

The contribution of comfort, convenience, and liking of bicycling to the bicycling gender gap: Evidence from Davis, California

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ABSTRACT

Bicycling as a mode of transportation has many benefits for women, yet throughout most of the world, women cycle less than men. Researchers have put forth many reasons for the gender gap in cycling, including that bicycling is less convenient for women, that they are less comfortable bicycling, and that they like bicycling less than men. Thus, a deeper understanding of women's attitudes toward bicycling is an important step towards the development of policies and programs to increase bicycling among women. To that end, this paper explores results from a series of studies in Davis, California that have aimed to identify key factors influencing bicycling as a mode of transportation. The studies, conducted between 2006 and 2012, include both quantitative and qualitative approaches, with some focusing on adults and some on children. The results from these studies point to comfort and liking of bicycling as more important factors than convenience, and they suggest that differences between men and women begin early in life. These findings have implications for the development of policies and programs to reduce the gender gap in bicycling.

KEYWORDS: Travel behavior; Bicycling; Cycling; Gender.

INTRODUCTION

Bicycling as a mode of transportation has many benefits for women, including improved health, low monetary costs, and a smaller environmental footprint. Yet throughout most of the world, women cycle less than men. The notable exceptions are the Netherlands and Denmark, where over half of bicyclists are women; in Germany, Sweden, and Finland, nearly half of bicyclists are women (Garrard, Dill, and Handy, 2012). But in countries that are less friendly to cycling, the shares are much lower: less than one-third of bicyclists are women in Canada, the U.K., Australia, and the U.S. Within any given country, men and women face the same cycling environment – the same distances to destinations, the same bicycle infrastructure, the same vehicle traffic. The fact that women are less likely to cycle than men in most countries suggests that they are less able to overcome or less willing to overlook limitations of the cycling environment in these places.

Researchers have put forth many reasons for the gender gap in cycling (Garrard, Dill, and Handy, 2012). One potential explanation is the burden of household responsibilities that women often bear, including childcare duties and household chores. These responsibilities often mean less flexibility in daily schedules and more need for transporting others that could make bicycling inconvenient. Another potential explanation is that women feel less confident and comfortable bicycling and, conversely, that they are more concerned about safety and security when bicycling than men. A third possibility is that women simply don't like bicycling as much as men. Although the high shares of female bicyclists in the Netherlands and Denmark suggest that a good bicycling environment can erase these differences or at least their effect on the decision to bicycle, it is clear that, in other parts of the world, how women think and feel about bicycling plays a critical role in explaining their lower bicycling shares.

Thus, a deeper understanding of women's attitudes toward bicycling is an important step towards the development of policies and programs to increase bicycling among women. To that end, in this paper I explore results from a series of studies in Davis, California that have aimed to identify key factors influencing bicycling as a mode of transportation. The studies, conducted between 2006 and 2012, include both quantitative and qualitative approaches, with some focusing on adults and some on children. My exploration of the results from these studies points to comfort and liking of bicycling as more important factors than convenience, and they suggest that differences between men and women begin early in life. I conclude with a discussion of the implications of these findings for policies and programs.

BACKGROUND

Davis, a prosperous university town with a population of around 65,000 located in the Central Valley of California, is well-known for its bicycling culture. According to data from the 2005–2009 American Community Survey, 15.5% of Davis workers usually bicycle to work, far above the national rate of less than 1%. Nearly half of employees at the University of California, Davis (UC Davis) who live within the city commute to campus by bicycle. Its flat topography, compact development patterns, and generally good weather make it a good place for bicycling, and since the 1960s the city has supported bicycling through infrastructure investments and other bicycle-friendly policies (Buehler and Handy, 2008).

