

Latent Bicycle Commuting Demand and Effects of Gender on Commuter Cycling and Accident Rates

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A recent survey by the City of Calgary, Canada, found that more than 75% of cyclists commuting to downtown Calgary are male. The intent of this research is to determine whether this is also true for cyclists commuting to a university campus located in the second most popular employment area of the city, what obstacles are preventing women from bicycling, and what measures could increase the number of female commuter cyclists. An online survey was conducted to collect information that allowed the grouping of respondents as potential, occasional, or regular cyclists. Analysis showed that women are more likely than men to be possible or occasional cyclists, while men are more likely than women to be regular cyclists. These findings suggest that if women's cycling needs were addressed, the modal share of bicycle commuting could be increased. Investigation of cycling barriers indicated that women are more concerned than men about safety issues associated with cycling, with being able to carry daily items while cycling, and with the need to fix their hair on arrival. In analysis of desired improvements, women were found to place a higher value on bicycle maps and literature but share similar facility preferences with men. High proportions of both genders indicated a desire for bicycle lanes, more pathways, and more direct bicycle routes. Analysis of falls and collisions suggested that men and women experience a similar number of falls per unit of exposure, while men experience more collisions per unit of exposure than women do.

The 2006 Downtown Commuter Cyclist Survey Report of the City of Calgary, Canada, stated that "typical cyclists commuting to downtown are male (75 per cent), over 35 years of age (65 per cent) and earn more than \$90,000 a year (45 per cent)" (1). The intent of this research is to determine whether the characteristics and needs of commuter cyclists bound for another major destination in Calgary are similar to those found for downtown commuters. Of particular interest is whether women constitute a higher proportion of cyclists bound for other destinations. The intent is also to determine what obstacles restrain women from bicycle commuting, and whether those obstacles differ from those for men.

In the city's study, questionnaires were distributed to cyclists as they entered the downtown core during their morning commute.

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Questionnaires were also mailed to people who phoned to request one. Because of this distribution method, no information was obtained from people who had considered cycling, but had not yet done so. By using an online survey, it was possible to reach these people and gain information about their cycling needs and barriers. Potential and occasional cyclists present a huge possibility for increasing the modal share of bicycle commuting, and it is important to consider what improvements can be made to tap this latent demand.

The analysis of possible bicycle commuters focuses on barriers to cycling and desired on-route and destination improvements and the effects of gender and age on both. Current cyclists are subsequently analyzed to determine if the personal attributes of gender and age affect cycling frequency, trip characteristics, or desired improvements. Because safety has been shown to be a considerable concern for potential cyclists, women particularly, the occurrence of falls and collisions will be analyzed to determine if the frequency of either is related to the gender or age of the cyclist.

Calgary is a city of just over one million people located in the foothills of Alberta, Canada; it covers approximately 730 km². Although it is a northern city with occasionally severe winter weather, the city is working to facilitate commuter cycling, and there are people who cycle year-round. The current bicycle network in Calgary includes 7 km of bicycle lanes; 13 km of bicycle stencils, which are marked shared-use lanes; 707 km of multipurpose pathway; and 290 km of on-street bicycle routes marked by posted signs.

LITERATURE REVIEW

Research conducted in North America, Britain, and Australia has found that women are significantly less likely to commute by bicycle than men (2–6). Pucher and Buehler recognized that in countries where bicycle commuting accounts for a small portion of the total number of trips made, women tend to commute by bicycle less frequently than men do (7). This is not the case in countries such as the Netherlands, Denmark, and Germany, where commuting by bicycle accounts for a large portion of total trips made, and women cycle as often as men do (7). Statistics Canada estimated in 2008 that trips by bicycle account for 1.3% of trips made in Calgary (8). Although women appear to commute by bicycle less often than men once they enter the workforce, one study concluded that women are more likely than men to cycle to school as students, but the age group and school level were not specified (6).

Previous research conducted in the field of gender differences in transportation by all modes has concluded that women and men have differing transportation needs, goals, and obstacles. Although the

work patterns of men and women have converged significantly over the last half century (9) and women are working outside of the home now more than ever, there still appear to be several important differences in the working and lifestyle characteristics of women and men. Women tend to live closer to the workplace (10, 11), and as a result have shorter commutes than men do. In addition to working outside of the home, women are often responsible for a large portion of the household duties and because of this are more likely to chain trips, carry goods, and take passengers during their work commute than men are (10, 11). In fulfilling these duties, women tend to have time-constrained schedules that require transportation modes that allow for fast and efficient trip chaining (10, 12). Women are generally more time sensitive, and therefore are more likely than men to use the most convenient form of transportation regardless of the cost (12). In addition, women tend to place a high value on safety, are more risk averse than men (9, 12), and often favor transportation modes that pose the least risk (5). Previous literature specifically dealing with commuting by bicycle found that women are more likely than men to identify feeling unsafe as a cycling problem (3, 4, 6).

