/15 (20.0)	10/19 (52.6)	4/10 (40.0)	5/19 (26.3)	4/19 (21.1)	3 (20.0)	12 (80.0)	0 (0.0)
The Globe and Mail	10/14 (71.4)	4/14 (28.6)	694	0/14 (0.0)	11/19 (57.9)	5/11 (45.5)	6/19 (31.6)	2/19 (10.5)	5 (35.7)	7 (50.0)	2 (14.3)
The National Post	2/3 (66.7)	1/3 (33.3)	593	1/3 (33.3)	3/4 (75.0)	0/3 (0.0)	0/4 (0.0)	1/4 (25.0)	0 (0.0)	1 (33.3)	2 (66.7)

Note: Article size was calculated for articles written primarily about Vancouver bike share

The distribution of the authors' opinion slant by media source is also represented in Table 4.4 and in Figure 4.4. Articles interpreted as having an overall *positive* opinion slant varied between zero for the National Post, and five for the Globe and Mail (35.7%). Articles written with an overall *negative* opinion slant were more prevalent (13 vs. 11 articles), and varied between zero for the Vancouver Courier, and five for The Province. The National Post had the largest proportion of articles written with a *negative* opinion slant (66.7%), however, the newspaper with the largest number of articles published with a negative author opinion slant was The Province (38.5%). The Vancouver Courier and Globe and Mail published the fewest articles with a negative opinion slant and the most positively slanted articles.