Several things make Davis an interesting setting for a study of bicycling behavior. First, there is enough bicycling that it is possible to acquire a sufficiently large sample of bicyclists. Second, the supportive physical environment makes it possible to study the effect of individual and social factors on bicycling; in other communities, a poor cycling environment can outweigh favorable individual and social factors. In addition, although the physical environment is generally supportive of bicycling throughout the city, there are notable variations (e.g. central Davis has few off-street bike paths), and distances to destinations (e.g. downtown or the high school) differ substantially depending on residential location.

With a team of enthusiastic students, I have undertaken seven studies since 2006 in Davis that aimed to identify key factors influencing bicycling as a mode of transportation. Four studies focused on adults, three on children. Four studies involved large sample surveys, while three employed semi-structured interviews. I provide an overview of the studies and their methods below; more detailed descriptions can be found in the papers cited.

- *Six-city Survey*. The purpose of this study was to explore the relative importance of physical environment, social environment, and individual factors in explaining bicycling behavior. In 2006, we surveyed adult residents of Davis and five other small cities in the western U.S., chosen for their similarities to Davis with respect to size, climate, and topography, but differences with respect to bicycling culture and infrastructure. For each city, we purchased a random sample of residents from a commercial provider and recruited participants by mail to complete an on-line survey. We achieved an overall response rate of 12.6%, with a rate of 18.8% in Davis. Analyses of the survey data are published in Emond et al., 2009; Xing et al., 2010; Handy et al., 2010; and Handy and Xing, 2011. Results presented in this paper are for the 335 Davis respondents in the sample.
- *Campus Travel Survey*. The annual Campus Travel Survey is a joint effort by Transportation and Parking Services and the Institute of Transportation Studies at UC Davis. The main purpose of the survey is to assess how the UC Davis population travels to campus, awareness of campus transportation services, and perceptions of mobility options. The 2010 survey was administered online in November to a stratified random sample of 15,704 students, faculty, and staff (of an estimated total population of 40,618). Invitations with a link to the online survey were sent to university e-mail addresses, and 26% of those invited completed the survey. Results presented in this paper are for the 2980 faculty and staff respondents who live in the City of Davis (other communities are at least 10 miles from the campus and thus generally beyond a reasonable bicycling distance). Analysis of the survey data is presented in Miller and Handy, 2012.
- *Formation of Attitudes Toward Cycling*. The purpose of this study was to explore the formation of attitudes towards cycling among adults using a “mobility biography” approach. We recruited participants through advertisements posted in the local newspaper and other means. All participants were required to be English-speaking residents of Davis between the ages of 25 and 65. We conducted semi-structured interviews between July and October 2010 of about one hour in length with each of 54 participants. Participants were asked about their experience with bicycling throughout their lifecourse. Interviews were professionally transcribed and then analyzed for key themes. Analyses of the interviews can be found in Lee et al., 2013; and Underwood et al., 2013. In this paper, we present selected examples from these interviews.
- *E-bike Early Adopters*. In this study, we qualitatively explored the experiences of early adopters of electric bicycles (e-bikes) in Davis and the surrounding Sacramento region. We used a variety of techniques, including the snowball method, to recruit 27 e-bike owners, all adults, to participate in semi-structured interviews about their experiences in the fall of 2011. We conducted 3 interviews by phone and 24 in person, with the semi-structured interviews lasting between 20 and 45 minutes. Interviews were

professionally transcribed and then analyzed for key themes. Interview results are available in Handy et al., 2013. In this paper, we present selected examples from these interviews.

