

## Electric bicycles and cargo bikes—Tools for parents to keep on biking in auto-centric communities? Findings from a US metropolitan area

Alainna Thomas 

Department of City and Regional Planning, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

### ABSTRACT

Despite a marked increase in electric bicycle (e-bike) research, few studies have looked at how parents or caretakers use e-bikes specifically to transport children. This is a missed opportunity, as parenthood often results in increased auto dependence. Getting more parents or caretakers on e-bikes or to continue biking would align with policies aimed at decreasing automobile dependence and increasing physical activity. This paper presents findings from in-depth interviews aimed to understand how families used e-bikes daily to transport their children, what factors motivated them to start, and what encourages them to continue this practice. Twenty parents and caretakers in the San Francisco Bay Area of the United States participated in the interviews which resulted in the following findings: e-bikes increased accessibility to communities, provided opportunities for greater physical activity, substituted for car trips, and allowed for more family quality time with the added benefit of reducing stress. The interviews also uncovered barriers like price and social stigmas, especially among less experienced or less committed cyclists. Finally, context matters. Bike infrastructure, local policies, and a supportive biking culture make it more likely that barriers would be overcome. More research is needed to understand the prevalence of family use of e-bikes, particularly in places with less supportive bike infrastructure and culture.

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### Introduction

Electric bicycles, or e-bikes provide an opportunity to expand upon and diversify sustainable transportation options (McQueen et al., 2020). Research shows they reduce reliance on cars, allow users to overcome physical limitations, and support a healthier lifestyle (Bourne et al., 2018; Dill & Rose, 2012; Langford et al., 2013; MacArthur et al., 2018; Pierce et al., 2013; Popovich et al., 2014). These benefits and their ability to carry heavy loads could be expanded to include commuters wanting to carry children (Ling et al., 2017; MacArthur et al., 2018; Moser, 2015; Riggs & Schwartz, 2018).

While the electric bicycle market in the United States remains small, it has grown fast. In 2012, only 185,000 e-bikes were sold in the US; by 2019, 400,000 units were sold, a 73% increase over 2018 (Sallomi et al., 2019). The market has also expanded and diversified to incorporate more types of electric bicycles, including cargo bikes (front and rear loading, see Figure 1), off-road bikes, and portable bikes.

A small but growing number of families in the United States are adopting e-bikes, particularly electric cargo bikes (e-cargo bikes), and use them like family cars (Granger, 2019; Moser, 2015). Cargo bikes have only been available for purchase in the United States for a short time, thus research on the US experience remains limited (MacArthur et al.,

2018; Masterson, 2017; Riggs & Schwartz, 2018). An extensive study on e-bikes by Fishman and Cherry (2016) in the United States captured some family use, but it was limited. Overall, an underlying weakness of e-bike research to date is the e-bike's impact on family travel (Behrendt, 2018).

Parenthood marks a major turning point in travel behavior (Chakrabarti & Joh, 2019; Chatterjee et al., 2013; McCarthy et al., 2019; Scheiner & Holz-Rau, 2013; Zwerts et al., 2010). Many parents experience increased auto use (Chakrabarti & Joh, 2019; Oakil et al., 2016; Prillwitz et al., 2006; Zwerts et al., 2010), and a loss of physical exercise (Bonham & Wilson, 2012; Chatterjee et al., 2013; Emond et al., 2009; Oakil et al., 2016). Research suggests that encouraging family use of bikes has positive impacts (Bourne et al., 2018; McCarthy et al., 2017). E-bikes, therefore, have the potential to have similar positive impacts. They offer parents not only the ability to chauffeur children but also the opportunity to exercise, reduce stress, and achieve greater mobility, while reducing their environmental impact.

This exploratory study presents findings from in-depth interviews that sought to understand how families used e-bikes, what motivated them to start, and what gets them to continue. From March 2015 through June 2015, we profiled 20 parents and caretakers in the San Francisco Bay Area,

**CONTACT** Alainna Thomas  [alainna@ad.unc.edu](mailto:alainna@ad.unc.edu)  Department of City and Regional Planning, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3140.

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**Figure 1.** Edgerunner Xtracycle back loader electric bicycle (l) and Metrofiets (r) a frontloader electric bicycles. Sources: Xtrarunner Edge Bikes and author.

