# SECURE INVESTMENT FOR ACTIVE TRANSPORT: WILLINGNESS TO PAY FOR SECURED BICYCLE PARKING IN MONTREAL, CANADA

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**ABSTRACT**

Fear of bicycle theft and related vandalism discourages bicycle usage. The present study recognizes this problem and aims to understand whether or not users are willing to pay for secured bicycle parking (SBP) in Montreal, Canada by examining the following research questions: 1) Are users willing to incur some of the extra cost of improving bicycle parking infrastructure? 2) Of those willing to pay, what are their common characteristics? and 3) Is there a distinction between those who are willing to pay and those who are able to pay? Results from a bilingual (English/French) online bicycle theft and parking survey provided 1,533 responses about cyclists' willingness to pay for (SBP). Forty-three percent would be willing to pay at least $0.50/day for SBP, and the highest daily amount that some participants are willing to pay is $15.00. Findings from this study demonstrate that cities will benefit from improving their cycling infrastructure by installing SBP facilities and cyclists who state that risk of theft influences their decision to cycle are more likely to pay for SBP. The results show that pricing of SBP facilities can be an option, yet should stay low to ensure that security provided by paid bicycle parking always remain an incentive to use a bicycle.

## INTRODUCTION

Transportation professionals have been promoting more sustainable urban transportation systems that include well-designed pedestrian and cycling infrastructure. Most recent research focuses on the environmental, economic, health, and social benefits of walking and cycling, and often includes the opinions of active transportation users on the built environment [*1-2*]. While there is much literature about users' experiences of cycling on bicycle lanes, boulevards, and paths, few studies evaluate cyclists' perceptions about the security and availability of bicycle parking facilities, especially paid bicycle parking. Much like motorized vehicles, bicycles are more often kept in parking or storage facilities than being ridden by a cyclist. While the development of cycling networks deserves continued attention, the study of bicycle parking must not be left behind as cities continue to promote active transportation.

Previous studies found that fear of theft and bicycle vandalism discourages bicycle usage among some groups of cyclists [*3-6*]. The present study recognizes this problem and aims to understand whether users are willing to pay for secured bicycle parking (SBP) by examining the following research questions: 1) Are users willing to incur some of the extra cost of improving bicycle parking infrastructure? 2) Of those willing to pay, what are their common characteristics? and 3) Is there a distinction between those who are willing to pay and those who are able to pay? The data used here is from an online survey conducted in Montreal, Canada, designed to better understand bicycle theft. Although the survey includes information about travel and parking behavior, and cyclists' theft histories, this research primarily uses the socio-demographic data and information about participants' willingness to pay (WTP) for SBP to analyze the abovementioned research questions. While this research analyses the amount cyclists are willing to pay per day for SBP in the Montreal region specifically, transportation professionals in other cities can benefit from these findings as it provides insight into a new area of research.

## BICYCLE PARKING

Transport Canada [*7*] recognizes that providing SBP is necessary to promote bicycle use. It identifies two types of parking required by cyclists, short-term and long-term, and distinguishes them by design and level of security. Short-term parking can encourage individuals to use bicycles for utilitarian trips (e.g., shopping, running errands); it is most frequently free of charge, located in highly visible outdoor locations, and used by the general public. Short-term parking generally has a low level of service, often without weather protection, and limited protection against vandalism and theft. On the other hand, long-term parking can promote bicycle use for commuting since commuter cyclists often need a place to store their bicycles for long periods of time. Some integrate transit into their trips, thereby requiring long-term SBP at transit nodes, rather than at final destinations. Long-term parking is often made up of bicycle racks in a partially or fully enclosed area, or lockers that enclose each bicycle individually. It can be located either indoors or outdoors and frequently has higher levels of weather protection and security against vandalism and theft. Some of these facilities charge a fee for usage and are commonly designed for exclusive use by paying cyclists. These facilities are available on a pay-per-use basis or assigned for long term rentals (e.g., weekly, monthly) [*7*].

In Canada, several examples of paid long-term SBP exist. Toronto's Union Station and Victoria Park Bicycle Stations, for example, charge CA$2.15/day, or $64.57 for four months plus a one-time CA$26.91 membership fee [*8*]. In Montreal, Concordia University's SBP Facility

charges staff and students CA$30 a trimester [*9*]. Metro Vancouver's transportation authority, Translink, provides bicycle lockers at transit interchanges for CA$30 for three months [*10*]. Though no counterpart currently exists in Canada, the US-based consulting, management, and development firm Bikestation has engaged in several public-private partnerships to facilitate the development of SBP facilities [*11*]. Bikestation charges a US$20.00 annual membership fee plus US$2.00/day for casual users, or a US$96.00 annual fee. Since the installation of bicycle lockers in many cities, the service has become overwhelmingly popular, thereby creating wait-lists. Although paid bicycle parking is only sparsely available throughout North America, it is beginning to become more popular in regions where bicycle use is increasing.

This paper aims to identify and understand the factors that contribute to cyclists' WTP for long-term SBP facilities in Montreal, Canada. It follows the framework of earlier studies that aim to assess users' WTP for a non-market good by using the stated preference contingent valuation method. This method provides quantitative measures to assess the financial value representative of theft-preventing bicycle infrastructure. Since WTP for SBP is a relatively unexplored area of research, the related literature on the contingent valuation (CV)/WTP method, parking pricing strategy, and users' WTP for improved transportation infrastructure is discussed below.

