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Riding First Class: Impacts of Silicon Valley Shuttles on Commute & Residential Location Choice

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ABSTRACT

Employer-provided private shuttles have become a prominent part of the transportation network between San Francisco and Silicon Valley. As the Bay Area plans for transportation investments to meet sustainability goals and accommodate future population and employment growth, an understanding of the role of regional commuter shuttles becomes increasingly important. This study investigates the impacts of private shuttles on commute mode and residential location choice by conducting a travel time comparison and surveying shuttle riders. The authors find that the provision of shuttles and knowledge of shuttle stops influences both commute mode and residential location choice. Shuttles are an attractive option due to their time and cost savings compared to other modes. However, shuttles exacerbate the jobs-housing imbalance by enabling individuals to live farther from work. The extent to which location of shuttle stops influences residential location choice varies from person to person, though the vast majority of shuttle riders live within a short walk from the nearest shuttle stop. Policies should strike a balance between improved sustainability with existing land use patterns and better long-term regional transportation and land use planning.

INTRODUCTION

Employer-provided private shuttles have become a prominent part of the San Francisco Bay Area's transportation network, ferrying workers between San Francisco and other parts of the region and Silicon Valley. These services have grown rapidly in the last ten years. Shuttles provide substantial environmental and congestion reduction benefits compared to solo driving, and they enable employers to compete for high tech workers across a much larger labor shed than conventional transit. However, in San Francisco, shuttles have also engendered community concerns about local traffic impacts and escalation of housing costs.

In the coming decades, the San Francisco Bay Area is projected to see significant growth in population and employment, as city and state policies promote and support added infill development to meet increasing housing demands and address sustainability goals. A better understanding of the role of employer-provided shuttles and their impacts on residential location and commute choice thus becomes increasingly important.

This study investigates employer-provided shuttles and their impacts on commute mode and residential location choice for Silicon Valley tech employees, focusing on the San Francisco to Silicon Valley services. We ask, does the provision of shuttles reduce vehicle miles traveled? Does the availability of shuttle service influence residential location choice near shuttle stops?

BACKGROUND

San Francisco Bay Area transportation network: Issues, trends & policies

The San Francisco Bay Area is a dynamic region with a population of 7.2 million, a land area of approximately 18,000 sq km (7,000 sq mi), and a gross regional product of \$535 billion. Across this region, twenty-eight transit agencies collectively carry some 1.6 million passengers a day (Metropolitan Transportation Commission). Nevertheless, solo driving is the dominant commute mode in the Bay Area, and this auto dependence imposes major costs to society including congestion, lost productivity, noise, pollution, and other negative externalities (Terwilliger Center for Workforce Housing 2009). In 2012, the San Francisco-Oakland area ranked second in the country for yearly hours of delay per auto commuter due to congestion, while San Jose ranked 28th (Lomax et al. 2012).

The population is projected to increase to 9.3 million by 2040, and employment to increase 33% (Association of Bay Area Governments et al. n.d.). The existing transport network is strained, as are its funding sources. While congestion is getting worse, the automobile transportation network is not expected to expand commensurately with vehicle miles traveled (VMT) (Cervero 2002; Association of Bay Area Governments et al. n.d.). Likewise, few major transit expansions are anticipated. To accommodate population and employment growth, and mitigate travel externalities, the region is emphasizing "sustainable" transportation strategies such as demand management and optimization of existing highway and transit operations. These strategies are relatively inexpensive and have low environmental costs, while providing increased accessibility.

Affordable, environmentally benign strategies are also needed to meet the greenhouse gas reduction targets set forth in state laws, notably Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006, and California Senate Bill 375 (SB 375), the California Sustainable Communities and Climate Protection Act of 2008 (Association of Bay Area Governments et al.

n.d.). SB 375 requires metropolitan areas to develop a Sustainable Communities Strategy (SCS) that coordinates transportation, land use, and housing in the long-range transportation planning process to meet these goals.

A comprehensive approach must be taken under SB 375. Locating housing and services close to employment centers and transit is crucial. In addition, a suite of Transportation Demand Management (TDM) strategies is needed, including fast, reliable transit and safe and convenient walking and biking environments. Parking management, carpooling, carsharing, programs that shift travel to off-peak periods, and even road pricing initiatives are often part of TDM strategies (Victoria Transport Policy Institute 2013).