- *Bike-to-Soccer Study*. In October and November 2006, we surveyed parents of players in the local youth soccer league as to their mode of travel to the game and to practices. The two-page survey was administered in-person at Saturday morning soccer games. Survey takers covered 76 games over three weekends. The final dataset includes surveys for 1,084 players, nearly half of all players in the league. The players in the league range in age from 5 to 18. Survey results are published in Tal and Handy (2008).
- *High School Survey*. In April 2009, we conducted a survey at Davis High School to measure mode share for school trips as well as attitudes toward bicycling. The two-page survey was administered during home period on a selected day, yielding a 75% response rate and 1,357 valid surveys. Davis High School has grades 10 through 12, with most students in the age range of 14 to 18. Survey results are published in Emond and Handy (2011).
- *Kid’s Attitudes Study*. In 2009, we launched Phase I of a longitudinal study of the formation of attitudes towards bicycling and driving beginning in childhood. We conducted semi-structured interviews with 20 fourth graders (ages 9 and 10) in Davis and their parents. In 2011, we re-interviewed 14 of the original child-parent pairs and added 11 new pairs for a total sample of 25; the children were now sixth graders (ages 11 and 12). The interviews lasted about 40 minutes on average, including questions for both the child and the parent. Interviews were professionally transcribed and then analyzed for key themes. We plan to repeat the interviews at two- to three-year intervals. Phase I results are summarized in Maiss and Handy, 2010, and Phase II results in Driller and Handy, 2013.

RESULTS

Although gender differences were not the primary focus of any of the seven Davis bicycling studies, they produced an abundance of quantitative and qualitative data that shed light on differences between women and men with respect to both the amount of cycling and attitudes towards cycling. First I present a variety of findings for adults from bivariate analyses, multi-variable logistic regression models, and qualitative analyses, then for youth.

Adults

In Davis, as in the rest of the U.S., men bicycle more than women, though the differences are not as great. Among Davis residents, half of women reported having bicycled in the last week on an average of 2.78 days, compared to 56.4% of men on an average of 3.31 days (Table 1). The differences in percent bicycling last week or not are statistically significant, however. Among UC Davis employees (faculty and staff), the gender differences for bicycling to campus are starker: women are less likely to report any travel by bicycle to campus, that the majority or the entirety of their travel to campus is by bicycle, or that they bicycled as their primary mode at least once in the previous week.

TABLE 1. Gender Differences in Bicycling - Adults

Davis Residents	Women	Men	p-value
Biked last week	50.0%	56.4%	0.240
Days biking last week	2.78	3.31	0.051
UC Davis Employees			
Any travel to campus by bike	51.8%	57.6%	0.003
Majority of travel to campus by bike	41.7%	50.9%	0.000
All travel to campus by bike	29.1%	40.0%	0.000
Bike as primary mode at least once	50.3%	55.9%	0.003

Convenience does seem to play a role. For UC Davis employees, women are more likely to say that they need to use a car during the day and to have responsibility for picking up children than men; the differences are statistically significant but not large (Table 2). Among women, those who bike are far less likely to need to use a car or to have pick-up kid duty than those who don’t bike. In other words, household responsibilities do

seem to help explain which women are and aren't bicycling, but they do not seem to explain much of the gender difference in bicycling, at least in the UC Davis sample. Note that other aspects of convenience not measured in the survey might have a stronger contribution to gender differences in bicycling.

TABLE 2. Gender Differences in Bicycling Convenience – Adults

UC Davis Employees	Women	Men	p-value	Women who bike	Women who don't bike	p-value
Need to use car during day	34.6%	31.9%	0.000	23.9%	45.1%	0.000
Pick-up kid duty	17.4%	15.4%	0.003	8.3%	20.8%	0.000

The differences in bicycling comfort for men and women are dramatic both among Davis residents and UC Davis employees (Table 3). Men express greater comfort bicycling on all types of facilities, with the differences increasing with the exposure of the bicyclist to traffic. For example, about 60% of women said they are comfortable riding on a four-lane street with a bike lane, in comparison to nearly 72% of men. Among women, those who bicycle are far more comfortable than those who don't on most facilities, but they are equally unlikely to feel comfortable bicycling on a four-lane street without a bike lane. The patterns are similar for UC Davis employees. The majority of UC Davis employees report agreement or strong agreement with the statement "I am very confident riding a bike," but again the share is higher for men than women and higher for women who bicycle than those who don't.