## CONTINGENT VALUATION/WILLINGNESS TO PAY METHOD

### *Strengths and weaknesses*

The CV/WTP method asks individuals to price a service, and uses the stated prices to determine the value of a non-market good. The method is used in the absence of a price for a good and has been tested in many disciplines for the last two decades. It was initially popular in the environmental and public health fields, but has recently been utilized in crime and justice studies [*12-13*]. Like most methods, CV/WTP has strengths and weaknesses. According to Piquero et al. [*13*], it accurately estimates an individual's attitude toward the perceived price of a good and is, therefore, useful to place economic value on something that has not previously been assigned a monetary price. Yet, without understanding what the respondent believes to be the cost of the service, it is difficult to determine on what a respondent's stated price is based [*13*]. In this study, when determining the appropriate price of SBP in Montreal, individuals are able to state the amount that they would be willing to pay without having been given any indication about how much the costs of SBP would be. A problem with CV/WTP is that individual stated prices may not at all reflect actual costs. Another issue with this method is that the stated price is not certain to accurately reflect the dollar amount individuals will pay for a service when it becomes available. Cohen [*14*] calls this a "hypothetical bias" because the hypothetical dollar value is not always in accordance with the actual dollar value. Cohen [*14*] claims that a caution should be made with regard to participants' likeliness to state what they believe is the socially appropriate amount of dollars they are willing to spend, rather than a purely personally evaluated amount [*15*]. Another common objection to assessing WTP is that it fails to account for ability to pay. For lower income groups, low ability to pay often results in low reported WTP, thereby leading to a greater provision of non-market goods, such as SBP, to higher income groups [*16*].

### *Improving the public realm*

Whereas charging a fee for bicycle parking is relatively new, paid automobile parking was first introduced in Oklahoma in 1935 [*17*]. Manville and Shoup [*18*] state that "most cars are parked

most of the time, and both auto use and auto ownership are easier if a car can be cheaply and reliably stored when it is not being driven." Optimizing the security, design, and availability of both car and bicycle parking facilities deserves attention in transportation, not only because it is where these vehicles spend most of their time, but also because parking is currently the part of the bicycle network that is the least efficient in terms on security and availability.

Whereas fees for paid car parking can be set high to function as a negative incentive for driving to certain locations, fees for SBP should not be a disincentive for using a bicycle or a motivation to vacate spots quickly, as with car parking [*19*]. Rather, SBP should be an incentive for bicycle use due to increased levels of security. Aiming to better understand how to determine an appropriate price for SBP in Montreal, the following section reviews literature that uses CV/WTP to determine how much users are willing to pay for other transportation infrastructure.

*Transportation infrastructure improvements*

Anastasiadou et al. [*20*] used CV/WTP to determine the demand and appropriate fee for new car parking facilities before they are constructed. Whereas past studies have determined parking fees by estimating elasticity-price curves and comparing alternative services, these authors claim that parking fees should instead be determined based on three principles: the fee should reflect service quality, the economic viability and security of the project, and the demand and needs of the population, especially during peak hours. In their study, they surveyed participants' WTP for parking and socioeconomic characteristics, and found that younger drivers, those with more education, and people with higher incomes were willing to pay more for parking than other groups [*20*].

Outside of the parking realm, dell'Olio et al. [*21*] used a stated choice survey to construct logit models to measure individuals' WTP for transfer time, information, and services at transport interchanges. Jou et al. [*22*] used CV in combination with a spike model to determine freeway drivers' WTP for a distance-based toll. O'Garra et al. [*23*] used CV to compare public WTP for pollution-reducing hydrogen buses in four cities. McDonnell et al. [*24*] used a stated choice analysis, multinomial logit, and random parameters logit models to investigate how residential location and temporal experience of bus priority and mode choice influence participants' WTP. More recently, Russo et al. [*25*], used a dynamic search methodology approach to determine university workers' WTP for commuting time. Although these abovementioned studies are not specifically about parking, they contain useful information that can help better understand cyclists' WTP for SBP.

*Bicycle parking and security*

Although CV/WTP does not appear to have been used in the literature to determine cyclists' WTP for SBP, other studies have analyzed how the design, availability, and geographic location of bicycle parking influence ridership. For example, Taylor et al. [26] included the variables 'on-street bicycle facility type,' 'bicycle parking facility type,' and 'bicycle access distance to transit' in a mode choice study and found that cyclists were more likely to increase usage when bicycle lockers and lanes were present. Papon et al. [27] surveyed cyclists to determine the most optimal location for SBP and found that most cyclists prefer secured parking near rail stations, and expect it to be free of charge and available 24 hours a day. These authors note that WTP for SBP is an area of research that requires further attention [27].

## STUDY CONTEXT

The cycling mode share for the Montreal region is 1.2% of all trips, which is in line with the Canadian national average [*28-29*]. The City of Montreal's 2008 Transportation Plan aims to increase the cycling mode share, not only by expanding the bicycle network, but also by increasing the number of parking facilities by 500% [*30*].