In this context, the rise of employer shuttles offers new opportunities for reducing VMT and emissions. The shuttles expand transit services at little cost to the public (assuming local traffic impacts are manageable) and attract many commuters who might otherwise drive. Nonetheless, the shuttles also raise questions about the impact on public transit services and the land use implications raised by long-distance commutes.

Employer-provided shuttles in Silicon Valley

“Shuttles” can refer to a variety of public or private transportation services; serve entities like academic institutions and private employers; operate within specific geographic areas, including to/from transit stops; operate on a schedule or on demand; and use vehicles ranging from mini-vans to full-sized coach buses (SFCTA 2011). This study focuses on employer-provided commuter shuttles that ferry employees from San Francisco to Silicon Valley. These privately operated shuttles are often full-size coach buses with regular, fixed schedules.

Private commuter shuttles are not a new phenomenon. Private commuter buses operated in California as early as the 1950s, and grew during the 1980s (Singa & Margulici 2010). Employer-provided bus services existed by the 1980s, when Hughes Aircraft, a Southern California aerospace company, contracted with a private operator to run ten bus routes at a subsidized cost to employees (Cervero 2012). At the same time, private companies were running intercounty routes to large work sites in Southern California and the Bay Area (Cervero 2012).

The employer-provided shuttles serving Silicon Valley are distinct from previous shuttles that focused primarily on the “last mile” problem between suburban workplaces and the closest rail station. These shuttles are express buses provided primarily as an employee benefit for recruitment, retention, and productivity purposes; as such, they are free for employees and need not operate profitably (SPUR 2013; Harrington 2013; Cosgrove n.d.; Singa & Margulici 2010). These shuttles offer amenities such as spacious seats, working tables, and wireless internet (Singa & Margulici 2010). Employers value the shuttles as an effective TDM strategy to improve their environmental footprint and reduce parking requirements (Apple, Inc. 2012; Genentech, Inc. 2013; Google, Inc. 2011; Google, Inc. n.d.; SPUR 2013). The shuttles are usually one of several transportation options provided, including guaranteed rides home, onsite carsharing or bikesharing, intra-campus shuttles, transit subsidies, and carpool programs (SPUR 2013; Harrington 2013).

Google was the first tech company to provide this type of shuttle at its Mountain View headquarters (Harrington 2013). In 2004, Google upgraded its vanpool program to a shuttle route that made two stops in San Francisco and carried 155 passengers a day (Thomas 2012). Ridership doubled within a year. Google currently operates about 100 buses at 80 shuttle stops across the Bay Area with 380 daily departures and approximately 10,000 daily one-way trips (Harrington 2013). In comparison, the San Francisco transportation network accommodates approximately 1.9 million auto trips and 600,000 transit trips per day (Cambridge Systematics 2012). Google's shuttle ridership and fleet are similar in scale to the fixed-route suburban bus service of Central Contra Costa Transit Authority (Metropolitan Transportation Commission 2012b). While Google's shuttles cover a large portion of the Bay Area, two thirds of their shuttles and ridership are between San Francisco and Mountain View (Harrington 2013).

Other Silicon Valley technology companies have followed suit, with competitors such as Yahoo! launching service in 2005, Genentech in 2006, Apple and eBay in 2007, and Facebook in 2009 (Helft 2007; Anon 2007; Kincaid 2009; Roche n.d.). By 2012, at least 9 employers were offering shuttles between San Francisco and Silicon Valley, with at least 7,000 people riding the shuttles daily (SFCTA Plans and Programs Committee 2012). Other companies that provide shuttle services include Netflix, Electronic Arts, and LinkedIn (SFCTA 2011).

The need for these shuttles is in part a reflection of the region's fragmented transit services. The Bay Area Rapid Transit District (BART) operates in four counties but does not currently serve Silicon Valley (San Francisco Bay Area Rapid Transit District 2009). From San Francisco, Caltrain offers rail service to 32 stations between San Francisco and southern Santa Clara County, but many users require a lengthy access trip to reach Caltrain (Caltrain n.d.). The San Francisco Municipal Transportation Agency (SFMTA), which operates Muni, the public transit system for San Francisco, does not offer services outside of the city. SamTrans offers an express bus between Palo Alto and San Francisco, but the route serves only the Financial District in San Francisco and runs hourly (San Mateo County Transit District 2012). The region's inability to better integrate its transit services has created gaps that the corporate shuttles are now filling.