California, United States who chose e-bikes, including e-cargo bikes, over cars for daily commuting. Understanding how they have integrated e-bikes into their daily lives could provide ways to expand the e-bike market and strengthen policies that promote more sustainable modes of travel.

In the following section, I review previous research on electric bicycles and travel behavior of parents. I then present methods, study findings, and conclude with a discussion of family use and policy implications.

### ***E-bikes, key events, and shifts in travel behavior***

This section reviews previous research on e-bikes and how key events, such as parenthood, affect travel behavior. While research on e-bikes continues to grow, the role it plays in family life remains understudied. If parenthood is a major turning point in travel behavior linked to higher car dependence, it also provides an opportunity to keep parents on bikes. In addition, as the research also shows, e-bikes can attract new users. Within the context of North America, auto-oriented urban form remains a key challenge. Not only the size of a city but its land use mix can challenge bicyclists, with many cities separating residential from retail and office areas. Therefore, e-bikes could be a tool for parents to continue biking and mitigate these challenges.

### ***The need for more family related e-bike research***

Fishman and Cherry (2016) reviewed over 50 peer-reviewed studies on e-bikes published between 2007 and 2014. Most studies focused on China, the largest e-bike market. Most e-bikes in the Chinese studies resembled scooters or mopeds and required no physical exertion. Other studies reviewed included emerging markets in North America, Australia, and Europe and focused on pedal assist e-bikes.

Studies on pedal assist e-bikes, the subject of this study, have consistently shown that e-bike use results in increased physical activity (Bourne et al., 2018), lower environmental impact, and the ability to overcome physical challenges (Bourne et al., 2018; Dill & Rose, 2012; Edge et al., 2018; Fishman & Cherry, 2016; Fyhri & Fearnley, 2015; Johnson & Rose, 2013; Jones et al., 2016; Langford et al., 2013; Leger et al., 2018; MacArthur et al., 2014; Popovich et al., 2014; Wachotsch et al., 2014).

Family use of e-bikes has been mainly anecdotal and in small qualitative studies. Jones et al. (2016) found that early adopters in the UK and the Netherlands not only wanted to continue biking and chose e-bikes to overcome physical and environmental barriers, but some users had made concerted efforts to find e-bikes specifically to carry children. Similar sentiments were echoed in a study of 24 users in the Netherlands, with picking up and dropping off children as a motivation for purchase and use of e-bikes (Plazier et al., 2017). In a Canadian study, Edge et al. (2018) found several participants used their e-bike to carry children to school. They interviewed 10 participants.

On a larger scale, in a follow-up to an earlier North American e-bike study, J. H. MacArthur et al. (2018) conducted an online e-bike study with 1,755 e-bike users in the United States and Canada. Their study pointed to a growing and diverse group of users in North America, including parents, although the number of parents in the study is difficult to determine. Sixteen percent of respondents stated their primary motivation for buying an e-bike was “to carry kids or cargo”; this makes it hard to separate uses. In open-ended responses, however, a few respondents explicitly stated they used it to carry children.

### ***Understanding shifts in travel behavior with the arrival of a child***

Studies that have looked at parenthood and travel behavior (Chakrabarti & Joh, 2019; Chatterjee et al., 2013; McCarthy et al., 2017; Prillwitz et al., 2006; Scheiner & Holz-Rau, 2013; Zwerts et al., 2010) have mixed results as to the impact children have on mode choice. Some studies point to increased dependence on cars (Chakrabarti & Joh, 2019; Prillwitz et al., 2006; Scheiner & Holz-Rau, 2013). Yet, not all parents do so. Chatterjee et al. (2013) in their UK study found that some parents bicycled instead of driving because it was easier to accompany their children to school. Also, those participants that stopped biking when their children were small, had taken it up again when their children were older and were more independent.

Chakrabarti and Joh (2019), looking at two-parent households in California, found that having children reduced parents’ physical activity and increased vehicle miles, but



Figure 2. Map of San Francisco Bay Area, California.

other factors mitigated the impacts. This included job flexibility and the age of the child(ren). Similar findings to what Scheiner and Holz-Rau (2013) found in an earlier study in Germany. They found that free parking and the age of the child were factors in parents driving more.