In addition to increasing cycling, bicycle parking expansion is intended to reduce bicycle-related crime. According to the city's police department, approximately 2,500 bicycles are reported stolen every year but this number likely represents a small portion of all thefts [*31*]. A Montreal bicycle theft committee estimated the actual theft numbers to be more likely between 15,000 and 30,000 in 2011 [*32*].

## DATA AND METHODOLOGY

The data used here was compiled from a bilingual (English/French) online survey on bicycle theft that was conducted in the Montreal region. A variety of measures were taken to allow for broad exposure and reduce sample bias normally associated with online surveys. As recommended by Dillman et al. [*33*], they included circulation through a combination of email newsletters, mailing lists, newspaper articles in French and English, a radio interview, and a number of social networking platforms.

The survey yielded a total sample of 2,039 individuals over a one-month period in late spring 2012. This is similar to the number of home-based cycling trips recorded in the regional origin-destination survey, which samples 5% of the region's population [*34*]. While the survey posited a number of questions relating to bicycle theft, this study uses data only from participants who answered the question, "Would you consider paying for supervised or secured bicycle parking? (i.e., security guard, bicycle locker, bicycle parking garage)." The analysis also uses socio-demographic information from the survey, including participants' age, gender, income, employment status, and household size. Respondents who left any of these questions unanswered were removed from the sample. The final sample size used in this study is 1,533 Montreal cyclists, of whom 43% are willing to pay for secured parking.

As mentioned previously, this study recognizes that fear of bicycle theft and vandalism can discourage cycling for transportation. The paper aims to understand whether users are willing to incur some of the costs of improving bicycle parking infrastructure, the common characteristics of those who are and are not willing to pay, and whether these characteristics change when an individuals' ability to pay is taken into consideration. Socio-demographic information about the survey participants is presented in Table 1. This is followed by a series of logit models. The first is a binary logit model that determines the characteristics associated with whether cyclists are willing to pay for SBP. The second is an ordered logit model that takes into account the amount cyclists are willing to pay, and the third is a binary logit model that recognizes that WTP differs from ability to pay and only models the data for participants whose household income is high enough to likely offer them the ability to pay for SBP. The data collected from the survey question, "Would you consider paying for supervised or secured bicycle parking? (i.e., security guard, bicycle locker, bicycle parking garage)" is used for the first and third models. The results are used to identify factors that have the most influence on survey participants' WTP for SBP. The second model uses the results from the question "How much per

day?" to determine individuals' WTP. Data for this question is taken from survey respondents' selection from a dropdown menu with $0.50 as the lowest price and $50.00 as the highest, and options in between at $0.25 intervals. The ordered logit model is used to analyze the variation in cyclists' responses and to better understand the relative influence of factors on the price cyclists are willing to pay for SBP. Finally, to account for the potential discrepancy between WTP and ability to pay, a binary logit model that includes only the sample subset with an annual income greater than $60,000 is presented. This threshold captures the closest survey income category to Montreal's median total household income ($67,010) [*36*], and approximately half of the participants fall into this group, retaining a useful sample size. This final model demonstrates that the significant variables in the earlier models are similarly significant when only the sample subset that is likely to be able to pay for parking is taken into account. The results of this model confirm that WTP in this study is not affected by ability to pay.

## SUMMARY STATISTICS

The respondents' ages range from 18 to 85. The average age for cyclists who are willing to pay is 39, and the average for those not willing to pay is slightly lower at 36. Women, accounting for 42% of the survey, are slightly overrepresented, compared to O-D survey figures (see Table 1). Most of the respondents are employed full-time and have completed at least an undergraduate degree. In accordance with the O-D survey, the largest groups of participants live in two-person households and have a household annual income of between $20,000 and $60,000. Approximately 50% of the participants reported that they had been victims of bicycle theft in their life time, a finding that resembles previous studies in Montreal [*3*].