There is disagreement in previous research about the journey characteristics of women commuter cyclists. Some sources suggest that women make shorter trips than men do, in both time (5, 6) and distance (2). Others have found no significant difference in the length or duration of trips by gender (4). The facilities that women are using, and those they prefer to use, have also been topics of disagreement. Garrard et al. found that women, more than men, prefer to use bicycle paths that are separated from automotive traffic (5). Aultman-Hall found no significant difference between men and women in facility preferences (2). In another study, Garrard et al. found that "females were more likely to use on-road bike lanes than off-road paths, but showed similar preferences for these two types of bicycle facility. Males were also more likely to use on-road bike lanes than off-road paths, but, unlike females, they expressed a greater preference for on-road lanes" (4). Aultman-Hall found that commuter cyclists, both men and women, generally use the shortest route or a slight variation from this route (2). The respondents to Aultman-Hall's survey used pathways and trails less often than the proportion that was identified in the computer-identified shortest path. Krizek et al. found that women are more sensitive to low-quality cycling facilities than men are (6). They are more likely than men to rate lighting on bike paths and paved shoulders on roads as very important. Similarly, they are more likely than men to cite the lack of pathways and poor road conditions as key cycling problems.

Relatively little research has included people who identify themselves as possible cyclists. Gatersleben and Appleton studied students and staff at a British university and analyzed their progression from precontemplation, a stage of noncyclist status with no intention of change, through three stages of progression, to the final stage of maintenance, where the person has commuted by bicycle for 6 months or more (13). This study found that as people began commuting by bicycle, their attitude toward cycling improved and their perception of barriers became less significant. This study also found that women were more likely than men to be in the precontemplation stage, and that people with children were found in all stages, which suggests that family obligations were not necessarily an obstacle to bicycle commuting. Noncyclists who would not begin cycling in any condition most often stated that the commute distance was too far, even though it was comparable to the distance of people in the other four categories. People in the contemplative and prepared for action stages desired safer facilities. Other studies compared noncyclists and

cyclists, but did not specifically target people who stated they would like to begin cycling (3, 14–17).

SURVEY METHODOLOGY

The survey questionnaire was modeled after the questionnaire used for the City of Calgary's 2006 downtown commuter cyclist survey (1). Several questions were altered, omitted, or added in recognition of the different characteristics of the university population and to deal with possible cyclists. The survey incorporated a section to gain information about routes cycled. Respondents had the choice of using an online mapping site, www.maps.live.com, to digitally trace their route, or describing their route in words. The survey was pretested on a convenience sample of people at the University of Calgary before being released for data collection. A drawing for a gift certificate valued at \$150 to Bowcycle, a cycling store in Calgary, was offered as an incentive to complete the survey.

The survey was conducted online. A copy of the survey is included in the full report, which is available through the Calgary website (18). An invitation to complete the survey was sent to the student body via an e-mail from the registrar's office. This e-mail reached approximately 22,500 undergraduate students and 5,500 graduate students. Roughly 5,500 members of the university faculty and staff received notice of the survey through the UToday online news source, e-mailed each weekday. News articles about the survey containing a link to it were posted on the main University of Calgary webpage, the Office of Sustainability's webpage, Bowcycle's website, the campus Bike Root's webpage, and in the university's online magazine. In addition, sixty-five 11- × 17-in. posters were placed on bulletin boards around campus, and waterproof posters were placed at 10 of the major bike racks on campus. Business cards containing an invitation to the bicycle survey webpage were taped to the handlebars of bicycles parked on campus on two warm days when bicycle ridership was high.

The survey was conducted for a 3-week period from April 13 to May 1, 2009. Because the survey was distributed electronically, and because respondents were asked to think of their cycling throughout the year, the weather was not expected to have an effect on the number of participants. Tracking of the responses by date confirmed that the response frequency was unrelated to the weather.

SURVEY RESPONSE

There were 1,128 people who responded to the survey, of whom 498 (44.1%) were women, 548 (48.6%) were men, and 82 (7.3%) did not disclose their gender. Although the response rate of 3.4% appears at first to be low, it must be remembered that this was not intended as a random sampling of the university population. Because the research was targeted at people who currently cycle or who would consider cycling, information from the majority of (or a random sample of) the university population was not of interest. The number of current cyclist respondents is very close to the number of cyclists estimated in a recent survey as commuting to the university (19). That study found that 10.4% of 1,731 faculty members, 3.7% of 2,990 staff, and 3.2% of 24,238 students commute by bicycle to the university, for a total of 1,066 cyclists. Considering that 209 possible cyclists responded to the survey, the remaining 919 current cyclist respondents account for more than 85% of the estimated commuter cyclists on campus. This high proportion suggests that the web-based survey was quite successful in reaching the target population in the university community.

RESULTS AND DISCUSSION

Type of Cyclist, Gender, and Age

The first survey question asked respondents to identify their use of cycling as a means of transportation to campus (Figure 1). Respondents who selected Category 1 were considered noncyclists with no possibility of becoming cyclists, and were excluded from the majority of further analysis. Respondents who selected Category 2 were categorized as possible cyclists, and are discussed in the first subsection of the results. The respondents who chose Categories 3, 4, or 5 were considered current cyclists with varying degrees of bicycle commuting frequency, and are analyzed in the second section of the results.