Parenthood could be an opportunity to shift to more sustainable modes, particularly for millennials, as they saw a decline in car use amongst younger parents (McCarthy et al., 2017). Instead of assuming increased car dependence being the normal result of parenthood, these studies point to the need for more research.

Understanding how parents in auto-oriented urban environments integrate e-bikes into their daily routine provides insights and fills a gap in e-bike and travel behavior research. Because e-bikes can overcome challenges to daily commutes, such as topography or physical limitations, they may allow parents to continue to bike and to replace car trips. Therefore, studying how parents in auto dependent contexts avoid using cars and instead rely on e-bikes provides opportunities for policy interventions to support more sustainable transportation.

## Methods

This study used qualitative methods to understand how parents or caretakers use their e-bikes, their motivations for purchasing, the challenges they faced and how they navigated them. Previous studies have noted the value of qualitative methods to understand travel behavior (Clifton & Handy, 2003; Handy et al., 2014). The number of parents or caretakers that use bikes to carry children is a subset of the e-bike community, therefore, I looked at previous studies as

a reference for framing our approach at the time of this study (Dill & Rose, 2012).

## Recruitment and data collection

Interviews took place from March 2015 through June 2015. We solicited participants through a variety of means targeting parents or caretakers who used their bike to transport their children in local bicycle organizations' electronic newsletters or LISTSERVs, postings at electric bicycle shops or through their electronic mailing lists, and the Berkeley Parents Network, a popular website for Bay Area parents. We also used snowball sampling, getting references from participants about other users and community organizations to contact. Recruitment did not discriminate according to type of e-bike or gender. Participants received a \$20 Starbucks card for their time.

We used purposive sampling, therefore, participants may not completely represent the e-bike family user population. Given that this is an exploratory study, this strategy is suitable for our research goals. We conducted semi-structured interviews with 20 e-bike users who have children or take care of children. All live in the San Francisco Bay Area. The interviews lasted up to an hour. Interview questions, such closed- and some open-ended, addressed biking history, motivations for biking, daily travel patterns, children's comfort and acceptance with e-bikes, and challenges (see Appendix for interview questions). Most participants came from two cities—San Francisco and Berkeley. We interviewed by phone, in-person, or online (i.e., through Skype, Google Chat) according to participants' preferences. All interviews were digitally recorded. The recordings were professionally transcribed. We analyzed text through Atlas.ti with *a priori* categories based on the themes—motivations, benefits, and challenges.

## Study site

Located in northern California, the San Francisco Bay Area (Bay Area) includes 101 municipalities and nine counties, with a population of 7 million (see Figure 2). We chose the Bay Area as our study site because of characteristics that are associated with high biking rates: a strong biking community (Stehlin, 2015) and supportive bike infrastructure and policies (Pucher et al., 2010). Most participants lived in San Francisco or Berkeley. San Francisco has long been the home to bicycle activism as the "birthplace of Critical Mass" (Stehlin, 2015). Started in the 1990s, Critical Mass was a monthly demonstration of hundreds of bicyclists taking over the streets. These early demonstrations, along with advocacy groups, such as the San Francisco Bicycle Coalition, have been parlayed into bike-friendly policies and infrastructure (Stehlin, 2015). As of 2018, San Francisco, which is 46 square miles (119 square kilometers) had over 447 miles (719 kilometers) of bicycle network (San Francisco Metropolitan Transit Agency, 2019). San Francisco plans to invest over \$20 million US dollars annually in cycling infrastructure (San Francisco Metropolitan Transit Agency,