**TABLE 1 Summary Statistics**

| | 2012 Bicycle Theft Survey | | | | | | 2008 Origin-Destination Survey (Adult) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | General | | WTP Logit | | | | | | | |
| | All survey respondents | | Willing To Pay | | Not Willing to Pay | | Bicyclists | | All | |
| **GENDER** | | | | | | | | | | |
| Male | 58% | (1,037) | 63% | (416) | 55% | (479) | 65% | (1,029) | 47% | (58,890) |
| Female | 42% | (738) | 37% | (249) | 45% | (389) | 35% | (548) | 53% | (65,563) |
| **AGE** | | | | | | | | | | |
| Average Age | 37 | | 39 | | 36 | | 42 | | 48 | |
| 18-29 | 30% | (542) | 26% | (175) | 31% | (270) | 24% | (372) | 16% | (19,750) |
| 30-39 | 37% | (658) | 35% | (234) | 39% | (342) | 22% | (343) | 16% | (20,182) |
| 40-49 | 17% | (301) | 17% | (110) | 16% | (140) | 25% | (395) | 21% | (25,929) |
| 50-64 | 14% | (254) | 20% | (130) | 11% | (99) | 24% | (371) | 28% | (34,983) |
| 65+ | 2% | (41) | 2% | (16) | 2% | (17) | 6% | (96) | 19% | (23,609) |
| **HOUSEHOLD SIZE** | | | | | | | | | | |
| One | 21% | (369) | 20% | (131) | 21% | (182) | 22% | (346) | 15% | (18,203) |
| Two | 43% | (755) | 42% | (275) | 44% | (379) | 34% | (539) | 38% | (47,008) |
| Three | 19% | (335) | 19% | (129) | 19% | (160) | 20% | (310) | 19% | (24,121) |
| Four | 12% | (213) | 13% | (83) | 12% | (102) | 17% | (270) | 19% | (23,788) |
| Five or More | 6% | (100) | 7% | (44) | 4% | (38) | 7% | (112) | 9% | (11,333) |
| **OCCUPATION** | | | | | | | | | | |
| Employed | 71% | (1263) | 80% | (533) | 70% | (608) | 68% | (1070) | 58% | (71544) |
| Student | 21% | (370) | 14% | (93) | 24% | (207) | 13% | (200) | 8% | (9,872) |
| Retired | 3% | (50) | 3% | (18) | 3% | (22) | 11% | (181) | 25% | (31,057) |
| Other | 6% | (100) | 3% | (21) | 4% | (31) | 8% | (126) | 10% | (11,936) |
| **INCOME (household)** | | | | | | | | | | |
| <$20,000 | 14% | (245) | 9% | (59) | 16% | (143) | 15% | (186) | 12% | (10,217) |
| $20,000 - $60,000 | 36% | (618) | 29% | (192) | 40% | (346) | 46% | (588) | 44% | (38726) |
| $60,000 - $100,000 | 26% | (450) | 31% | (204) | 26% | (225) | 26% | (334) | 28% | (24688) |
| >$100,000 | 23% | (391) | 32% | (210) | 18% | (154) | 13% | (166) | 17% | (15,009) |
| *N** | 1,922 | | 665 | | 868 | | 1,577 | | 124,453 (all modes) | |

Figure 1 displays the reported rates that cyclists are WTP for SBP as cumulative percentages; it assumes that those WTP higher amounts would also be WTP lower amounts (i.e., all would be WTP $0). The highest amount that participants are WTP is $15.00. Less than 1% of participants are WTP more than $6.00, accordingly not included in Figure 1, but 43% are WTP at least $0.50. Ideal payments appear to be simple dollar amounts such $1.00 or $2.00. These findings are comparable to existing paid facilities where long-term SBP memberships often average less than $1.00/day, and casual SBP is priced at around $2.00/day [*8-11, 37*].

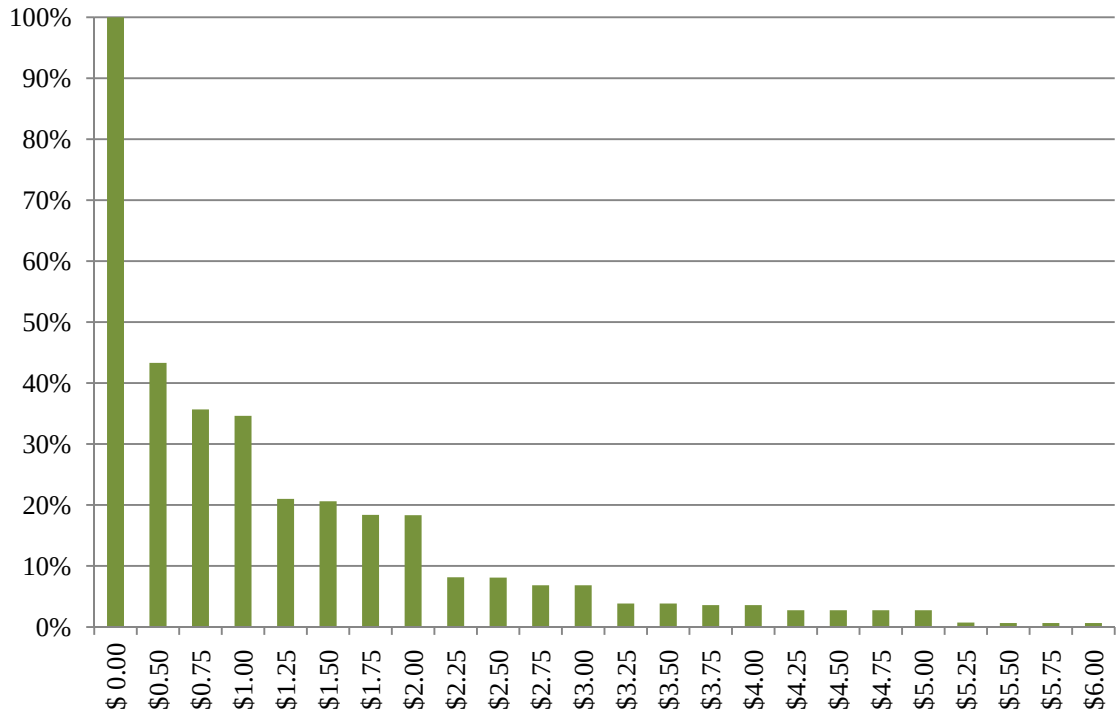


**Figure 1 Percentage of survey participants' WTP per price category.**

The following section discusses select summary statistics about different variables. It provides information regarding the sample's cycling habits, theft preventing attitudes, and household income.

*Cycling habits*

Survey participants ranked different motivations to cycle from 'not at all' to 'extremely' important. Figure 2 shows the number of cyclists who responded that a given reason was either 'very' or 'extremely' important, and compares the percentage of cyclists in each group who are and are not willing to pay for SBP. When survey participants were asked to rank six different kinds of bicycle parking facilities in terms of safety, secured bicycle lockers were the most favored [6].