A significant association was found between gender and type of cyclist. A significance level of .05 was used. If a probability for a result was found that was lower than this threshold, it is reported. In this case, the chi-square statistic is significant at the .01 confidence level. Female respondents were more likely than male respondents to fall into the possible or occasional cyclist category, whereas male respondents were more likely than female respondents to be regular cyclists, either when conditions were favorable or throughout the year. These findings are consistent with previous research findings that in North America women do not commute by bicycle as frequently as men do (2–7). Of current campus cyclist survey respondents, however, 44% were women, which is considerably higher than the 21% of Calgary downtown commuter cyclist survey respondents who were women (1). The large number of women who responded

as possible or occasional cyclists affirmed that women consider commuting by bicycle and account for a large portion of latent bicycle demand.

When the age of the respondent was considered, it was found that for males, older respondents commuting to the university for work were more likely to belong to the regular cyclist categories, whereas younger respondents traveling to class were more likely to belong to the possible or occasional cyclist categories (chi-square $p = .02$). There was no such relationship for female respondents. Thirty-three years was selected as the dividing age.

Possible Cyclists

Gender, Age, and Barriers to Cycling

Possible cyclists were asked what prevented them from commuting by bicycle to campus and were instructed to check all the listed barriers that applied to them. In Figure 2, the results are ordered by the overall percentage of respondents who selected each barrier.

A *t*-test was used to determine if significant differences existed between male and female respondents for each barrier. Significant differences were found in four barriers (Figure 2). In all four cases, female respondents selected the option significantly more often than male respondents did. These findings support previous research in women’s issues in transportation (9–12) and the findings from previous research on women and commuting by bicycle (3–6). With regard to the number of options selected by men and women, women

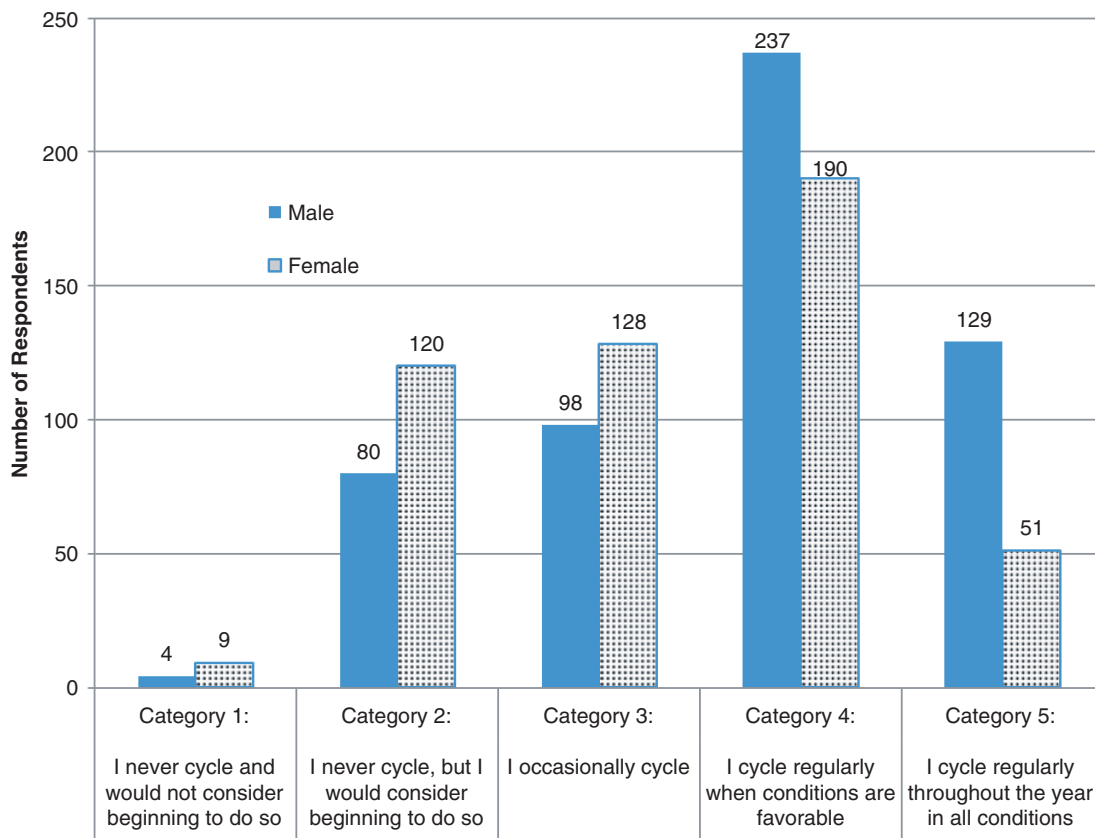


FIGURE 1 Distribution of respondents by type of cyclist and gender (possible cyclist, Category 2; current cyclist, Categories 3, 4, 5).