**Table 1.** Demographics of participants including previous mode, length of ownership.

Current E-bike	Gender	Location	Age of children (in years)	Previous mode	Length of e-bike ownership
Xtracycle Edgerunner	F	Albany	3 years old; 6 years old	Bike with a child seat and trailer	< 1 year
	M	Berkeley	4 and 7 years old	Xtracycle NA	>1 year
	M	Berkeley	2 and 6 years old	Car	3 months
	F	San Francisco	4 and 7 years old	Roadbike w/a trailer; car	> 1 year
	F	San Francisco	2 and 5 years old	—	< 1 year
	F	San Francisco	5 years old	—	< 1 year
	M	San Francisco	Two school age children	Regular bike	< 1 year
	M	San José	4 and 7 years old.	Electric Car	< 1 year
Bullitt with a kid box in the front	F	San Francisco	5 and 9 years old	E-bike	> 5 years
	F	Berkeley	2 children under 7 years old	Bike with trailer	1 year
Butchers and Bicycles MK1E bucket bike,	F	Berkeley	2 school aged children	Xtracycle NA; bus	1 year
Yuba El Mundo with a bionix motor	F	San Francisco	5 and 7 years old	Walk; bike	3 years
Metrofiets	M	San Francisco	5 and 10 years old	Xtracycle NA	3 years
Motiv	F	Berkeley	20 and 22 years old	Bike	1 year
Bionix motor kit on bike (n/a)	M	Oakland	5 years old	Bike	Removed
Focus Jarifa	F	San Francisco	4 years old	Bike	1 year
Kona Ute Long bike	M	San Francisco	1 child	Bike	2 years ago added electric assist
Civia Loring bike w/ Xtracycle FreeRadical, a Bionix 350-watt rear drive rearwheel motor, with a 48-volt battery	M	San Francisco	1- and 2-year-old	Civia Loring	2 years; had an Xtracycle FreeRadical since 2001
Hase (half recumbent bike)	M	San Francisco	3, 8, and 12 years old	N/A	> 5 years

2019). The city of Berkeley was one of the first cities in the US known for its Bike Boulevards. A bike boulevard is a “low-speed, low-volume street which has been optimized for bicycle traffic (City of Berkeley Transportation Division, 2021). Berkeley plans to spend over \$60 million US dollars in its bike infrastructure and has 51 miles (82 kilometers) of bikeways.

The San Francisco Bay Area also has characteristics closely associated with e-bike use—hilly topography, high education level, and high median income (Dill & Rose, 2012; MacArthur et al., 2018; Popovich et al., 2014; Wolf & Seebauer, 2014). This was supported through social media sites, such as Instagram, that showed a growing cohort of family e-bike users in the Bay Area.

## Results

### Participants

Of the 20 participants, half were women and half were men. No participants were related to each other or lived in the same household. Participants lived in the following cities: San Francisco (n = 11), Berkeley (n = 6), Oakland (n = 1), San José (n = 1), and Albany (n = 1). Their ages ranged from 30 to 55 years old. The number of children living in the household ranged from 1 to 3 children, and the children’s ages ranged from two years old to high school. High school students were not using e-bikes themselves. Younger children were riding in or on the cargo e-bike or had their bike attached to the e-bike.

Most participants (n = 16) described themselves as experienced cyclists. All participants viewed their bike as a utilitarian object. About half (n = 9) were on their first e-bike and the rest were on their second (see Appendix, Table 1). Almost all were daily cyclists (n = 17). Only three participants used an e-bike prior to having children to make up for their own physical limitations.

Most participants who carried their children had e-cargo bikes. They used front or back loader models, as shown in Figure 1. The brands include the Edgerunner Xtracycle (n = 8), Yuba El Mundo (n = 1), Bullitt (n = 2), Metrofiets (n = 1), and the Butchers and Bicycles’ MK 1E (n = 1). Others used more conventional-style e-bikes such as the Focus, Motiv, and Stromer. Two participants had designed and built customized bikes for themselves.

### Travel behavior

Daily cyclists used their e-bikes for all trips they might make in a car: taking their children to and from school, going to and from work, and running errands. All but three participants traveled within a seven-mile radius for their commute and non-commute trips. The other three participants rode over 10 miles each direction; one traveled 25 miles in each direction to work. One participant used both a conventional bike and e-bike for daily travel to get to the metro. In the morning, she rode her conventional bike to the rail station; her husband used their e-cargo bike to take their children to school in the morning, then returned home and left the bike there. In the evening, she would ride back to the house on her conventional bike, pick up the e-bike,

and then pick up her children. Others dropped off their children at school and then went to the local metro station and took a train to work, parking the bike at the train station.

One participant had a car-free household. Besides the participant who shared an e-bike with her husband, six participants had spouses who also had an e-bike. All other spouses ( $n = 12$ ) used a car for daily travel because of distance or comfort. One participant stated he planned on getting an e-bike for his spouse. One participant's husband had an e-bike but did not ride it.