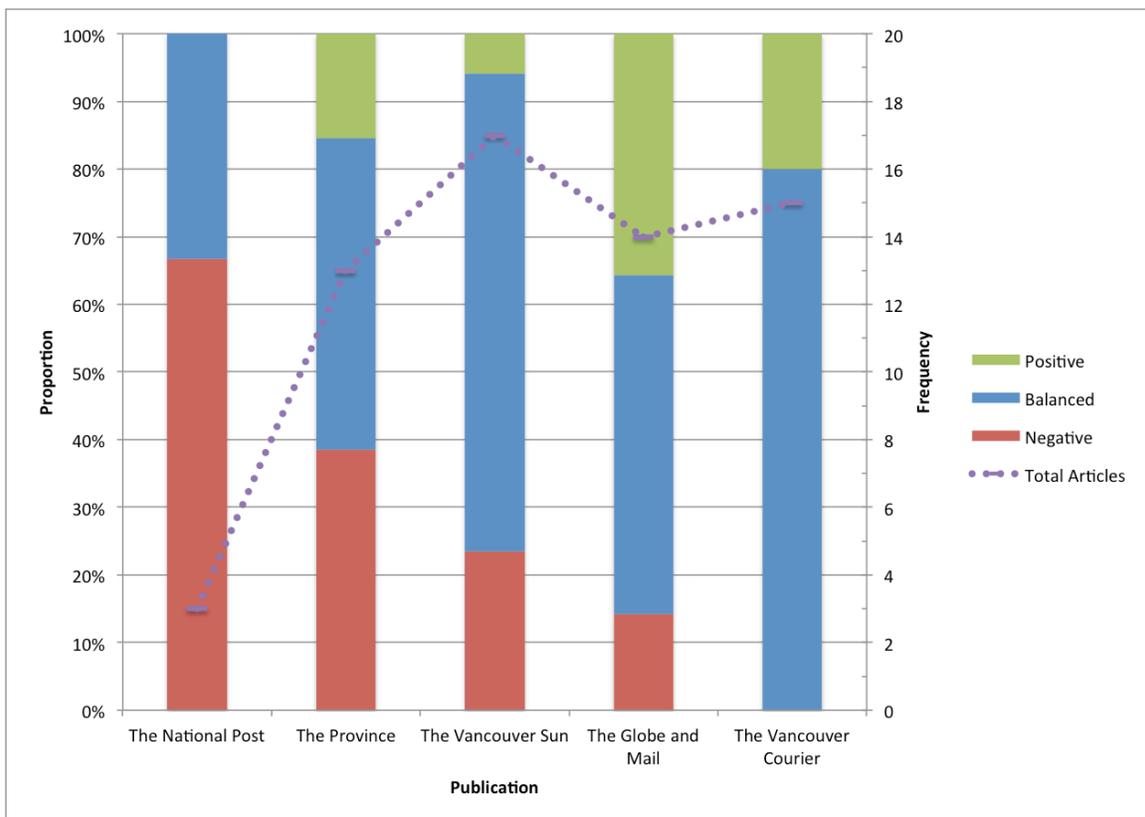


Figure 4.4. Author Opinion Slant Distribution by Media Source

4.4. Discussion

We conducted a news article content analysis to better understand how bike share was portrayed by the news media before its launch in Vancouver. We analysed

62-bike share articles published between 2012 and 2014, and identified 85 article topics. We coded bike share topics as a barrier or facilitator to bike share adoption or future success and assigned each article one of three codes for overall author slant.

Bike share articles published in June 2012 centred on user compliance with the Provincial compulsory helmet requirement and details of the proposed system's operating and financing arrangements. These topics were presented as barriers to Vancouver's proposed system. For example, in describing the likely impact of the Provincial helmet requirement on public bicycle use, Bateman states that the law "...will further hurt the potential for the bike share to operate..." (2012), and referenced the poor system performance in "warmer and sunnier Australia," which also requires helmets. This comparison positions the helmet law as an impediment to system use and commercial success in Vancouver, thereby cautioning against system adoption locally. In a similar manner, Bateman regarded the public capital investments in the program as "corporate welfare" amounting to a "war on taxpayers... to pay a big bill for furthering Vision's bike agenda" (2012). This oppositional view to the financing arrangements of Vancouver's program may negatively impact public opinion and increases the possibility of public resistance to bike share. Where topics were presented as a barrier to bike share, some articles included a way to overcome the barrier effect. Continuing with the topic of the helmet law, Dhillon regards the vending machine style distribution of helmets as a means to make helmets available and redress concerns over helmet hygiene, such as the "ick factor" of using shared helmets (2012). Both Bateman and Dhillon regard the compulsory helmet requirement as an impediment to bike share in Vancouver, but Dhillon goes on to include discussion of helmet vending machines (a barrier management strategy), that may help to mitigate the expected barrier effect of the law.

We noticed a more balanced distribution of facilitators and barriers in article topics during July 2013. PBS infrastructure and social factors as topic categories were largely rated as supportive of system success. For system infrastructure, articles referenced the proposed high network density, large service area, and use of sturdy upright bicycles with adequate gearing to support riders on Vancouver's hills—features important to system success. Social factors were also generally presented as facilitator topics. Bike share was regarded as symbolic of a city's progressivity and environmental values, and as part of a global cultural shift away from motoring toward "human

transportation” (Garr, 2013). The public popularity, in terms of the number of systems in cities world wide, or the rapid uptake of a system immediately following installation, is often cited as proof of merit to legitimise local adoption. A number of articles used bike share as a symbol for demonstrating these civic social qualities, and advocated system adoption to advance Vancouver’s social progressivity in an absolute and relative sense in the race to become the greenest city in the world.

We only categorised topics that were the main thrust of an article, thus, any brief mention was not coded. Cycling conditions were referenced with regard to the city’s new cycle track network and recent efforts to motor-traffic calm residential street corridors, noting the potential benefit to future system users. In a similar manner, Vancouver’s rainy weather and hilly topography were mentioned as factors that could hinder system use. Beyond bike share’s bicycle and docking station infrastructure, little mention was made about new system technology, social media, mobile apps or web based programs, likely because the system is not yet operating in Vancouver. Normally, discussion of system finances and operations focused on matters pertaining to the financing model for Vancouver’s system, how much the system will cost, and the commercial viability of bike share systems in other cities. A number of articles presented the case of a publicly financed bicycle rental system competing with local private bicycle rental companies. Concerns over the financial impact to these local businesses, the user fee model that would be used by the public system, and the siting of docking stations became a side theme to this topic category. Our inclusion of a ‘health’ topic category did not prove to be necessary, as public health impacts from the system, such as from physical activity, was not included as a topic in any article. A notable exception pertains to the mention of injuries (namely head and brain) as it related to cycling and the use of helmets. We categorised discussion of injury prevention with helmets under topic categories specific to the helmet law or helmet rental strategy. The lack of empirical data to substantiate claims of positive health or environmental impacts from bike share systems, especially ‘new’ evidence that can be reported as news, may have limited journalist commentary on health impacts.