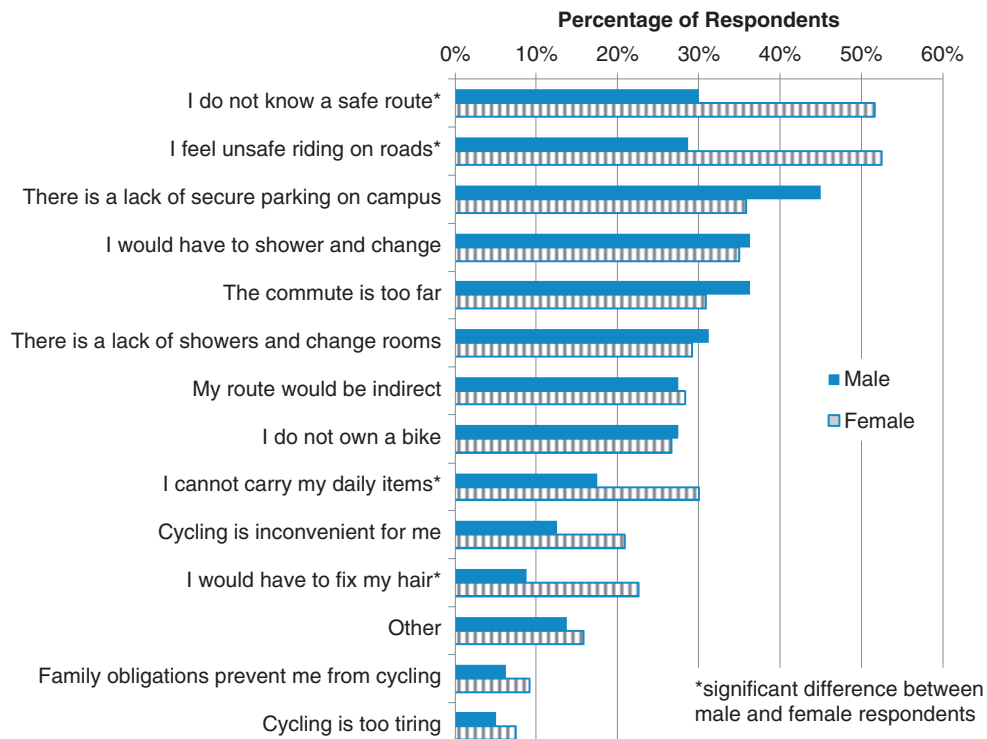


FIGURE 2 Possible cyclists' barriers to commuting by bicycle by gender.

selected an average of 3.96 reasons for not cycling, whereas men selected an average of only 3.26 reasons, which is a significant difference ($p = .02$). This difference suggests that women perceive not only different, but also more barriers to cycling than men do.

The possible cyclist respondents were grouped two ways to determine if age is an important factor in perception of cycling barriers. The group was first split by age and then analyzed by gender. When younger respondents were analyzed, the majority of the significant differences disappeared. The only barrier indicated by younger women significantly more often than younger men was not knowing a safe route. In analysis of older respondents, the barriers that were indicated significantly more often by women than men (ordered from largest to smallest difference) were the following: I feel unsafe riding on roads, I would have to fix my hair, cycling is inconvenient for me. Older men did not indicate any barriers significantly more often than older women did.

Next, the respondents were split by gender and analyzed by age. *T*-tests were used to compare older and younger respondents of the same gender. When women were analyzed, younger women were significantly more likely than older women to indicate that the commute is too far and that they do not know a safe route. Younger men were significantly more likely than older men to indicate that the commute is too far, that they would have to fix their hair, and that cycling is inconvenient. Both older men and women were more likely than their younger counterparts to indicate that family obligations created a barrier to commuting by bicycle.

From this analysis, two conclusions can be drawn. First, although all women are likely to indicate that safety concerns prevent them from commuting by bicycle, there is a difference in the type of safety concern expressed by older and younger women. Younger women are unsure about the route to take, while older women are more concerned with feeling unsafe riding on the road. Second, both male and

female younger cyclists are more likely than older cyclists to state that the commute is too far. This could be either because they are more sensitive to cycling distance, or because students who live with their parents tend not to have significant input about where they live.

Desired Improvements and Gender

Possible cyclists were asked to rank their top three most desired on-route and destination improvements from a list of 15 options for each (Figure 3). The list of on-route improvements was adapted from the city's downtown commuter cyclist survey to allow for comparisons with the findings of that study.

Considering on-route improvements, the largest percentage of possible cyclists indicated a desire for bicycle lanes, followed by more direct routes, and then by more bicycle paths. There was no significant difference by gender in the selection of any of the on-route improvements. This finding supports previous research that concluded that men and women have similar facility preferences (2, 4), and research that found that bicycle network connectivity (14, 16, 17, 20) and directness of route (2) are important factors in positively affecting levels of bicycle commuting. The similar desire for bicycle lanes is noteworthy because it contradicts previous research that suggested that women prefer to be separated from traffic (5). The strong desire for bicycle lanes is also interesting because there are currently only 7 km of on-road bicycle lanes in Calgary. Instead of developing bicycle lanes, the city has focused on implementing a marked (by roadside signs only) on-street bike route system, which received the lowest ranking from both male and female possible cyclists.