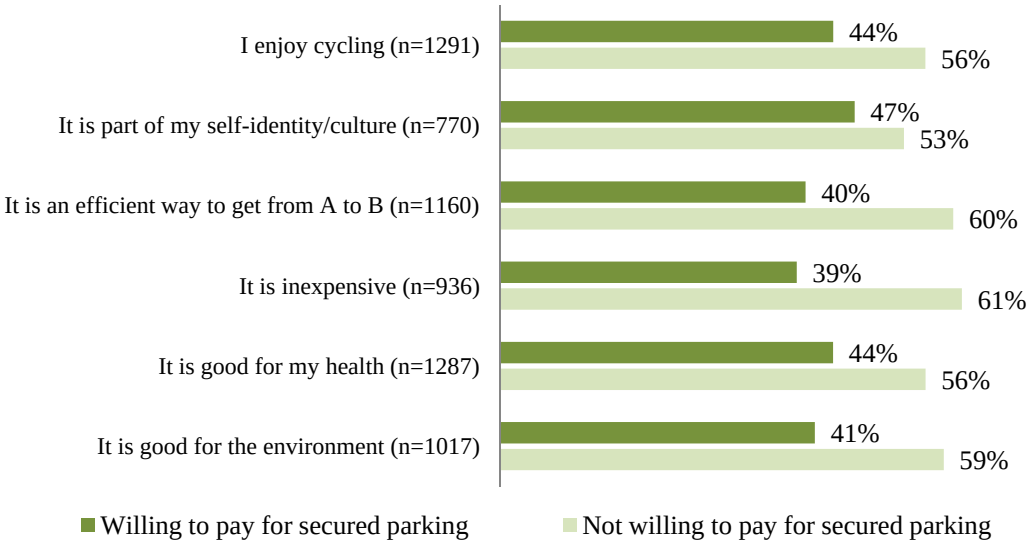


**Figure 2 Differences in WTP amongst survey participants who ranked reasons for cycling as 'very' or 'extremely' important.**

The enjoyment and health benefits of cycling ranked highest among reasons to cycle. When the chi-square of these variables was tested at a 95% confidence threshold, neither reason was statistically significant. In both cases, of the 84% of participants who ranked enjoyment and health benefits as 'very' or 'extremely' important, 44% were willing to pay for SBP, very near the survey-wide 43%. Using a bicycle because it is an efficient way to travel was statistically significant, and also highly regarded as important (76% 'very' or 'extremely' important). Finally, a cyclist's self-identity as a cyclist was also regarded as being important. Not surprisingly, cyclists who use a bicycle because it is an inexpensive form of transportation have the lowest percentage of WTP for SBP. Although only 50% of the total sample strongly identified with bicycle culture, nearly half within this subgroup were willing to pay for SBP.

With regard to seasonality, the survey results show that all cyclists in the sample cycle at least one summer month. Nearly all cyclists also ride in spring (98%) and fall (99%), with only 30% cycle during at least one winter month. This is most likely due to Montreal's harsh winter climate and seasonal bicycle network. While WTP for SBP is similar for spring, summer, and fall cyclists, it decreases slightly for winter cyclists, although this finding is not statistically significant. This could be because winter cyclists' higher levels of exposure may have allowed them to become more proficient with bicycle theft prevention practices.

Regarding the length of time cyclists feel comfortable cycling, those who were willing to pay for SBP indicated an average of 90 minutes (median 70 minutes), whereas those not willing to pay indicated only 79 minutes on average (median 60 minutes). It is likely that cyclists who are willing to pay for parking feel comfortable cycling longer periods than those unwilling to pay because they use their bicycles for commuting and, therefore, are more likely to require long-term SBP.

*Theft preventing attitude*

Survey respondents indicated that there are two contrasting strategies for theft prevention beyond simply locking the bicycles. The first, practiced primarily by owners of expensive bicycles, is to avoid storing a bicycle in open public places. Owners of these bicycles often keep them inside when not in use and are more likely to be willing to pay for SBP. The second strategy, more common with owners of lower value bicycles, is to use electrical tape, anti-theft rust stickers, spray paint, or decoration to make a bicycle less appealing to thieves. Owners of these bicycles are generally not willing to pay for SBP, and alternatively often engage in "fly-parking," the securing of bicycles to street furniture not intended to function as parking.

Another way to categorize different cyclists is by whether they have insurance for their bicycle(s). WTP for bicycle parking is clearly reflected in cyclists' WTP for insurance. Figure 3 demonstrates that most cyclists who have bicycle insurance are willing to pay for SBP, unlike those who in other categories.