In assigning article slant, we sought to categorise an overall tone based on the author’s use of language and phrasing. Many articles were ‘hard news,’ and presented a balanced mix of supportive and critical statements, facts, and quotes. Slanted articles

were typically column articles, opinion pieces, or editorials. Mark Hume of the *Globe and Mail* reported in January 2014 on the collapse of Bixi and the implications for Vancouver's proposed system. Hume's article was positively slanted based on his descriptions of the program and its history, and comparison to other cities that adopted bike share. Hume describes bike share as "wildly popular" and goes on to cite three American examples of system use whose "numbers are impressive" (2014). However, Hume cites these figures without providing the bicycle fleet size and may have selected ridership figures from shortly after system launch that may not reflect current usage. Hume defended Vancouver city council from criticism, stating that they "pursu[ed] the project with commendable caution" and praised the Mayor's "leadership" and "ambitious plan to dramatically reduce traffic... [for which] the bike-share system is seen as a crowning piece in that strategy" (2014). The article dispels criticism of Vancouver city council, while minimising the impact of Bixi's financial collapse on the development of Vancouver's system; these features collectively frame the author's opinion of bike share as positive. In contrast, an example of an article with a negative slant is Jon Ferry's July 2013 column piece entitled "Cycling addicts need understanding, treatment" which categorises cycling initiatives like bike share as "Vision Vancouver endorphin rush[es]... for which the noncycling, taxpaying majority is forced to fork out the green" (2013). Another negative example is Hubert Grubel's *Vancouver Sun* article which labels city councillors as "High Priests of the Green Religion" (2012) who minimise oppositions with "carefully designed propaganda campaign[s]" and will "saddle the silent majority of Vancouver taxpayers who [will] never use the program with a huge bill" (2012). Slant may impact readers' opinions of bike share through the overly positive or negative tone and biased presentation of evidence. This is in contrast to the more neutral presentation of events and facts that permits greater flexibility in interpreting significance and impact.

4.4.1. Limitations and Future Work

We focused our analysis on hard news articles, columns, opinion pieces and editorials, and did not include letters to the editor as our interest was in the messaging from legacy news media outlets, not the personal views of individual citizens. As the launch date of bike share approaches, we expect a new wave of news articles related to

bike share, and future work should look at the changes in the focus and framing of article topics.

A limitation of this media content analysis is that it was carried out without studying the perceptions of the public. It is also possible that we misrepresented the messages that readers would actually interpret, particularly for persons who are not invested in cycling or bike share. As well, in the absence of data, any suppositions about the relationship of media representations to attitudes and behaviours of both the public and policymakers are speculative.

4.4.2. Conclusions and Policy Implications

The focus of bike share topics in the media shifted over time, and reflected new developments related to program implementation and the political climate. In June 2012, discussion centred on the provincial compulsory helmet requirement and the associated impacts to bike share use. Reporting of bike share topics in July 2013 looked at the social and environmental impacts of the system, and featured discussion of bike share infrastructure. The proposed system's financing and operating arrangements was the single largest topic category, and was the nearly exclusive topic discussed in January 2014, coinciding with the BIXI financial collapse.