The most requested on-campus improvement by possible cyclists was that of new showers and change rooms, followed by enclosed or caged parking and improved rack location. Significant differences

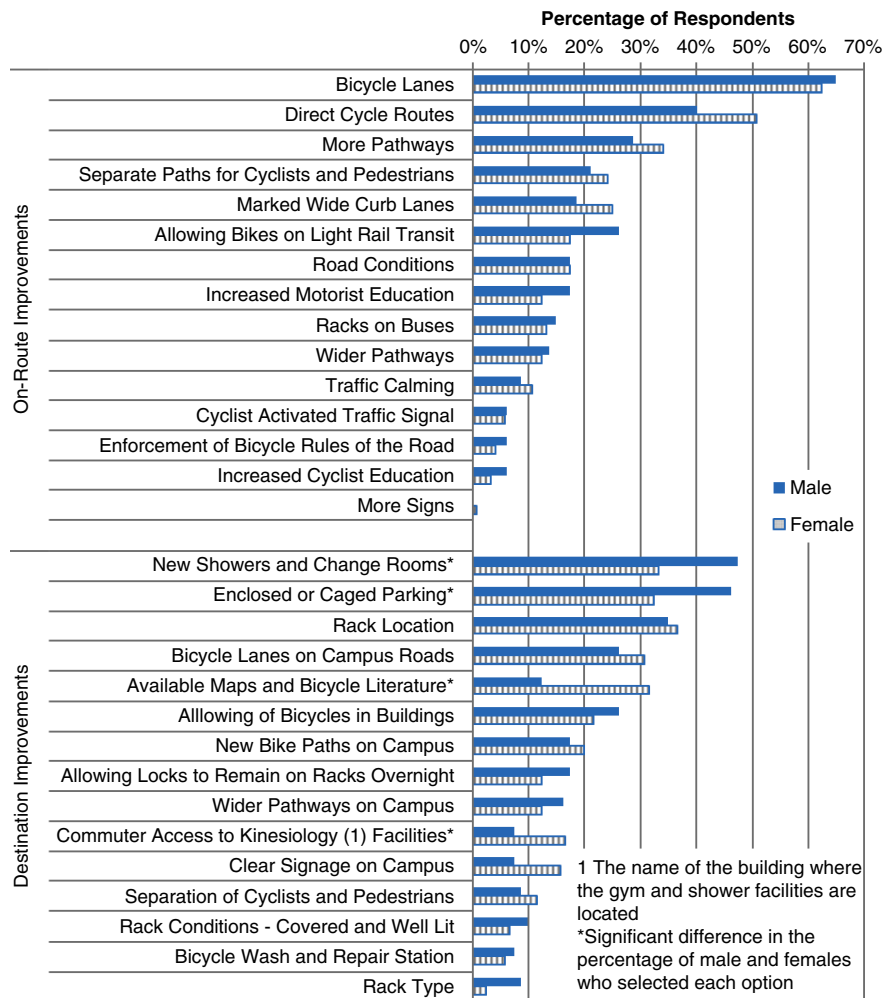


FIGURE 3 Percentage of possible cyclists who selected each option as first, second, or third most important improvement.

were found between male and female respondents in the desire for four improvements, marked with asterisks in Figure 3. The most notable difference is in the desire for more bicycle maps and literature. This finding appears to be related to not knowing a safe route, a barrier that was reported considerably more often by women than men. Garrard et al. suggested that women require more support, motivation, and instruction to begin cycling than men do (4), which appears to be supported by this finding. Male respondents indicated a greater desire for secure bicycle parking and for showering and changing facilities on campus.

Cyclists

Frequency of Commute, Gender, and Age

Current cyclists were asked how many days per week they commute by bicycle on average in spring, summer, fall, and winter. From those data, the average number of days per week commuted by bicycle during the entire year was calculated. The average number of days per week cycled by men and women in both older and younger age groups was compared using a *t*-test (Table 1). The shaded numbers signify differences between men and women within the age category signif-

icant at the .01 confidence level. (The cycling categories are those defined in Figure 1.) When the seasons were considered individually, winter was found to be the only season with significant association between frequency of cycling and gender (using a chi-square test). Women in Categories 4 and 5 cycled significantly less frequently than men in the same categories during the winter.

Length of Commute, Gender, and Age

Cyclists indicated their length of commute by selecting the appropriate category in two questions, one pertaining to the duration of the journey in minutes and the other to the distance of their commute in kilometers. There were 460 males and 364 females who responded to the duration question, and 300 males and 229 females who responded to the distance question. The disparity in the response rate between the two questions is likely because the duration question appeared near the beginning of the survey and the distance question appeared near the end. The distance question was not asked of respondents who chose to digitally trace their routes. Their distance was extracted from the digital maps and manually entered into the distance variable. A significant positive correlation (Spearman’s rho) was found between age and both distance and duration for males, but not for females.