### **Motivations for E-bike use**

Participants had been highly motivated to find an e-bike. Several participants stated they spent a few months to two years finding theirs. Few stores sold e-bikes in the Bay Area until recently. A participant from San José went to San Francisco to buy his e-bikes. One participant, who was an early cargo bike enthusiast before getting an electric assist, traveled to Portland, Oregon. She later created a website where she reviewed different cargo bikes and spoke about the benefits of carless travel and electric assist. Her website was also cited by a few participants in interviews as an information source.

Participants cited the physical environment, their own physical limitations, the weight of their children, or a combination of all three for their use of an e-bike instead of a conventional bike.

I was living on a hill... and going up was really hard, especially with a kid. She was still small at that time [when I bought the e-bike], but she was growing. — Father of one, San Francisco, CA

At the time that we bought these bikes, we lived on a hill and the commutes we have to school and work are also extremely hilly, and our kids, who we carry on our bikes, because even though they are good riders, it's hard for them to get up some of these hills. They just kept getting heavier. — Mother of two, San Francisco, CA

The reason why I got [my e-bike] was I felt like I was safer with it. When I was trying to get going even on the slightest hill with my kids I couldn't get out of the intersection, and I was crossing a busy street I felt really exposed, and that for me is like the really great aspect of the electric assist—just getting moving. — Mother of two, Albany, CA

Physical exercise was another motivation. About six participants stated exercise as a motivation and a benefit.

It's a way you can spend time with your kids and exercise at the same time, which as a parent, one of the things that really hits you is like it's so hard to find time for exercise, but this way you can actually be with your kid and exercise, which is amazing, and I think it's often overlooked with these bikes. — Father of two, Oakland, CA

### **Benefits of E-bike use**

Several parents cited avoiding waiting in the child drop-off line as a major benefit of taking their children to school by e-bike.

The convenience factor—their school has no parking, they've got kind of an intense drop-off situation... it's actually slower to be driving in rush hour, and then lap around the block and do this crazy drop-off thing. Whereas now I can roll up on the sidewalk and give them a high-five and off they go. — Father of two, San Francisco

Passing other parents stuck in traffic only reaffirmed the decision to use an e-bike.

Several also cited the freedom from hunting for parking and the ability to make impromptu trips.

I hated looking for parking in the city, and once I found it, I was always angry that I had to pay for the parking. I had to pay parking fees after it took me twenty minutes to find the spot. So, the fact that I can pull up right in the library, lock my bike, and walk in, and not circle ten times, it's a great feeling... Now, I just feel like I can go wherever I want and it's great. —Mother of one, San Francisco CA

My daughter has a favorite tree in Golden Gate Park. She's like "Oh, can we stop at the tree?" And I'm like, why not? You never have to worry about finding parking, you just stop. —Mother of two, San Francisco, CA

Their e-bike also allowed participants to take full advantage of bike lanes or paths for their trips, even if they had to go out of their way to use it.

My favorite place to go is... a bike path with no traffic that goes along a [metro] track. It goes for 2-5 miles under the [metro] tracks, and one of the interesting things is that on the electric bike it's a lot easier to go way out of the way, including up and down hills, which I found is a real asset compared to a regular bike.... So, to get to my work I actually go maybe as much as two miles out of the way to take the bike path... because it's so much more relaxing and enjoyable than riding on streets, even with bike lanes, because you have to worry about cars. — Father of two, Oakland, CA

One participant felt having bike paths provided him with a predictable ride home. He commutes from San José to Mountain View for work.

Because I have noticed that it takes me about an hour and fifteen, an hour and twenty minutes by bike to get home from work, and it takes about that long—not quite that long, but about that long, by car. The ability for me to take bike trails and not go through traffic cameras and traffic stoplights is a huge difference. — Father of two, San José, CA

Another benefit for parents was their children's enthusiasm for the bikes.

Oh, she cried when I picked her up in the car one day. She cried all the way home. I wanted to ride in the bike! She loves it. — Mother of one, San Francisco, CA

Oh, they love it! I wish I could capture the glee. They like it because the bucket is in front... they really like being in the front and having the wind in their face, and I think they also love the assist because Mommy can go kind of fast in a way that I didn't before when I was hauling all that weight [behind my conventional bike]. So, they get a kick out of that. — Mother of two, Berkeley, California

Oh, they won't shut up about it. And in fact, it's sort of inspired my daughter to sort of figure out how to ride a bike, so she wants to ride alongside the bike on her own. — Father of two, San José, California

Some children who have commuted by e-bikes since they can remember are no longer as enthusiastic.