The proportion of topics presenting as a barrier or facilitator to bike share varied across time, topic, and media source. Articles published in July 2013 had the largest proportion of topics presented as a facilitator and lowest proportion as barriers to bike share, compared to articles published in June 2012 or January 2014. Not surprising, as Vancouver has all-ages compulsory helmet legislation, the helmet law and its application to bike share was the second most discussed topic, and presented as the leading barrier to PBS adoption and success in Vancouver. While all media sources presented a majority of bike share topics as barriers to adoption or success, The Province published the largest number of topics as barriers to bike share with the lowest proportion of accompanying management strategies. Amongst the five newspapers we reviewed, The Province also stood out as having a large proportion of its articles written with a negative author opinion slants; this suggests that the publication may have a systemic leaning against the adoption of PBS in Vancouver. Support for bike share, as defined by the

proportion of facilitator topics and positive article opinion slants, was highest from the Vancouver Courier and the Globe and Mail. We may reject the null hypothesis as our findings provide evidence that the distribution of facilitator and barrier topics varied across time, topic category and media source.

Media advocacy and news framing shape public opinion by defining the problem, its cause, and proposed remedies. We have characterised the framing of bike share news topics and articles reported by five media sources in Vancouver. The tendency toward one-sided article slant and topic presentation may reflect the socio-political orientation of the parent company and intended audience.

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Chapter 5. Conclusions

Bike share is a novel population level program for cycling promotion, with the capacity for increasing the amount of physical activity regularly performed by citizens and minimising the negative environmental impacts from transportation (Pucher, Dill, Handy, 2010). We sought to understand which factors were important to prospective bike share users, and if these factors functioned as a facilitator or barrier to bike share adoption or future success. We used a mixed-methods approach to better triangulate the impact and relative importance of these factors, for example, by using self-reported and field observation data.

We found a high prevalence of helmet use in both the self-reported telephone survey (Chapter 2) and observational field surveys (Chapter 3), and in both studies we found women were more likely than men to wear helmets. Bike share users are different from general cyclists in some key socio-demographic variables associated with helmet use, like gender and age, which will influence their prevalence of helmet use (Kraemer, Roffenbender, Anderko, 2012). Regardless of these individual characteristics, we found that a main reason people did not wear helmets was because they did not have one conveniently available; this suggests that if helmets are not readily available, people may not wear them. Having helmets conveniently available for rental at bike share docking stations will be key to supporting helmet use on PBS.

Interestingly, Vancouver residents did not highly rank helmets as important to their decision to use bike share (Chapter 2), compared to the news media's presentation of the helmet law as a leading barrier to bike share. The lack of importance cited by residents may be because helmet use is not a major consideration when using a personal bicycle, and by extension, is not expected to be a hurdle for bike share. Alternatively, if residents are well aware of the integrated helmet and bicycle rental strategy, helmet use may not seem important relative to other factors. Awareness of the planned integrated helmet option may be a function of the heavy media attention on this

topic, as was found in Chapter 4. We know that two-thirds of articles written about the helmet law and rental strategy were published in June 2012, just prior to the telephone survey of Vancouver residents. Respondents may have been well informed about the City's plan to include helmets with a bicycle rental, and this could have influenced their scoring of this factor. We will evaluate the effectiveness of the helmet rental strategy to support the use of helmets amongst bike share riders when the field survey of downtown cyclists is repeated after system launch in 2015.

The presence of a connected and protected network of quality cycling facilities will be a very important consideration to using bike share, as found in Chapter 2. In the helmet observations in Chapter 3, infrastructure was also associated with helmet use, with prevalence being much higher on cycle tracks and bike lanes than on off-street paths. We cannot be sure if infrastructure is an independent predictor of helmet use, or if it is associated with trip type and confounds the relationship for helmet use. Our observations of higher helmet use with on-street facilities, coupled with the reduced traffic risk associated with travel on cycle tracks, suggest a recommendation to expand the cycle track network. Regardless of the trip type or if a personal or public bicycle is used, people prefer to travel on physically separated routes or shared streets where motor-traffic volume and speed is low (Winters & Teschke, 2010).