TABLE 1 Frequency and Length of Bicycle Commute by Gender and Age

Age and Gender	Average Number of Days per Week Commuted by Bicycle			Digital Map Distance (km)
	Category 3	Category 4	Category 5	
All				
Men	0.97	2.51	4.43	7.50
Women	0.92	2.23	3.70	6.34
Younger than 33 years				
Men	0.97	2.52	4.53	6.53
Women	0.98	2.27	3.64	6.30
Older than 33 years				
Men	0.98	2.50	4.30	8.95
Women	0.75	2.13	4.00	6.44

NOTE: Shading signifies differences between men and women within the age category significant at the .01 confidence level.

Using distances from the digital maps, it was possible to compare the mean distances traveled by men and women. The results in Table 1 are based on 67 women and 116 men. The mean difference of 1.16 km is not significant. Although the average female respondents' commute is consistently shorter than the average male respondents', the lack of significance of the difference limits support for previous studies that found that women travel less than men do when commuting by bicycle (2, 5, 6). From the digital mapping distances, older men were found to commute significantly further than younger men. Although older women traveled slightly further on average than younger women, the difference was not significant.

Gender and Occurrence of Collisions and Falls

Current cyclists were asked if they had ever experienced a fall or collision while cycling to campus. Following Aultman-Hall's approach (2), a collision was defined as an event where the bicycle hits, or is hit by another person, vehicle, or object. A fall was defined as an event where, without colliding with another object, vehicle, or person, the cyclist lands on the ground. Cyclists who had experienced a fall or collision were asked how many of each type of incident they had experienced. The proportion of cyclists who had experienced a fall or collision was compared by gender using a chi-square test

(Table 2). The three categories of cyclists were analyzed separately because people who cycle more often are more likely to have experienced a fall or collision. In all three categories, men were more likely to have experienced a fall, although this result was significant at the .05 confidence level only for cyclists in Category 4.

When collisions were analyzed, male cyclists were found to have more collisions on average than female cyclists in all three categories. The difference was not significant in any of the categories, but was for all categories combined. When people who had experienced a fall or collision were asked if they had been injured in the event, there was no significant difference in the proportion of male and female cyclists reporting an injury (chi-square).

To test if the difference in the proportion of men and women who had experienced a fall or collision was because men cycle further and more frequently on average than women, three exposure rates were calculated, as shown by Equations 1, 2, and 3:

Ordinal time categories, 769 cases analyzed:

$$\text{time exposure} = \frac{\text{days cycled}}{\text{week}} \times \frac{\text{time cycled}}{\text{day}} \times \frac{52 \text{ weeks}}{\text{year}} \times \text{years cycled} \tag{1}$$

TABLE 2 Occurrence of Falls and Collisions

Incident Occurrence	All		Younger than 33 Years		Older than 33 Years	
	Men (%)	Women (%)	Men (%)	Women (%)	Men (%)	Women (%)
Respondents who have experienced a fall						
All cyclists	58.9	39.6	53.1	37.1	69.3	46.0
Category 3	39.6	28.2	36.8	22.8	46.4	43.8
Category 4	54.9	39.7	50.3	37.7	63.8	44.1
Category 5	80.6	66.7	74.6	66.7	87.9	66.7
Respondents who have experienced a collision						
All cyclists	13.9	7.1	11.2	6.4	18.6	8.9
Category 3	6.2	4.0	5.8	2.2	7.1	9.1
Category 4	11.0	6.9	10.3	6.9	12.3	6.8
Category 5	24.8	15.7	18.3	14.3	32.8	22.2

NOTE: Shading denotes significant differences at $p = .05$.

Ordinal distance categories, 501 cases analyzed:

$$\text{distance exposure}_1 = \frac{\text{days cycled}}{\text{week}} \times \frac{\text{distance (ordinal)}}{\text{day}} \times \frac{52 \text{ weeks}}{\text{year}} \times \text{years cycled} \quad (2)$$

Digital mapping distance, 174 cases analyzed:

$$\text{distance exposure}_2 = \frac{\text{days cycled}}{\text{week}} \times \frac{\text{distance (mapping)}}{\text{day}} \times \frac{52 \text{ weeks}}{\text{year}} \times \text{years cycled} \quad (3)$$

Respondents were asked to select the year that they began commuting by bicycle to campus from provided categories. The earliest option provided was 2006 or before. If the respondent selected this option, his or her number of years was counted as 5, even though it may have been more. By use of the calculated exposure rate and the number of falls and collisions reported by the respondents, an average number of incidents per time and distance exposure was calculated and compared (Table 3).

The most noticeable difference in fall rates was found when younger and older cyclists were analyzed separately. Older cyclists were found to experience consistently fewer falls than younger cyclists, although this is significant only when the rates are calculated from ordinal distance categories for all cyclists together. A similar trend was also found in analysis of collision rates, with older cyclists experiencing consistently fewer collisions than younger cyclists. When fall rates were investigated with no split by age, no significant differences were found in the number of falls experienced per unit of exposure between men and women in time, ordinal distance, or digital mapping distance. When collision rates were analyzed, men consistently experienced more collisions per exposure unit than women did, but the difference was not significant at the .05 confidence level.