Responses to the shuttles & the Commuter Shuttles Policy and Pilot Program

The shuttles have been met with mixed reception by San Franciscans. Most shuttle stops are located at Muni bus stops, and the shuttles occasionally impede Muni access or block bicycles and auto traffic (Riley 2012). Residents have also raised complaints about noise and vibrations from shuttles, particularly on residential streets (SFCTA 2011). Moreover, there is anecdotal evidence that some tech employees choose to live close to shuttle stops, causing real estate prices to rise further and gentrify portions of San Francisco (Helft 2007; Roose 2012; Carroll 2013; Lloyd 2008; Pisillo 2012).

The San Francisco County Transportation Authority (SFCTA), which administers the half-cent local transportation sales tax program and acts as the congestion management agency for the city, reports that the shuttles have reduced VMT and solo driving trips, leading to decreases in greenhouse gas emissions and air pollution (SFCTA 2011). Shuttle riders themselves are extremely positive about the shuttle's impact on their quality of life, often citing it as their most important employee benefit (SPUR 2013; Helft 2007).

In response to the growth of privately operated shuttles, the SFCTA undertook an extensive study focusing on the regional employer shuttles. The resulting Strategic Analysis Report documented benefits and impacts of the shuttles, and recommended the creation of the Muni Partners Program at the SFMTA coordinate, manage, and support the growth of the private shuttle sector (SFCTA 2011). Established in 2011, the Commuter Shuttles Policy and Pilot Program (formerly known as the Muni Partners Program) is one component of the city's overall TDM strategy.

The primary goals of the Commuter Shuttles Policy and Pilot Program are to better understand the private shuttle sector, establish clear and coherent curb use policies, develop identification and communication processes to increase accountability of shuttles, and collaborate with shuttle providers for mutually beneficial outcomes (SPUR 2013; SFCTA Plans and Programs Committee 2012). To this end, the program has inventoried shuttle providers, studied their fleets' fuel and activity profiles, surveyed shuttle riders, and collected data on operational conflicts. The Commuter Shuttles Policy and Pilot Program has not focused on the shuttles' impacts on residential location choice. In July 2013, SFMTA announced plans for an 18-month test of a new set of shuttle regulations (Cabanatuan 2013). Shuttles would be limited to a network of 100 designated Muni stops, and would be required to purchase permits and display visible identification placards. Shuttle operators would also be required to give priority to Muni buses at stops, and share data on ridership and routes with SFMTA.

Transportation and land use connection

Strategies to address California's sustainability goals and ensure the economic vitality of the region must take into consideration the connections between transportation, land use, and housing. Transportation and land use influence each other, so strategies that do not address both factors are apt to be ineffective (Cervero & Landis 1995).

The San Francisco Bay Area faces major transportation, land use, and housing challenges. Housing costs are high, with the Bay Area ranking number one in median home value and median gross rent. Bay Area households spend nearly 60% of their income on housing and transportation (Terwilliger Center for Workforce Housing 2009). The state mandates that cities plan for housing by affordability level in their general plans, and regional agencies assign housing allocations to the cities and counties (Association of Bay Area Governments et al. n.d.). In the Bay Area, Priority Development Areas (PDAs), infill development opportunity areas with easy access to transit, jobs, and services, have been the focus for most recent regional housing allocations (Association of Bay Area Governments et al. n.d.). These efforts focus on meeting housing needs in transit-oriented environments to facilitate regional connectivity, and assign much of the responsibility for housing to the largest cities. While the Bay Area has made progress in aligning land use, housing and transportation policies, most cities have not been able to meet their housing allocations except for the most affluent residents. According to the 2013 Silicon Valley Leadership Group CEO survey, the high cost of housing is the top challenge to attracting and retaining employees (Hirahara 2013).

A major challenge is the jobs-housing imbalance. Employment is concentrated in job-rich communities that do not house a commensurate portion of the workforce. For instance, the region as a whole has about 0.46 jobs per capita (Association of Bay Area Governments et al.

n.d.; California Employment Development Department 2010); Palo Alto has 2.5, while San Jose has 0.83 (Arieff 2012). This imbalance increases driving, raises greenhouse gas emissions, expands the commute shed for workers, and raises equity and job access concerns (SPUR 2012). Improving this balance means less commuting, more personal time, and better quality of life (Hirahara 2013). However, a simple numeric balance is not the whole story, since housing choice depends on factors such as housing type, price, and local amenities.