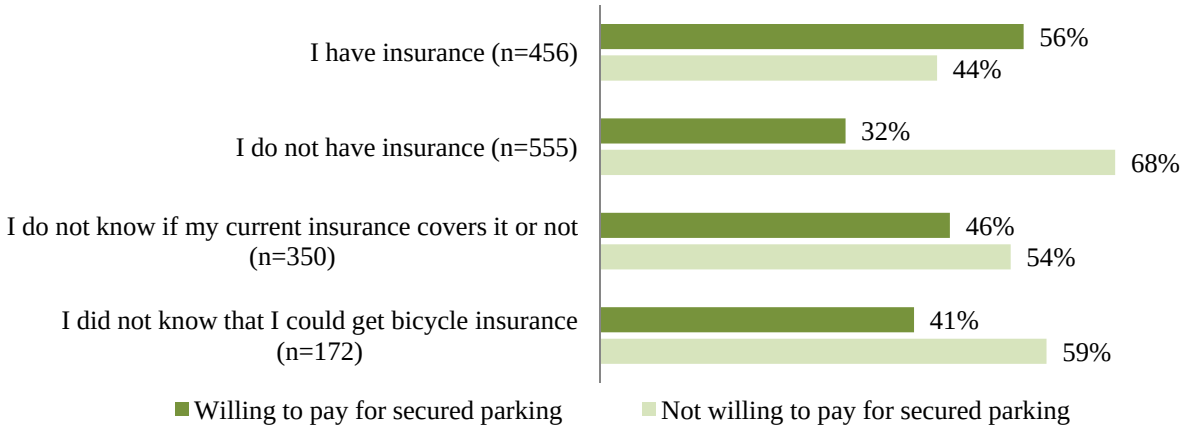


**Figure 3 Differences in WTP amongst survey participants who do and do not have insurance for their bicycle(s).**

*Household income*

Household income is a strong determinant of WTP. Analysis of the survey data shows that as a cyclist's household income increases, so does the WTP for SBP. Similarly, as the price of an individual's bicycle increases, so does the WTP. In the survey sample of respondents, cyclists who earn over $60,000 will, in general, be more willing to pay for SBP than not. Similarly, over half of cyclists who own bicycles worth more than $500 are willing to pay for parking. These findings substantiate concern that WTP can be influenced by individuals' ability to pay. The differences in participants' WTP and ability to pay are further discussed in the analysis of the third model below.

## DETERMINANTS OF WTP

The following section uses a series of logit models to better understand cyclists' WTP for SBP. First, a binary logit model identifies factors with the most influence on cyclists to be willing to pay for SBP. The second is an ordinal logit model that demonstrates which factors are more

likely to influence a cyclist's WTP nothing, $0.50-$1.00, $1.25-$2.00, or more than $2.00/day for SBP. The third model, which accounts for cyclists' ability to pay for SBP, is a binary logit that includes only the survey respondents with annual incomes of $60,000 or higher.

*Choice of variables*

A correlation matrix was used to choose appropriate variables for the models. Variables included individuals' habits, choices, and socio-demographic statuses. Many variables pertaining to monetary values such as 'insurance' and 'lock price' were not included because they were highly correlated with the 'income' variable. Other variables were not included because they did not show significance. Surprisingly, having been a victim of bicycle theft was not statistically associated with a cyclists' WTP for parking. The variable 'bicycle value' was included in the model to demonstrate that it is not only how much cyclists earn that affects WTP, but also the amount that cyclists are willing to spend on a bicycle. The variable 'theft influence' was included to account for how much risk of theft influences a cyclist to use a bicycle. Relevant literature was also consulted to decide which variables should be used.

The logit models below include information about cyclists' employment status, gender, age, and household income. The employment statuses 'retired' and 'other,' although not statistically significant, are kept in the model in accordance with the relevant literature which commonly accounts for participants' employment or work status. Gender, although not significant, is similarly included in the models for literature consistency. Cyclists' level of education is not included in the models because it was highly correlated with both employment status and income. Because the survey data does not have information about the distances cyclists commute, the continuous variable that describes the distance cyclists are comfortable cycling ('time comfortable') is included. The model also includes the continuous variable 'commute,' which determines the number of years that a cyclist has been using a bicycle commuter. Of the altitudinal questions from the survey that considered cyclists' reasons for using a bicycle, only the variable 'culture,' which represents the statement, "It is part of my self-identity/culture," was found to be statistically significant and, therefore, retained while other reasons for cycling were removed.

*Binary logit model*

In this first binary logit model (see Table 2), WTP for SBP is the dependent variable. It possesses a reasonable amount of explanatory power (Cox & Snell R square = 0.16, Nalgelkerke R square =0.22) and its variable coefficients all have the expected signs.

**TABLE 2 Binary Logit Model (All Participants)**

| Parameters | | Coefficient | | t-stat | Odds Ratio |
|---|---|---|---|---|---|
| Theft influence: | Slight | 0.633 | *** | 4.510 | 1.883 |
| | Moderate | 1.073 | *** | 6.538 | 2.923 |
| | Very | 1.564 | *** | 7.431 | 4.779 |
| | Extremely | 2.133 | *** | 6.550 | 8.437 |
| Employment status: | Student | -0.342 | * | -1.934 | 0.711 |
| | Retired | -0.579 | | -1.492 | 0.561 |
| | Other | 0.175 | | 0.553 | 1.191 |
| Gender: | Male | 0.100 | | 0.840 | 1.105 |
| Age: | Age | 0.016 | *** | 2.604 | 1.016 |
| Annual household income: | Less than $20,000 | -0.680 | *** | -3.003 | 0.507 |
| | Between $20,000 - $60,000 | -0.714 | *** | -4.553 | 0.489 |
| | Between $60,000 - $100,000 | -0.365 | ** | -2.340 | 0.694 |
| Reason: | Culture | -0.437 | *** | -3.597 | 0.646 |
| Commuting: | Time comfortable | 0.002 | | 1.610 | 1.002 |
| | Years commuting | -0.065 | *** | -3.978 | 0.937 |
| Cost of bicycle: | Low (less than $500) | -0.684 | *** | -5.717 | 0.504 |
| Constant: | | -0.210 | | -0.622 | 0.811 |