You know, I think that they like checking out the world around them a little bit, but actually—but there's no novelty for them. I've been bike commuting them since before they could really talk and say anything about it, so to them there's none of that kind of brochure joy of getting out on a bike and checking out the world around them. — Father of two, Berkeley, CA

Some found others were impressed:

Most [people] when they see two or three kids on the bike ... that's amazing. They look at the bike like "How does that work? That's not possible." So, they will stop and literally study the bike, like, which part is turning what. — Father of three, San Francisco, CA

Many stated that e-bikes helped them overcome their fears of biking on urban streets. Some ( $n=5$ ) pointed to the size of their e-cargo bike, saying they felt motorists could see them more easily.

The thing is so freaking huge that nobody can miss it, so I don't worry too much about visibility because everyone is really surprised when they see me, so they really give me a wide berth. — Father of two children, San José, CA

I know there are a lot of people who are very hesitant about putting their kids on a bicycle on these city streets, but for me it's just not an option. But I did end up choosing a far more expensive bicycle than I would have because it is so—it's bigger, it's very solid, it's white, I mean, it's like a beluga on the street; everybody sees you! — Mother of two children, Berkeley, CA

As a commute vehicle, e-bikes allowed participants to get to work and still look presentable. Participants stated they could bike to work without getting sweaty, since most work-sites do not have showers.

Overall, when asked if they would recommend an e-bike to other parents or caretakers, all but one enthusiastically stated they would.

## Challenges of E-bike

E-cargo bikes are large. For example, the Xtracycle is over 6 feet long and 3 feet wide. Thus, e-bike parking can be challenging. They are too long for some bike racks and can block sidewalks. If parked flush against the rack, an e-bike can prevent all other bicyclists from using the rack. All participants except two had secure parking at work. The other two participants parked their bikes at the metro station when they commuted. But in other places, parking is not guaranteed.

I do bike racks if I have to, but I usually put it on a lamp post or something, where it's not in the way. Like when I ride to the zoo I go inside the little plaza and I put it on a lamp post. — Mother of two, San Francisco, CA

Participants either had a garage, secure storage area, or access to a garage. It would be difficult for someone with a second-floor apartment and no secure space to store the bike because of the weight. Renters had negotiated for parking.

We live in an apartment building and the parking situation in the building is not great. We had to negotiate with the landlord to have our own special space. — Mother of two, Berkeley, CA

Even homeowners experienced difficulties.

We have a flight of stairs to get to the [entrance] level [of our home] and then it's like one of those typical San Francisco houses where there's a narrow gap along the side of the house to the backyard... I got one of those ramps for putting a motorcycle in the back of your truck... I get that out, unfold it, and... it goes right over the stairs. I push it up the stairs. It's hard, but doable. Then to get through the gap I actually had to get the bike shop to chop off the end of the handlebars a little bit to fit it through there... I've got to fit [myself] inside the gap and then pull [my bike] by the handlebars, walk backwards and then open up the gate and take it in the yard. Then I've got a storage shed in the back... so that's where I charge it. It takes time to get it in and out, like five minutes or something, which is not great... It's like a routine that I've got to get through. — Father of two, San Francisco, CA

This homeowner emphasized that an e-bike is better than a car: "I'm never looking for parking when I get home, I'm never driving around the block." His story suggests the effectiveness of parking policies in the Bay Area, which are strongly enforced and costly (Hao, 2017).

Part of the reason parking at home is a challenge is weight. E-cargo bikes weigh approximately 75 to 85 pounds (35-39 kilos). Accessories can bring them to over 100 pounds. Participants said that they were concerned about weight, fearing that the battery might go out on a hill or prevent them from using public transit to go across the bay with their bikes. However, only three participants have bikes small enough to fit into a metro train car.

Some participants believed the e-bike's weight is a theft deterrent, but most were concerned that someone might steal their bike or one of its components ( $n=15$ ). E-bikes can cost close to \$10,000 when fully outfitted. One participant described his process of securing his bike:

I have five locks on my bike, and two locks are meant to secure the parts to make sure people are not taking the seats and front rack, and three locks are made to attach the bike to some structure from different points, so making it really hard to steal anything, including the wheel—which is probably the most expensive part. — Father of one, San Francisco, CA

## Adverse weather

A greater number of participants were sanguine about inclement weather. At the time of the interview, California was experiencing a drought that had gone on since 2011, all but six participants stated that when it was raining, nothing but the severest weather would stop them from biking.