The Bay Area is home to the nation's most competitive knowledge services sector, which represents the fastest-growing portion of the regional economy (SPUR 2012). Many of these tech jobs are located in low-density office parks and corporate campuses in Santa Clara County, locations that are less conducive to transit use, and encourage solo driving (Cervero 2012; Singa & Margulici 2010). However, congestion is chronic on the freeway corridors that serve Silicon Valley (Rosenberg 2012). To ensure the economic vitality of this sector in light of the jobs-housing imbalance, TDM strategies like shuttle service become increasingly important.

METHODOLOGY

Scope

The study investigates whether provision of employer-provided shuttles and knowledge of their location influences employees' commute mode and residential location choices. There are several types of shuttle service, and this study focuses on employer-provided commuter shuttles that ferry employees from San Francisco to Silicon Valley. These privately operated shuttles are most often full-size coach buses with regular, fixed schedules.

While regional shuttle services operate throughout the Bay Area, the largest concentration originates in San Francisco. The study focuses on individuals who board shuttles in San Francisco and work full-time in San Mateo and Santa Clara Counties at technology-related companies.

Data & Approach

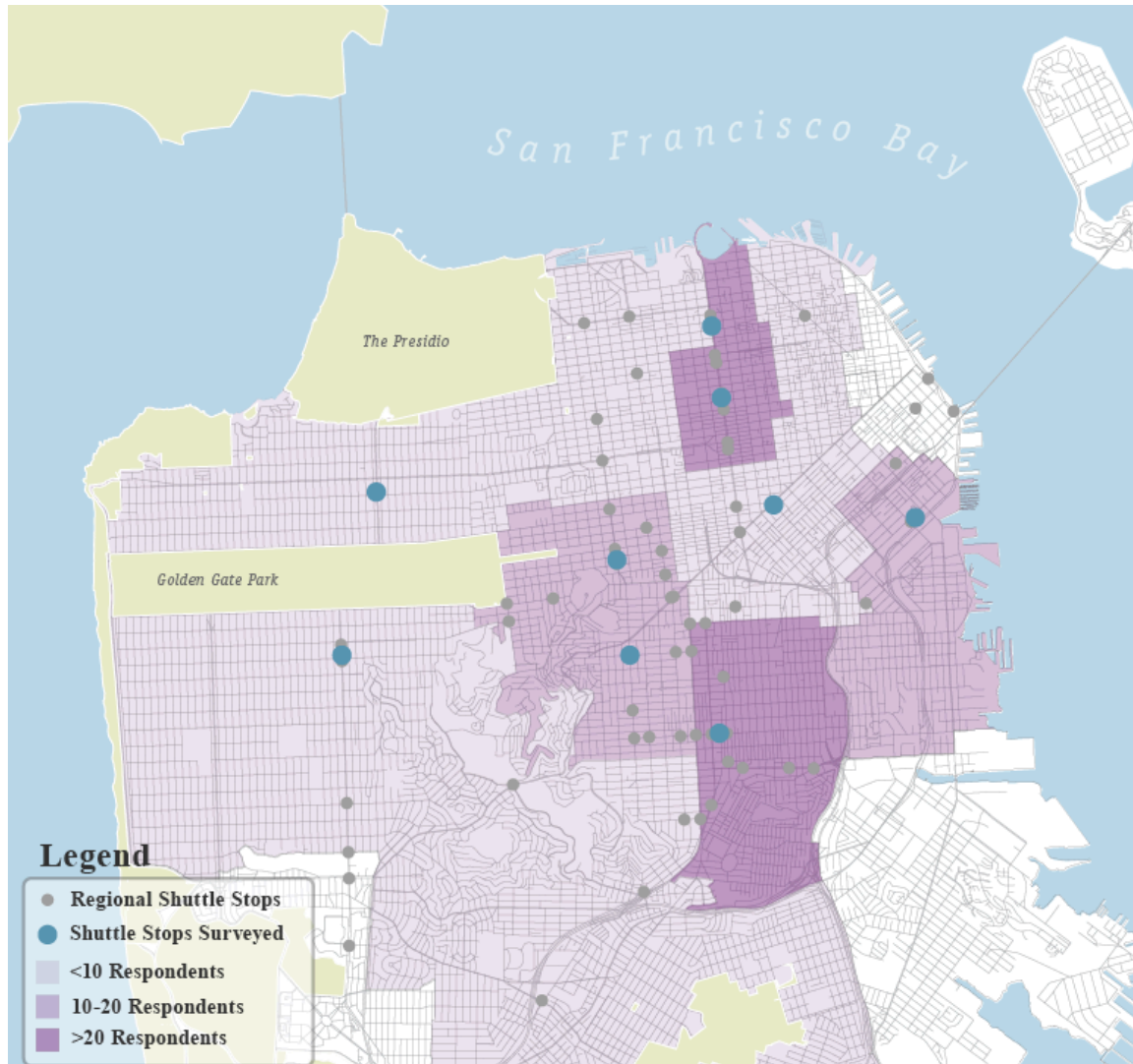
To better understand the role that shuttles are playing in commuting along the Peninsula, we compared travel times by shuttles and transit between nine of the roughly 200 shuttle stops in San Francisco and four major employers offering shuttles. We also developed and implemented a survey to investigate how the provision of shuttles and knowledge of stops influence Silicon Valley employees' residential location choice and commute mode. We supplemented our findings with interviews with the SFCTA, SFMTA, and Google, and by attending a San Francisco Planning and Urban Research-hosted panel on the Silicon Valley commuter shuttles.