Cox & Snell R Square = 0.162
Nagelkerke R Square = 0.218
N=1533

*** 99% significance
** 95% significance
* 90% significance

The variable 'Theft influence' is highly significant; the greater the influence of theft risk has on a cyclist's decision to use a bicycle, the more likely a cyclist is willing to pay for SBP. The model compares cyclists whose decision to cycle is slightly, moderately, very, or extremely influenced by the theft risk to those who are not at all influenced. The odds of being willing to pay are 88% higher for those slightly influenced by theft than for those uninfluenced by theft and 744% higher for those who are extremely influenced. Not surprisingly, the odds for students' WTP is 29% lower compared to participants who are in the work force and they are also less willing than 'other' cyclists. Similarly, younger cyclists are less likely to be willing to pay. With regard to annual household income, cyclists who have an annual income lower than $60,000 are significantly less likely to be willing to pay for SBP than those with higher incomes. Similarly, cyclists who own low-value bicycles (under $500) are only half as likely to be willing to pay compared to cyclists with bicycles valued at over $500. The amount of time that a cyclist is comfortable using a bicycle is not significant, while as the number of years that a participant has been commuting by bicycle increases, their likeliness to be willing to pay for parking decreases. This may be due to cyclists' increased level of exposure having led to long-term commuters becoming more aware of theft prevention strategies. Cyclists who report culture/identity as important are less likely to pay and the effect of culture/identity is negative.

340 *Ordered logit model*

341 The results of the ordered logit model are similar to those of the binary logit model (Table 1). In
342 this model, the dependent variables are the amounts that cyclists are willing to pay for parking.
343 The first group (n=869) contains cyclists who are not willing to pay. The second group (n=342)
344 represents cyclists who are willing to pay between $0.50-$1.00/day for SBP, the third (n=197)
345 $1.25-$2.00, and the fourth (n=125) more than $2.00. These categories were chosen because they
346 represent the ideal rates represented in Figure 1, and because they correspond to the
347 abovementioned existing paid bicycle parking facilities.

348 **TABLE 3 Ordered Logit Model (All Participants)**

| Parameters | | Estimate | | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Odds Ratio | Upper Odds Ratio |
| Theft influence: | Slight | 0.667 | *** | 1.499 | 2.533 |
| | Moderate | 1.035 | *** | 2.087 | 3.800 |
| | Very | 1.420 | *** | 2.897 | 5.905 |
| | Extremely | 1.762 | *** | 3.595 | 9.432 |
| Employment status: | Student | -0.356 | ** | 0.504 | 0.973 |
| | Retired | -0.344 | | 0.362 | 1.386 |
| | Other | 0.083 | | 0.605 | 1.951 |
| Gender: | Male | 0.080 | | 0.874 | 1.343 |
| Age: | Age | 0.018 | *** | 1.007 | 1.029 |
| Annual household income: | Less than $20,000 | -0.629 | *** | 0.350 | 0.812 |
| | Between $20,000 - $60,000 | -0.614 | *** | 0.409 | 0.715 |
| | Between $60,000 - $100,000 | -0.287 | ** | 0.573 | 0.984 |
| Reason: | Culture | -0.370 | *** | 0.556 | 0.858 |
| Commuting: | Time comfortable | 0.002 | * | 1.000 | 1.004 |
| | Years commuting | -0.059 | *** | 0.916 | 0.970 |
| Cost of bicycle: | Low (less than $500) | -0.746 | *** | 0.382 | 0.589 |

Cox & Snell R Square = 0.179
Nagelkerke R Square = 0.200
Total N=1533

*** 99% significance
** 95% significance
* 90% significance

Similarly to the first binary logit model, results of the ordered logit model show that the variable ‘Theft influence’ is highly significant. The lower and upper odds ratios describe the 95% confidence interval of the effect of each parameter on WTP a higher price for parking. Cyclists who are slightly influenced by theft risk in their decision to use a bicycle are more likely to be willing to pay a greater amount than cyclists who are not at all influenced by theft risk. Likeliness to be willing to pay more for SBP increases greatly for cyclists who are extremely influenced by the theft risk. Students are willing to pay less, as are cyclists with incomes under $100,000. The variable ‘gender’ remains insignificant, but the variable ‘time comfortable,’ becomes significant at the 90% confidence level. The longer a cyclist is comfortable commuting, the more likely s/he is willing to pay a higher amount for SBP. This may be because cyclists who are comfortable cycling for longer distances are likely to use their bicycles for commuting and, therefore, more likely to require long-term parking. Similar results were demonstrated in the analysis of the summary statistics. Similar to the results from the binary logit model, the variables ‘year commuting,’ and ‘culture,’ are also significant here.