TABLE 3. Gender Differences in Bicycling Comfort – Adults

	Women	Men	p-value	Women who bike	Women who don't bike	p-value
Davis Residents						
<i>Comfortable riding on...</i>						
Off-street bicycle path	92.8%	94.9%	0.718	98.7%	86.8%	0.017
Quiet residential street	96.1%	98.9%	0.191	100.0%	92.2%	0.044
Two-lane local street with bike lane	87.0%	92.5%	0.026	96.1%	77.9%	0.004
Four-lane street with bike lane	60.5%	71.8%	0.011	73.3%	48.1%	0.004
Four-lane street without bike lane	5.2%	14.8%	0.000	5.2%	5.2%	0.034
UC Davis Employees						
<i>Comfortable riding on...</i>						
Off-street bicycle path	80.9%	90.3%	0.000	87.2%	74.4%	0.000
Quiet residential street	92.0%	96.8%	0.000	96.7%	87.2%	0.000
Two-lane local street with bike lane	77.5%	89.4%	0.000	88.7%	65.9%	0.000
Four-lane street with bike lane	61.4%	80.1%	0.000	71.7%	50.7%	0.000
Four-lane street without bike lane	11.7%	27.8%	0.000	12.4%	11.1%	0.000
I am very confident riding a bike	63.5%	84.3%	0.000	72.6%	54.3%	0.000

Concerns about potential safety hazards are related to bicycling comfort. Among Davis residents, women are more likely than men to be very concerned about being hit by a car, bitten by a dog, mugged or attacked, or crashing because of road hazards (Table 4). Women who bicycle are less likely to report such concerns than women who don't bicycle. Interestingly, concerns about being hit by another bicyclist are not statistically significantly different for women and men, or for women who bicycle versus those who don't. By far the greatest concern for all groups is being hit by a car.

TABLE 4. Gender Differences in Bicycling Concerns – Adults

Among Davis Residents	Women	Men	p-value	Women who bike	Women who don't bike	p-value
<i>Very concerned about...</i>						
Being hit by a car	25.3%	19.3%	0.025	15.6%	35.1%	0.014
Being hit by another bicyclist	11.2%	7.4%	0.419	6.5%	16.0%	0.177
Being bitten by a dog	5.8%	3.4%	0.078	1.3%	10.4%	0.055
Being mugged or attacked	4.6%	3.4%	0.000	1.3%	7.9%	0.003
Crashing because of road hazards	12.3%	6.9%	0.123	5.2%	19.5%	0.011

In addition to convenience and comfort, some observers have hypothesized that women simply like bicycling less than men. Our data show that this is indeed the case. Among Davis residents, women are less likely to agree and to strongly agree that “I like riding a bike” than men (Table 5). Among UC Davis employees, women are more likely to say that they agree that they like riding a bike, but far less likely to strongly agree that they like riding a bike than men. For both populations, women who don’t bike are almost as likely as women who bike to agree that they like riding a bike, but they are far less likely to strongly agree. This is particularly true for women in the Davis population, less than 4% of whom strongly agree that they like riding a bike. In other words, simply liking bicycling is not enough; really liking bicycling is what seems to get women (as well as men) on their bikes.

TABLE 5. Gender Differences in Attitudes – Adults

Davis Residents	Women	Men	p-value	Women who bike	Women who don't bike	p-value
I like riding a bike (agree)	43.1%	45.3%	0.05	42.9%	43.4%	0.000
I like riding a bike (strongly agree)	27.5%	35.2%		50.6%	3.9%	
UC Davis Employees						
I like riding a bike (agree)	42.5%	39.8%	0.000	44.7%	40.2%	0.000
I like riding a bike (strongly agree)	33.2%	44.8%		46.5%	19.5%	