We are pretty diehard about riding anyway, so we all have rain boots, rain pants, raincoats, and we all suit up and wore it [when there has been rain]. And we learned and loved that if you don't shy from rain, it's actually a kick! It's a good experience. — Mother of two, San Francisco, CA

The participants who avoided riding in the rain feared motorists might not see them, and one had had an accident

in the rain. Others avoided riding during the winter months, not because of weather, but because it gets darker earlier.

### **Battery life—not a major concern**

When asked about challenges or downsides to an e-bike, no respondent mentioned distance anxiety. With improvements in technology, some electric bikes can travel 80 miles on one charge, depending on the load. Most participants stated they charged at least once a week. Some charge every day because of the length of their commute, topography, concerns about load size lowering battery life due to the number of children they transported, or out of habit. Much as with parking, participants who lived in apartment buildings had to negotiate space to charge with their landlords and the cost of electricity.

Our landlord, initially when we told him we were going to plug the bike in, he was going to charge us like \$50 a month or something... I contacted the company and found out that to charge the bike costs like ten cents and it goes 40 miles, so I thought it might be more like 25 cents a month or something? 50 cents a month? So, that was a misconception. He didn't at all understand how little energy it uses. — Mother of two, Berkeley, CA

### **Price compared to a car**

Price caused some hesitation for participants to purchase an e-bike. Some justified the costs by comparing it to the cost of car ownership, such as parking fees or gas. Others felt it was a way to use their car less for short trips.

[The price tag] is pretty significant—but using it in a year of biking would be the equivalent [to] paying for parking and driving, so after a year it would start to pay for itself. It's expensive, and I bought it from a place that I was able to finance it so that made a big difference. — Mother of two, San Francisco, CA

I was on the website and looking at the prices and they're not that expensive if you factor in using X amount of gasoline every day. You can pay for these in six months or whatever. — Mother of two, Berkeley, CA Repairs

A more ongoing concern pertained to the difficulty of getting repairs. A few participants referenced the lack of stores or expertise in their area. The e-bike's weight makes it difficult to do repairs. A few participants have a service contract with a local e-bike shop to get towed for repairs.

### **Social stigma**

Social stigma continues to be an issue for e-bike users, even if they are using their e-bike to chauffeur children. One participant describes being judged for biking with children and how it affected route choice:

I've had drivers yell at me for riding on the road with kids. So now I tend not to [cross a particular large street in Berkeley] if I have kids. Instead, I'll go back almost two or three blocks to Alston where there's a light and I haven't been yelled at before.— Mother of two, Berkeley, CA

Another participant describes the more common criticism of “cheating” by using a pedal assist motor but also more positive reactions:

I had an Xtracycle before I had the electric part of it, so a lot of my colleagues were like, “Oh, you're getting old! You're cheating with the engine.” So that was kind of funny to me. One interesting reaction is that it was me sort of saying uncle to my physical abilities. I couldn't do it anymore. And then you also get reactions like that's really cool, that looks like you guys are having a great time. I see some people see it as a liberation from a car, and so they get really excited about it and see how cool it is and how they want one. — Father of two, Berkeley, CA

In response to other bicyclists calling e-bikes cheating, participants pointed to what they were carrying and where they lived. No one was deterred in using their e-bikes by what others said.

I talked to the head of the San Francisco Bike Coalition family division, and the way she put it is “I know people say they're cheating, but when you have a family, if it gets you on the streets it doesn't matter. The electric assist becomes the reason you got out of the car, and that's what you needed.” — Mother of one, San Francisco, CA

Participants took it upon themselves to educate people. One participant set up an e-bike demonstration program at his children's school with a local merchant specializing in e-cargo. Some allowed other parents or even strangers to try their bike. They felt this type of proselytizing had been effective and could cite acquaintances who bought their own e-bike after seeing theirs.