Nine of the roughly 200 shuttle stops in San Francisco were selected for study, with time and resource constraints being the limiting factor on the number of locations surveyed. Shuttle stops were chosen with attention to geographic coverage and ridership volumes. The authors relied on maps of shuttle stops compiled by the SFCTA, Stamen Design, and Google (SFCTA 2011; Stamen Design 2012; Anon 2013). Shuttles with particularly high ridership were identified in the field data collection through the Muni Partners Program (Nelson/Nygaard Consulting Associates, Inc. 2012). Clusters of stops were also given special consideration due to the possibility of reaching a broader base of shuttle riders. All shuttle locations surveyed were served by more than one tech company.

Travel Time Comparison

Using Google Maps, travel times for the shuttles and transit were calculated between each of the nine sampled shuttle stops and four of the largest shuttle providers: Apple, Facebook, Genentech, and Google. Shuttle times were approximated as seven minutes of walking access time (based on survey responses from shuttle riders), plus the non-congested driving time between the shuttle stops and employers escalated by 40 percent, plus five minutes for loading and unloading. The escalation factor corresponds to the ratio between congested and non-congested travel times from San Francisco to San Jose during the weekday morning peak, based on Caltrans data for June 2013 (California Department of Transportation n.d.). The average walking access time was calculated using the responses of shuttle riders to the survey presented in the next section of this paper. Only access times for those who live within a 15-minute walk of a shuttle stop were considered, since it is assumed that commuters living more than 15 minutes away from shuttle stops would be likely to use a faster access mode. This assumption is borne out by the survey data as well: 76 percent of shuttle riders lived within 15 minutes of their shuttle stop, and a commensurate 80 percent of shuttle riders reported walking to their shuttle stop.

Transit travel times assume that a last-mile shuttle would be provided, and are calculated as seven minutes of walking access to transit, plus the travel time for arrival at the destination Caltrain station (or, if faster, BART station for Genentech) by 9:00am, plus three minutes for a transfer to a last-mile shuttle, plus the non-congested driving time between the rail station and the corporate campus. The seven-minute access time for transit may be a slight overestimate since there could be a bus stop closer to a commuter's home than the shuttle stop, but the maximum magnitude of this bias is very small. The travel time comparison evaluates the walk-to-transit and walk-to-shuttle accessibility to Silicon Valley of the areas around the nine sampled shuttle locations.

FIGURE 1 Map of Regional Shuttle Stops & Locations Surveyed

Employee surveys

Surveys were administered online using Qualtrics survey software. Flyers displaying a QR code and the URL for the survey were distributed to employees waiting at nine shuttle stops in spring 2013. Unlike the travel time comparison, which was limited to four major companies, the survey was distributed to all employees waiting at the shuttle stops. A \$50 cash prize was used as an incentive for participation. In total, 1,169 individuals were approached with a flyer, and 924 total flyers were distributed. The survey link was opened 291 times; however, responses were excluded from the analysis if the respondent stopped before finishing the survey (44 respondents), or if the respondent did not work at a technology-related company in San Mateo or Santa Clara counties, or left critical questions blank such as commute mode choice (77 respondents). Of the 170 valid responses, 130 were from commuters taking employer-provided shuttles between San Francisco and Silicon Valley.

The online survey took approximately 10 minutes to complete. Respondents were asked about their workplace location, whether their employer offers shuttles, their primary commute mode, and other ways of commuting in the past three months. Subsequent questions asked about their reasons for using the shuttle and how they would commute without it, and their residential choices, including the factors that went into choosing their home. Additionally, basic demographic information was collected. Finally, respondents were given the opportunity to elaborate on previous answers in a free response.