Multi-variable binary logistic regression models show significant differences in the importance of just some of these factors for women relative to men in predicting whether an individual is a bicyclist (defined as having bicycled at least once in the last week) or not while controlling for other factors. For Davis residents, having child pick-up duties was important for both men and women to an equal degree, but in an unexpected way: those with such duties were almost twice as likely to bicycle as those who didn’t (see Table 3 in Emond et al., 2009). Bicycling comfort was a significant factor in predicting bicycling for women though not for men, but safety concerns were not a significant factor for either men or women, while liking biking was a significant predictor for both men and women. Among UC Davis employees, liking biking was also significant for both men and women, but strongly liking biking had over 7 times the effect of just liking biking (see Table 5 in Miller and Handy, 2012). Comfort and convenience were equally important for men and women, and had much smaller effects than liking biking. These results suggest that while women and men differ on average with respect to bicycling convenience, comfort, and liking, the effect of these factors on their bicycling is largely similar. In other words, gender differences in bicycling occur because women, on average, are less comfortable bicycling and like it less than men, not because comfort and liking are more important to their decision.

Our interviews with Davis residents also highlighted the importance of convenience, comfort, and liking of bicycling for women. In one analysis, we focused on bicycle crashes and their impact on the participant’s comfort with and continued desire for bicycling (Lee et al., 2013). Interestingly, while crashes reduced comfort and desire for some women, for women with a strong liking of bicycling they seemed to have little effect. In addition, women who didn’t bicycle were affected by hearing about bicycle crashes. The following comments illustrate these points:

“Once I was not paying attention or something and I ended up twisting the front handlebars and then skidding and scraping my shoulder blade. And that was a little scary, but it was nothing, I was just not being attentive, and both of those things just forced me to be more cautious and attentive. It didn’t detract me from riding. No way, I got right back on.”

“I fell off my bike once in Madison [Wisconsin], on a fairly busy street and if a car had been coming it would have run over my head. That was kind of traumatic. I wasn’t injured or anything, it was just a big scare...but I don’t think it stopped me from biking any more or anything like that.”

“I’ve had two major falls. One of them was when I was living in Austin... I fell off my bike and I got so scared that I didn’t really want to get on my bike again in Austin after that. I was on a busy, four-lane road and there was no bike lane... I wasn’t injured, just scared myself.”

“I had a little accident on my bike riding on the gravel in the parking lot. A car came in unexpectedly and scared me, so I slipped on the gravel and fell down and got all scratched up. So that turned me away from bicycling for awhile.”

“I was afraid after hearing about all those bike accidents. I think my perception would probably be different if I biked as well... If I were an experienced biker, what I read in the paper wouldn't so much influence me... But when you don't have that experience, you tend to believe and base your reaction on what you read. I mean, that's what you have to go by.”

In these interviews, women also described the ways in which they like bicycling, whether the feel of bicycling itself or the social aspects of bicycling:

“I feel like I'm flying.”

“You can join with your friends to bike together to just to a new place and explore new places... I like [bicycling] because [of] this.”

“I think my experience as an undergrad in Davis really shaped my like for biking. Biking was a really fun thing I did... it wasn't just a mode of transportation to campus... I have some really good memories attached to doing social activities on my bike.”

Youth

Gender differences in bicycling start at an early age, even in Davis (Table 6). Boys are more likely to usually bicycle to their soccer games, to middle school, and to high school. By middle school, the gap is already over 12 percentage points (as reported in retrospect by high school students); by high school it has increased to 13 percentage points.

TABLE 6. Gender Differences in Bicycling – Youth

	Girls	Boys	p-value
Share biking to soccer games	14.3%	21.4%	0.000
Share biking to middle school	44.3%	56.9%	0.000
Share biking to high school	30.1%	43.4%	0.000

As for adults, differences in convenience, comfort, and liking of bicycling seem to contribute to these differences, though parents and peers are also a factor. In high school, girls and boys differ significantly on factors related to convenience: girls are more likely to say they are rushed in the morning, have lots of stuff to carry, and wear clothes that make bicycling difficult (Table 7). Boys are more likely to say that they are confident in the bicycling ability, feel comfortable riding on busy streets, and feel comfortable getting places on their own, though the majority of girls also agree on these points. Girls are less likely to say they like bicycling and also less likely to say that they like being physically active. On the other hand, they are more likely to agree that protecting the environment is important to them, and they are less likely to agree that driving is the coolest way to get to school, attitudes that might encourage more bicycling. Boys are more likely to say that their friends bicycle to school, but few boys or girls admit that they worry what their peers will think of them if they bicycle. With respect to parental influences, the differences between girls and boys are not statistically significant.