## **Discussion**

This study aimed to understand how and why parents in the San Francisco Bay Area used e-bikes in their daily lives. The objective of this research was to expand our understanding of this subset of e-bike users and the potential for encouraging e-bike use as an intervention to reduce parents' car dependence. Interviews revealed participants viewed and used their e-bikes as utilitarian objects. This echoes other studies findings (Jones et al., 2016; MacArthur et al., 2018; Plazier et al., 2017; Wolf & Seebauer, 2014).

In line with previous studies (Dill & Rose, 2012; Jones et al., 2016; MacArthur et al., 2014; Popovich et al., 2014; Wolf & Seebauer, 2014), participants point out that e-bikes provide them with greater access to their community than regular bikes or sometimes, greater access than cars. They could overcome topographical and physical barriers (Dill & Rose, 2012; MacArthur et al., 2018; Popovich et al., 2014). This was both a motivation for purchase and its use. They could bike without concern about physical stamina or finding parking.

From participant interviews, women were more likely than men to mention feeling more comfortable and safer using an e-bike than a conventional bike. The size of the e-bike, whether a Strommer or a Xtracycle, gave these participants greater confidence. In auto-oriented cities, e-bikes may fill a bigger gap by providing a means to get errands done and give women more confidence on the road.

In North America, women are less likely to use bikes than men (Emond et al., 2009; Garrard et al., 2012b). The trips women make, such as chauffeuring children (Emond

et al., 2009; Garrard et al., 2012a; Plyushteva & Schwanen, 2018) are one factor in their decision not to bike. Time constraints, spatial constraints (Bonham & Wilson, 2012; MacArthur et al., 2018; Shirgaokar & Lanyi-Bennett, 2019) or comfort level (Emond et al., 2009) can all impede her ability to break away from car dependence.

Safety is another factor. Women also bicycle less because of traffic safety concerns (Garrard et al., 2012b). Even in countries with more bike-friendly infrastructure, women are likely to express concern about traveling in mixed traffic (Prati, 2018).

Other factors mentioned by all participants, such as bike-friendly infrastructure and stringent parking policies, played a role in their choice of biking, echoing previous findings (Pucher et al., 2010). Parking in cities like San Francisco, Berkeley or Oakland can be difficult, time-consuming, and costly. Participants found avoiding parking and daily congestion enormously relieving. Trips to school, to work, or impromptu stops were easier on an e-bike than they would be in a car. These experiences reinforced their decision to purchase the e-bike and use it daily.

### Policy implications and future research directions

Mirroring previous studies in the US and abroad, this study identified price as the biggest barrier for greater e-bike adoption (Dill & Rose, 2012; Jones et al., 2016; MacArthur et al., 2018; Popovich et al., 2014). All participants were committed bicyclists and considered themselves experienced. Less enthusiastic or less experienced bicyclists may find price a major barrier to use, especially in more auto-friendly communities where parking is plentiful and free. Incentives such as tax rebates or subsidies should be considered to support purchases, particularly since it can play a role in reducing emissions (McQueen et al., 2020). The California Bicycle Coalition has proposed one for California and in 2021, a federal law is being proposed to reduce the costs of e-bikes. This is in line with policies in Austria, Germany, Switzerland, and France (Wachotsch et al., 2014; Wolf & Seebauer, 2014), where the e-bike market has grown significantly.

Providing opportunities to test out e-bikes is another way to demonstrate their benefits. Local governments in the Bay Area have been supportive of bike share programs, including e-bike share. Employers could also provide opportunities to test e-bikes (Edge et al., 2018). These programs are continuing to expand. Arranging opportunities for people to test e-cargo bikes as well through a bike share program could expand the market for family users. Switzerland has grown its e-cargo bike share program from only a few hundred users to over 10,000 users and 30,000 locations through such programs (Schmid, 2018). Sweden piloted a cargo bike pool (Rivera & Henriksson, 2014) in which cargo bikes were shared within a housing community. This bike share model is one way to address the cost and make e-cargo bikes available to people with less affluence. It can also be a way to get women on bikes as well. Studies that allowed participants to

test out e-bikes show increased use (Cairns et al., 2017; Fishman & Cherry, 2016).

Finally, large-scale national studies on bike use should include questions on family use. Questions should make clear the difference between cargo and children. As this study shows, e-bikes provide opportunities not only to carry heavy loads, but also children.

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### ORCID

Alainna Thomas  <http://orcid.org/0000-0002-8892-2493>

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