Because time and distance were collected only in categories, the midpoint of the selected category was used as the time or distance value for the calculation. This selection makes these calculations less accurate, and is the probable cause of the disparity between the incident rates per distance calculated using digital mapping distances and those calculated using ordinal mapping values. The rates based on digital mapping distances are probably a better estimate, even though the number of observations is smaller. From all of the rate calculations, it is clear that falls are more common than collisions.

Desired Improvements and Gender

Current cyclists were asked to rank their most desired on-route and destination improvements in the same way that possible cyclists were. The percentage of respondents who chose each option as one of their three most important improvements categorized by gender is shown in Figure 4.

The most requested on-route improvement, by a factor of two over the second most requested improvement, is the desire for more bicycle lanes. Although more pathways was the second most requested improvement, the number of requests by women for more pathways is less than half of the number requesting more bicycle lanes. This finding suggests that women do not appear to have a strong preference for off-road bicycle paths and have an equally strong desire for bicycle lanes as men do. Considering that the top three selections by both men and women pertain to the connectivity of the network, the availability of bicycle facilities, and the directness of route, the type of infrastructure may not be as important as the existence of a facility. Women, as much as men, seem to desire a fast, easy route to their destination. Men and women were also similar in the low importance they placed on signage, with the option of more signs ranking as the least-cited improvement.

A *t*-test was used to determine if there was any significant difference in the desire for an improvement between male and female respondents. For on-route improvements, there was a significant difference in the desire for bicycles to be allowed on the light rail transit system at all times, with women selecting this option significantly more often than men. Currently, bicycles are not permitted on the train during weekday peak hours (6:30 to 9:00 a.m. and 3:00 to 6:00 p.m.) or in crowded conditions such as before and after National Hockey League hockey games or concerts. Men were more likely than women to indicate a desire for wide curb lanes, a facility that is similar to an on-street bicycle lane.

With a *t*-test, significant differences were found between men and women in three destination improvements: clearer signage on campus, more bicycle maps and literature, and wider pathways on campus. The first two improvements were indicated significantly more often by women and the last by men. The first two desired improvements are consistent with findings about women's need for cycling instruction and encouragement. The third finding is somewhat unexpected in that it is not supported by any previous literature. Bicycle lanes are a highly desired amenity on campus and were the most requested destination improvement by both genders. Secure parking, the availability of showers and lockers, and permission to bring bicycles in campus buildings are all improvements that are highly desired by men and women.

TABLE 3 Occurrence of Falls and Collisions per Time and Distance Exposure

Incident Occurrence and Exposure Rates	All		Men		Women	
	Younger	Older	Younger	Older	Younger	Older
Falls						
Average number of falls per 100 hours	1.11	0.99	1.13	0.90	1.10	1.16
Average number of falls per 10,000 km (from ordinal categories)	7.28	5.20	7.53	5.53	7.10	4.67
Average number of falls per 10,000 km (from digital maps)	5.75	5.42	5.50	5.62	6.23	5.13
Collisions						
Average number of collisions per 100 hours	0.18	0.07	0.22	0.08	0.13	0.05
Average number of collisions per 10,000 km (from ordinal)	1.29	0.48	1.79	0.58	0.73	0.29
Average number of collisions per 10,000 km (digital maps)	1.70	0.58	2.79	0.77	0.17	0.05

NOTE: Shading denotes significant differences at $p = .05$.