Girls who bicycle are more likely to report agreement with statements related to confidence and comfort than girls who don't bicycle. The share of girls agreeing that they like biking is nearly 30 percentage points higher than for girls who don't bicycle. Girls who bicycle also like physical activity more, and they care more about the environment. They are more likely to have friends who bicycle to school, and less likely to say that driving is the coolest way to get to school. The largest difference between girls who bicycle and those who don't is for parental encouragement: 79% of girls who bicycle agree that their parents or guardians encourage them, compared to less than one third of girls who don't bicycle. Girls who bicycle are more likely to say that their parents or guardians bicycle and less likely to agree that they can rely on them to drive them places. However, convenience seems to matter less: the two groups do not differ with respect to being rushed in the morning or having stuff to carry, though girls who bicycle are less likely to say they wear clothes that make bicycling difficult.

TABLE 7. Gender Differences in Attitudes* - Youth

High School Students	Girls	Boys	p-value	Girls who Bike	Girls Who Don't Bike	p-value
<i>Convenience</i>						
I am always rushed to get ready in the morning.	56.7%	48.2%	0.002	52.7%	58.4%	0.165
I have lots of stuff to carry to school.	59.1%	41.5%	0.000	63.2%	57.2%	0.146
The clothes I wear make it hard to ride a bicycle.	17.4%	5.7%	0.000	12.3%	19.6%	0.021
<i>Confidence and comfort</i>						
I am confident in my bicycling ability.	79.6%	88.6%	0.000	92.7%	73.9%	0.000
I feel comfortable bicycling on a busy street with a bicycle lane.	53.0%	69.0%	0.000	69.8%	45.6%	0.000
I feel comfortable getting places on my own.	81.6%	88.5%	0.001	87.8%	78.9%	0.006
<i>Preferences</i>						
I like bicycling.	49.1%	56.1%	0.012	69.8%	40.1%	0.000
I like being physically active.	75.3%	83.1%	0.001	82.4%	72.2%	0.005
Protecting the environment is important to me.	74.9%	60.5%	0.000	81.0%	72.2%	0.160
<i>Social influences</i>						
My friends bicycle to school.	46.9%	53.2%	0.023	61.5%	40.6%	0.000
Driving is the coolest way to get to school.	26.4%	39.9%	0.000	20.0%	29.2%	0.013
I worry what my peers will think of me if I bike to school.	5.6%	7.8%	0.806	4.9%	6.0%	0.000
<i>Parental influences</i>						
One or both of my parents/guardians bicycle frequently.	27.9%	25.8%	0.391	41.2%	22.1%	0.000
My parents/guardians allow me to go places by myself.	84.9%	87.5%	0.183	89.3%	83.1%	0.038
My parents/guardians encourage me to bicycle.	46.5%	44.3%	0.412	79.0%	32.4%	0.000
I can rely on my parents/guardians to drive me places.	43.9%	39.8%	0.142	35.5%	47.5%	0.004

*Percent agreeing or strongly agreeing with the statement.