Compulsory helmet legislation has been debated as a barrier to the adoption and success of bike share in Vancouver. While the news media largely regarded the helmet law to be a barrier to bike share, Vancouver residents expect cycling infrastructure to be a more important consideration on whether they will use the service. Our content analysis of print news articles proved useful in highlighting this disparity between public opinion and the bike share topics reported as newsworthy. Findings from the content analysis and survey of Vancouverite's motivators to bike share use may serve as a foundation for future media advocacy efforts. Such efforts must focus on drawing the attention of policymakers to the need for developing a connected network of quality cycling facilities. If Vancouver is to leverage its capital investment in a bike share program, it will need to provide facility types proven to support cycling.

5.1. References

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Appendix I.

Abstract for Manuscript Chapter 2

Background: Vancouver, B.C., is preparing to launch a public bicycle sharing system. This study captures perceptions of the motivating and deterring factors to future use of the system. As Vancouver has all-ages helmet legislation in place that will apply to public bike share (PBS) users, we also sought to determine the motivating and deterring factors to helmet use by personal bicycle riders.

Methods: We used data from a telephone survey of Vancouver residents (aged 16+) conducted in Fall 2012. The survey had 901 respondents (298 were asked questions about their helmet use), and responses were weighted to match the sex and age distribution of the Vancouver population. Factors expected to influence use of bike share were assessed using 5-point Likert questions. We computed respondents' mean scores and used an ANOVA analysis for hypothesis testing with R version 3.0.3.

Results: A majority of cyclists were supportive of a bike share system in Vancouver, with regular riders the most supportive. The top three factors to influence bike share use would be the presence of a connected network of bicycle routes, rain and adverse weather, and separated bicycle facilities (mean=4.16, 3.73, and 3.65). Most respondents reported wearing a helmet on their last bicycle trip (79.9%, n=238/298). The main reason for wearing a helmet was "It protects my head" (78.5%, n=235). The top reasons for not wearing a helmet were not having a helmet at the time of the trip, discomfort associated with helmet use, and low perceived risk (31.2%, n=63; 23.5%, n=40; 17.6%, n=30).

Conclusions: While support for introducing bike share is strong, reported likelihood of use by cyclists is low. The presence of a connected and protected network of quality cycling facilities will be a very important consideration to using bike share. The importance of convenient helmet access and limited readily accessible helmet rental options for PBS systems portends a lower prevalence of helmet use on public bicycles compared to personal bicycles.

Appendix II.

Telephone Survey Questions

Questions Assessing Cycling Behaviour

1. In the previous 12 months, have you used a bicycle? (Yes or No)
2. In the previous 12 months, how frequently did you bicycle during the following seasons [summer, spring or fall, and winter]?
 - less than once a month
 - 1-3 times a month
 - 1-3 times a week
 - 4 or more times a week

Question Assessing Awareness of Bike Share

1. Have you ever heard of a public bike share program? (Yes / No)

Likert Questions Assessing Attitudes to Bike Share and Likelihood of Use

1. Do think that a public bike share program is a good or bad idea for Vancouver?
 - 1 is 'very bad idea' and 5 is 'very good idea'
1. How likely would you be to use the Vancouver bike share program, given that cost and station locations are accessible to you?
 - 1 is 'very unlikely' and 5 is 'very likely'

Likert Questions Assessing Importance of Six Factors on the Decision to Use Bike Share

1. The fear of injury from crashes or falls
 2. Rain and adverse weather
 3. Steep hills along your route
 1. The presence of separated bicycle lanes along your route
 2. A connected network of bicycle routes through the city
 3. The law in BC requiring you to wear a helmet when riding a bicycle
- 1 is 'not at all important' and 5 is 'very important'

Questions Assessing Behaviour and Attitudes Toward Helmet Use

1. On your last bicycle trip, did you wear a helmet?
2. When you do wear a helmet, what is your main reason for wearing it?