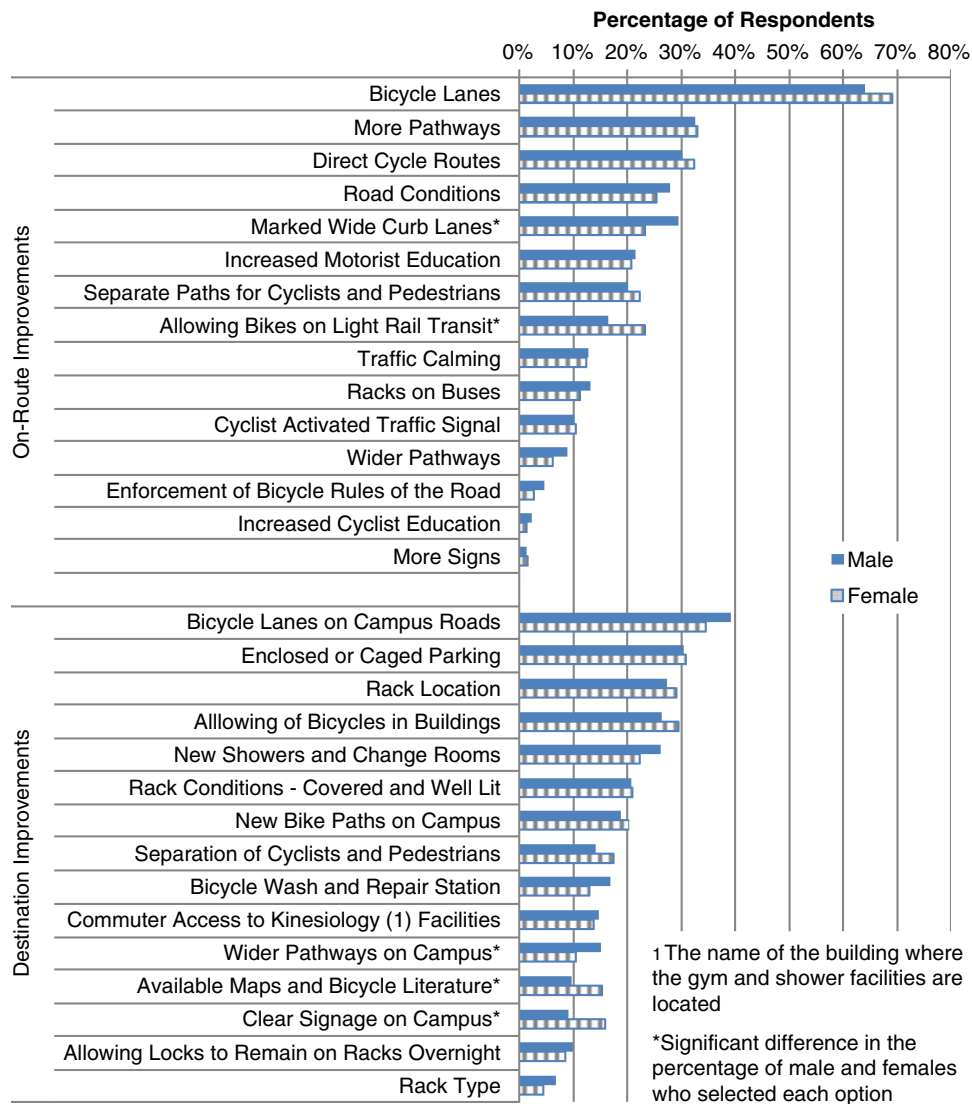


FIGURE 4 Percentage of current cyclists who selected each option as first, second, or third most important improvement.

CONCLUSIONS

The intention of this research was to gain information from both people who currently cycle to a university and those who have considered doing so. The online survey method allowed the entire campus community access to the survey, which ensured that possible cyclists and occasional cyclists also had an opportunity to voice their opinion. This method also proved very successful at reaching commuter cyclists to campus because more than 85% of the estimated cyclists on campus responded to the bicycle survey.

Possible and occasional cyclists are an important demographic to consider because they present a huge possibility to increase bicycle modal share. The distribution of respondents to the survey suggested that women are more likely to belong to the possible and occasional cyclist groups, whereas men are more likely to be regular cyclists, either in favorable conditions or throughout the year. Consequently, women’s cycling needs should be addressed to attract a large proportion of the possible and occasional cyclists to regular bicycle commuting. In the analysis of barriers to cycling for possible cyclists, women

were found to have a greater concern for safety while cycling than men were. When desired improvements were analyzed, women indicated a much stronger desire for bicycle maps and literature. These two findings together suggest that a combination of improving cyclist safety to and on campus and informing women about safe routes would increase the likelihood of female possible cyclists beginning to commute by bicycle. Female possible cyclists shared similar on-route facility preferences with male possible cyclists. Both indicated a strong desire for more bicycle lanes, more direct routes, and more bicycle pathways.

Analysis of current cyclists to the University of Calgary indicated that women cycle less frequently than men in the same cyclist categories, and women cycle shorter distances on average than men do, although this was not found to be significant. This finding suggests that even in the current cyclist category, women present a large opportunity to increase bicycle commuting if their needs were directly addressed. A clear desire for more bicycle lanes became apparent when the desired improvements for current cyclists were analyzed. There was no difference in the desire for bicycle lanes between men and women. Although women indicated more concern for safety than

men did, analysis of the occurrence of falls and collisions concluded that male and female cyclists experience similar fall rates per measure of exposure, and male cyclists experience more collisions per rate of exposure on average than female cyclists do, although not significantly so. Cyclists also appear to become safer as the cyclists themselves age, with older respondents reporting fewer falls and collisions per exposure measure than younger cyclists.

Many improvements could be made on campus and by the City of Calgary to increase the modal share of bicycle commuting to campus. The single most important improvement that could be implemented by both the city and the university is the provision of bicycle lanes on roads to and on campus. This was the most requested improvement by both possible and current cyclists. Other requests clearly indicate a desire for a connected, direct, and safe cycling network. Considering that female possible cyclists identified safety concerns most frequently as a reason for not currently cycling, safety improvements could encourage these women to try commuting by bicycle. Many of these suggestions could be implemented to and on campus to create a better cycling environment. In addition, women at the university appear to need more encouragement and support to begin cycling then men do, so the promotion of cycling to and on campus by increasing the amount of available literature and bicycle maps may encourage women to cycle more.

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