A binary logistic regression model of bicycling to high school (or not) were estimated for girls and boys for this paper by Yan Xing using a market segmentation approach. She developed separate models for boys and girls, then used these results as a basis for a pooled model with interaction terms for gender. The final model shows several differences in the factors that matter to girls versus boys (Table 8). Confidence in bicycling ability is associated with a greater likelihood of bicycling for girls but not boys. Girls who are able to rely on parents to drive them places and often go off campus for lunch are less likely to bicycle; these factors do not matter for boys. On the other hand, needing a car and actual bicycling distance are deterrents to boys but not to girls, though both boys and girls are deterred by the perception that they live too far from school to bicycle. Surprisingly, having a parent with a high level of education (a proxy for family socio-economic status) is a strong predictor of bicycling for boys but not girls. For both boys and girls, having parents who encourage them to bicycle is one of the most important factors, as is having a driver's license and access to a car. Liking biking is also an important factor for both boys and girls. It is notable that, with the exception of the parent's educational level, the factors they have in common have larger effects than those that differ, suggesting that, as was true for adults, the differences in their level of comfort or liking are the primary explanation for their differences in bicycling.

TABLE 8. Binary Logistic Regression Model of Bicycling or Not for High School Students

Variable	Coefficient	Sig	Odds Ratio
<i>Constant</i>	-2.273	***	0.103
<i>Socio-demographics</i>			
Driver's license and car access	-1.493	***	0.225
Parent has least Bachelor degree*Male	1.183	***	3.265
<i>Attitudes</i>			
Like to bicycle	0.364	***	1.440
Bicycling ability confidence*Female	0.197	**	1.218
Often go off-campus for lunch*Female	-0.307	***	0.736
Need a car*Male	-0.304	***	0.738
<i>Social environment</i>			
Parents encourage bicycling	0.797	***	2.220
Can rely on parents chauffeuring them*Female	-0.311	***	0.733
<i>Physical environment</i>			
Live too far from school to bicycle	-0.524	***	0.592
Actual bicycling distance*Male	-0.235	*	0.791
Valid N	1064		
Pseudo- R ²	0.375		
Log-likelihood (full model)	428.158		
Log-likelihood(constant only model)	701.299		

***p < 0.01; **p < 0.05; *p < 0.1

Some of the attitudes held by high school girls as revealed in the survey were evident in our interviews with 6th grade girls living in Davis (Driller and Handy, 2013). Although most girls said that they enjoyed bicycling, many of them expressed discomfort with or dislike of certain aspects bicycling. It is notable that girls' concern over appearance was apparent even at this age. These patterns are illustrated by the following comments:

"I love biking. It's really fun."

"I don't really like – well, biking is not my thing."

"If it's in the morning and it's super cold, I don't like [biking]."

"Sometimes when I'm too tired, it's kind of uncomfortable and I'm just really pooped."

"I don't like traffic. It's bad – I'm bad enough as it is that like just on the bike lane. And then in the street, I don't know. No, I don't think I could do that well."

"Because then – I usually like wear a ponytail and if I had to put a helmet on, then it'd just mess it up."

In reflecting on their experience with bicycling during high school, the adult residents of Davis that we interviewed highlighted the social stigma associated with bicycling (Underwood et al., 2013). Although both men and women expressed these views, the effect seemed to be stronger and more lasting for women and more often associated with a sense of fashion that influenced their liking of biking. The following comments are illustrative of these views:

"Once I was in junior high school it was not the cool thing to do, to ride bikes."

"You know, I always liked riding my bicycle as a kid, but when I got to high school it was considered dorky, so then I never rode it in high school."

"In high school biking is not that cool; it didn't seem trendy enough to do."

"People that biked generally speaking were nerdier... big backpacks versus the cars with the purse and the book bag."

"My younger brother rode a bike a lot in high school, but I didn't. It wasn't a fashionable thing to do."

DISCUSSION

Several clear patterns emerge from this exploration of gender differences. First, women bicycle less than men, even in Davis, and the difference starts as early as middle school. Second, women are less comfortable and confident bicycling, and they like bicycling less than men; the same is true for girls. Third, factors related to convenience are more of a mixed bag, perhaps because of the many different dimensions of convenience. Convenience seems to be more important at the high school level, particularly for girls. Fourth, parents seem to be more important for high school students than peers for both boys and girls. Finally, across all of these factors, comfort with and liking of bicycling are consistently important for women as well as for men.