Habit- I just always have	1
It's the law/ I fear a ticket	2
It protects my head	3
Protection from the elements (i.e. It keeps my head warm/dry/ It blocks the sun)	4
As an example for others	5
Social pressure	6
I never wear a helmet	7
Other: Specify _____	98
DNK/DNA	99

3. When you don't wear a helmet, what is your main reason for not wearing it?

Helmets are only for children	1
Most people don't wear a helmet/ others I know don't	2
A helmet is not effective protection anyway	3
Unfashionable/ I don't like the helmet I own	4
Uncomfortable/ head sweaty/ enjoy the feeling (eg. sun / wind in my hair)	5
I ride my bike safely/slowly/ The risk of getting involved in an accident is so low	6
Cost of helmet	7
I didn't have a helmet with me at the time/Convenience	8
I don't own a helmet	9
I always wear a helmet	10
Other: Specify _____	98
DNK/DNA	99

Appendix III.

Abstract for Manuscript Chapter 3

Background: Public bike share (PBS) users typically have low prevalence of helmet use, and few PBS systems have readily available helmet rental options. Vancouver, B.C., is preparing to launch a PBS system and must address the issue of helmet provision head-on, as Vancouver has all-ages helmet legislation in place that will apply to PBS users. This study captures baseline data on helmet use by personal bicycle riders in Vancouver.

Methods: We conducted an observational survey of helmet use amongst adult cyclists (estimated at 16+ years) in Vancouver's Metro core at three sites with different bicycle infrastructure. Observations were made on fair-weather days between June and September 2012, during weekday and weekend mid-day (11.00-13.00) and PM-peak (16.00-18.00) periods. Observers recorded the gender of the rider and helmet use. We used multivariable logistic regression to calculate odds ratios for helmet use based on the rider's sex, location, time, and day of travel. Analysis was undertaken using R version 2.14.1.

Results: Forty-eight observation sessions (24 hours total) were made; 4146 cyclists were recorded. Overall, the prevalence of helmet use was 74.9% (n=3105/4146). Helmet use was significantly associated with rider sex, infrastructure type, and time of day. Women had higher odds of wearing a helmet than men (odds ratio [OR] 1.42; 95% confidence interval [CI] 1.22-1.66). Compared to off-street paths, riders using bicycle lanes or cycle tracks demonstrated higher odds of helmet use (OR 2.07; CI 1.59-2.71 and OR 2.36; CI 1.95-2.87). Riders in the PM-Peak period had lower odds of helmet use compared to mid-day riders (OR 0.64; CI 0.55-0.75).

Conclusions: Helmet use prevalence varies widely by personal demographic and trip characteristics. Efforts to improve the social inclusivity and safety of cycling, and increase helmet use, can be supported through the provision of an arterial cycle track

network. This observational survey will be repeated after a PBS launch: the current data serves as baseline data prior to the program.

Appendix IV.

News Article Coding Instructions

RATER INSTRUCTIONS:

1. The above variables have already been completed in your data collection spreadsheet. Briefly review these data to locate the correct article for analysis.
2. Review the **topic_#** variable description and topic table.
3. Read the article in its entirety.
4. Determine the primary article topic using the variable's topic table.
5. Review the variable description for **bar_fac#** and **mgt#**
6. With #5 in mind, re-skim the article and consider if this topic is presented as a barrier, facilitator, or non-issue for bike share in Vancouver.
7. If **bar_fac#=1**, decide if a management strategy is presented in the article, and assign code.
8. Review the **slant**, **pos_phrase**, **neg_phrase** variable descriptions before proceeding.
9. Re-read the article, thinking of how to code the opinion slant. As you read, highlight key terms or phrases that would support your choice for the slant code ('balanced' code exempted).
10. Make an assignment for the opinion slant
11. Choose an example from your highlighting to enter in the **pos_phrase** OR **neg_phrase** column ('balanced' code exempted).
12. Note the variable description for **vign** and comment as appropriate.

bar_fac#=Article topic is presented as a 'facilitator', 'barrier', or 'negligible' impact to bike share adoption or operations in Vancouver. A '0' code may also indicate that the topic's impact to Vancouver system adoption or operations is not clear.