*Binary logit model that accounts for ability to pay*

Several studies have put forth a concern that WTP often does not account for ability to pay [*16*]. Because income is found to be highly significant in both the binary and ordered logit models, a model that includes only cyclists who have an annual income greater than $60,000 is presented in Table 4. Unexpectedly, the factors affecting WTP for participants who are most likely also able to pay remains similar to those of the total sample. Only the variable ‘student’ becomes insignificant, most likely because this group often has incomes lower than $60,000.

Similarly to the models that include the full sample, the variable ‘theft’ is also highly significant in this model. Within this sample, however, cyclists whose decision to use a bicycle is extremely influenced by theft risk rises significantly compared to cyclists whose decision to cycle is not at all influenced by theft risk. This indicates that the likeliness to be willing to pay increases as a cyclist’s decision to use a bicycle becomes more influenced by theft risk, as annual household income increases, as well as with age. Because the same variables are significant in all of the models, the results suggest that the significant factors influence WTP regardless of ability to pay.

**TABLE 4 Binary Logit Model (Participants With Annual Income Greater Than $60,000 Only)**

| Parameters: | | Coefficient | | t-stat | Odds Ratio |
|---|---|---|---|---|---|
| Theft influence: | Slight | 0.555 | *** | 2.941 | 1.741 |
| | Moderate | 1.004 | *** | 4.403 | 2.730 |
| | Very | 1.649 | *** | 5.786 | 5.201 |
| | Extremely | 2.510 | *** | 4.456 | 12.307 |
| Employment status: | Student | -0.245 | | -0.815 | 0.783 |
| | Retired | -0.208 | | -0.404 | 0.812 |
| | Other | 0.596 | | 0.963 | 1.815 |
| Gender: | Male | -0.058 | | -0.340 | 0.944 |
| Age: | Age | 0.016 | ** | 1.970 | 1.017 |
| Annual household income: | Between $60,000 - $100,000 | -0.375 | ** | -2.366 | 0.687 |
| Reason: | Culture | -0.403 | ** | -2.397 | 0.669 |
| Commuting: | Time comfortable | 0.002 | | 1.073 | 1.002 |
| | Years commuting | -0.083 | *** | -3.701 | 0.921 |
| Cost of bicycle: | Low (less than $500) | -0.834 | *** | -5.146 | 0.434 |
| Constant: | | 0.095 | | 0.216 | 1.100 |

Cox & Snell R Square = 0.168
Nagelkerke R Square = 0.224
n=793

*** 99% significance
** 95% significance
* 90% significance

## CONCLUSION AND DISCUSSION

Cyclists are likely to become victims of theft or bicycle-related crime over the course of their lifetimes. In our sample, around half of the cyclists had a bicycle stolen at least once. SBP facilities that decrease the chance of theft are likely to encourage individuals to increase their bicycle usage and commute for longer distances.

In addition to implementing regional theft prevention strategies, policy makers and planners should recognize that many cyclists are willing to pay for bicycle security. Although this study provides information about WTP for SBP facilities for a sample of cyclists from Montreal, the findings are also relevant for transportation planners in other regions and this new area of research merits further scholarly attention.

A limitation identified with this study is that the survey did not ask cyclists who would be willing to pay for SBP how often they would use this service. Future studies would also benefit from comparing cost estimates to the expected effectiveness of SBP. Another topic that should be addressed is the role of bicycle sharing programs and their relationships with infrastructure investments and cyclists' WTP. Further research should also investigate whether cyclists would rather use a shared bicycle and not worry about theft, and relatedly whether public resources would be better spent on bicycle sharing programs instead of SBP.

Other considerations that city planners and transportation professionals should take into account are the reasons that cyclists would not pay for parking. The responses from the open-ended survey questions confirm that many cyclists are not willing to pay for SBP because they use a bicycle to save money. The statement that "the goal of using a bicycle, among others, is to save money on transportation costs" is representative of the opinions of many survey participants. This finding is also reflected in the summary statistics, which demonstrate that of

the people who stated that the low cost of cycling was very or extremely important in their decision to cycle, 61% were not willing to pay for SBP. The results of the binary logit model that includes the total sample also confirm that participants with annual household incomes lower than $60,000 are much less likely to be willing to pay than those who have household incomes higher than $100,000. Other reasons that cyclists are not willing to pay for SBP include the concern that the parking would not be located in the places where cyclists would want to go, and that their current bicycle lock was sufficiently secure. One participant stated that "[i]t would take a very long time, if ever, for such services to be located conveniently enough throughout the city. I want to lock my bike close to where I am going."

Even though many cyclists are not willing to pay (57%) for SBP, there is a substantial number who would be interested in increasing bicycle security for a price. Based on the findings of this study, cities will benefit from improving their cycling infrastructure by installing more SBP facilities, since there is a market that exists for these types of facilities and because they are expected to encourage cycling. Cyclists who state that theft risk influences their decision to cycle are more likely to pay for SBP, and more likely to pay higher prices. As theft risk becomes more influential, a cyclist's WTP for SBP increases. If potential cyclists whose mode choice is greatly affected by theft risk can have that risk reduced through SBP, then the amount that they cycle should increase. Therefore, if cities provide more bicycle parking, then bicycle mode share is likely to increase as well. Although the installation of paid SBP is highly recommended, transportation officials should ensure that the pricing of these facilities remains low to ensure that the security provided by paid parking is always an incentive to cycle.

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