These results have important implications for efforts to increase bicycling among women and decrease the gender gap between women and men. First, communities must build facilities that are more comfortable for women given their lower level of bicycling confidence. As recent studies have shown, women prefer facilities separated from traffic, such as bicycle paths and cycle tracks, or routes on low-traffic streets, sometimes called bicycle boulevards (Monsere et al., 2012). Second, communities must implement programs designed to increase bicycling comfort and confidence for women as well as girls. Several advocacy organizations across the U.S. now offer courses tailored to women, for example. Third, communities must adopt strategies to increase the convenience of bicycling in a variety of ways. This could range from land use policies that ensure that destinations are within bicycling distance to programs that provide subsidized bicycle trailers to families. Finally, communities must implement promotional programs that move women from simply agreeing that they like bicycling to the “strongly agree” category. Cyclovias and other community events may help on this score. The League of American Bicyclists has outlined a wide range of strategies for getting more women on bicycles (Szczepanski, 2013). Whatever strategies a community chooses to implement, it is important they rigorously evaluate the strategies to determine their effectiveness and guide further efforts (Pucher et al., 2010).

Such strategies are largely consistent with at least three of the traditional “4 E’s” approach to bicycling planning in the U.S.: engineering, education, and encouragement. To the degree that enforcement, the fourth “E” helps to increase bicycling comfort, it too has a role to play. Another “E” that could make a significant difference, though it has generally received less attention, is equipment (Lovejoy and Handy, 2012). Having the right bicycle with the right gear can help to increase comfort and convenience as well as liking of bicycling. Our qualitative studies especially highlighted the importance of equipment – helmets, bicycles, baskets, trailers, etc. – in several different respects. For example, our interviews with adults in Davis suggest a connection between equipment and fashion, as illustrated by these quotes:

“...most of the time I wear my hair in a ponytail, and then [wearing a helmet] goofs up your hair. I know it’s a silly thing...” [note the striking similarity of this quote to the quote from a 6th grader in the previous section]

“...after going to Copenhagen, and also Amsterdam and seeing women look so lovely on bicycles. And they were not slouched over with their butts up in the air, which is just so unfeminine... that was the first transition I made was a more female oriented bike.”

Beyond fashion, which may influence the liking of bicycling, equipment has important implications not just for comfort and convenience but for the very feasibility of bicycling for women, as illustrated by these comments:

From an e-bike user: “I’m 65, so I don’t think people should think age is a barrier. Who would have thought somebody my age would be commuting 20 miles a day on a bike to work?”

“... a little bit of pride that goes into it, like one time we went to Target. So, I have a two-year old son and so he was on the bike trailer. We went to Target and ended up buying all these storage baskets and bins... My son was carrying like 3 boxes in his lap, and then I had the back of the trailer stuffed full, and then I had like all these things that were precariously in my bike basket. I just felt kind of like proud of myself that I could do all that and get home without dropping anything.”

In addition to highlighting the importance of equipment, these last quotes also illustrate the old adage, “where there’s a will there’s a way.” These women had a strong will to bicycle, and they found a way to do it. Living in Davis made that easier, in that good infrastructure and abundant bicycling have created relatively safe and comfortable conditions there. In communities with less supportive bicycling environments, women may be unable to find a way, no matter how strong their will. By investing in bicycle infrastructure and adopting policies and programs to promote bicycling, communities can ensure that women with the will to bicycle have

a way to do it. But our Davis research also points to the importance of increasing the will of women to bicycle by addressing the comfort, convenience, and liking of bicycling, and doing so from an early age. By providing the way and promoting the will, communities can increase the proportion of women bicycling and the proportion of bicyclists who are women, to the benefit of all.

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