2=facilitator

1=barrier

0=negligible or unclear

mgt#= a management strategy for the barrier (bar_fac#=1) is included in the article. The strategy should directly redress the reported barrier and includes systemic changes or long and short-term fixes that serve to maintain system operations or aids system adoption.

1=yes

0=no

NOTE: Articles with topics presented as non-issues (code=0) differ from those that present as a barrier (code=1) and are accompanied by a barrier management strategy (mgt=1) which renders the barrier as a non-issue. The key is to recognize how the issue is presented by the author:

Example 1: bar_fac#=0

"...Bixi's financial problems will not affect the rollout of bike share in Vancouver. Alta has made arrangements with a former Bixi partner to provide the bicycles and docking stations if Bixi proves unable to meet equipment provision deadlines."
[topic is presented as a non-issue, not as a barrier + mgt strategy]

Example 2: bar_fac#=1; mgt#=1

"...Bixi's financial problems have delayed any plans to rollout bike share in Vancouver unless Alta can make arrangement with an alternate equipment provider. The company says they are negotiating with an alternate bicycle provider, and is confident that equipment procurement will proceed if Bixi proves unable to meet its deadlines."
[topic is presented as a barrier to bike share in Vancouver, and a management strategy is in place to overcome this barrier]

Example 3: bar_fac#=1; mgt#=0

"...Bixi's financial problems have delayed any plans to rollout bike share in Vancouver, unless Alta can make arrangement with an alternate equipment provider. The company says they are negotiating with a few companies, but no plans have yet been finalized. Unless the operator can find another company to provide the bicycles, bike share may still be a long way off."
[topic is presented as a barrier to bike share in Vancouver, and there is no direct/clear strategy to overcome the barrier]

Appendix V.

Abstract for Manuscript Chapter 4

Background: The news media have a long-standing role as both a conduit for information and as an actor that shapes public opinion and policies. As a novel approach to promote active transportation, news reports of bike share issues can influence public support and policy maker decisions. This print news content analysis captures the media's portrayal of public bike share (PBS) during the approval process and before program launch.

Methods: We conducted a full text search of newspaper articles related to Vancouver PBS published in legacy newspapers between 2012 and 2014 using the Canadian Newsstand database (n=246). 62 articles met inclusion criteria. We conducted a systematic analysis of article frequency, framing (slant), and topics. We coded article topics as a barrier or facilitator to a future bike share system, and assigned an opinion slant based on the author's use of language, figures of speech, and tone of writing. We assessed inter-rater reliability using the Cohen's kappa statistic.

Results: We coded 85 topics in seven of the original twelve topic categories. Articles were primarily published in three waves in each of mid-2012 and 2013, and early 2014. Articles were primarily written about system finances and operations (n=31, 36.5%), the helmet law (n=16, 18.8%), and social factors (n=13, 15.3%). The leading topics presented as barriers to bike share were the helmet law (93.8%), and system financing and operations (67.7%). Top facilitator was regarding bike share as a positive civic amenity (53.8%). All publication titles primarily reported bike share topics as barriers to adoption or success (52% to 78%). The Province published the most barrier topics and articles with a negative author opinion slant (n=14/18; 77.8% and n=5/13; 38.5%). The Vancouver Courier and Globe and Mail published the fewest articles with a negative opinion slant and the most positively slanted articles.

Conclusions: The focus of bike share topics changed over time, and reflected new policy developments related to the program. The Province may have a systemic leaning

against the adoption of PBS in Vancouver, while the Vancouver courier and the Globe and Mail may have a leaning toward system adoption. The tendency toward one-sided article slant and topic presentation may reflect the socio-political orientation of the parent company and intended audience.