An online survey could rule out users lacking internet access, but we believe it is not a limitation since the target demographic are technology-savvy individuals. The survey was opened by 31.5% of those who received flyers, and valid responses were received from 58.4% of those who opened the survey. Overall, valid responses were returned from 18.4% of those who received flyers. The non-completion rate among those who opened the survey is likely due to the personal nature of questions about work and home location and reluctance by some employees to share information about their employers. The results of this research could be strengthened by a larger sample, but a sample of 130 shuttle riders still provides useful insights into the factors influencing commute mode and residential location choices.

RESULTS AND ANALYSIS

Travel Time Comparison

The travel time comparison examines the added accessibility created by employer-provided shuttles. Shuttles will only impact commute mode and residential location choice if they offer a service more desirable than transit or driving alone. Cost and travel time are two of the most important factors in mode choice. Employer-provided shuttles, as a free employee benefit, are superior on user costs. They also offer dramatic time savings over transit in the San Francisco to Silicon Valley corridor, and over solo driving where shuttles are able to use carpool lanes. For Google, shuttle trips are usually limited to three pick-up stops per route, and up to five drop-off points on campus; other buses run express, with just one pick-up and drop-off, which contributes to time savings (Harrington 2013).

TABLE 1 Travel Time Comparison between Transit and Shuttles

Shuttle Stop	Apple (Cupertino)			Facebook (Menlo Park)		
	Transit Time	Shuttle Time	Ratio	Transit Time	Shuttle Time	Ratio
Park Presidio Blvd & Geary Blvd	126	82	1.5	107	72	1.5
19th Ave & Judah St	127	76	1.7	100	65	1.5
Castro St & 18th St	115	79	1.5	92	67	1.4
Divisadero St & Haight St	116	79	1.5	93	64	1.5
Guerrero St & 24th St	102	74	1.4	82	60	1.4
Van Ness Ave & Union St	119	86	1.4	98	71	1.4
Van Ness Ave & Pine St	113	83	1.4	93	68	1.4
8th St & Market St	103	78	1.3	80	61	1.3
4th St & Townsend St	81	74	1.1	61	57	1.1
Average (minutes)	104.3	79.0	1.3	82.6	64.9	1.3

Shuttle Stop	Genentech (South San Francisco)			Google (Mountain View)		
	Transit Time	Shuttle Time	Ratio	Transit Time	Shuttle Time	Ratio
Park Presidio Blvd & Geary Blvd	68	50	1.4	114	76	1.5
19th Ave & Judah St	60	46	1.3	114	69	1.6
Castro St & 18th St	57	40	1.4	103	71	1.5
Divisadero St & Haight St	61	39	1.6	104	68	1.5
Guerrero St & 24th St	43	34	1.3	90	64	1.4
Van Ness Ave & Union St	73	46	1.6	107	75	1.4
Van Ness Ave & Pine St	66	41	1.6	101	72	1.4
8th St & Market St	44	36	1.2	91	65	1.4
4th St & Townsend St	33	32	1.0	69	61	1.1
Average (minutes)	49.1	40.3	1.2	92.2	69.1	1.3

Notes:

- [1] All travel times are in minutes.
- [2] Transit travel times are calculated as seven minutes of walking access time plus the transit travel time for arrival at the destination Caltrain or BART station by 9:00am on Monday morning, followed by a 3-minute transfer, plus the drive time for a last-mile shuttle from Caltrain or BART to the corporate campus.
- [3] Shuttle travel times are calculated as the non-congested driving time escalated by 40%, plus seven minutes of walking access time to the shuttle stop (based on survey data) and five minutes for loading/unloading. The 40% escalation factor corresponds to the ratio between congested and non-congested driving times for the weekday morning peak from San Francisco to San Jose, based on Caltrans data for June 2013.

The employer-provided shuttles significantly increase alternative-mode accessibility between San Francisco and Silicon Valley. For all four employers, transit plus a last-mile shuttle takes about 1.3 times as long as shuttles on average (and up to 1.7 times as long). The 4th St & Townsend St shuttle location was the most accessible to Silicon Valley, primarily because this cluster of shuttle stops is directly adjacent to the San Francisco Caltrain station. However, even in this case, transit plus a last-mile shuttle would still take 10 percent longer than a shuttle for three of the four companies.

There are other reasons a commuter may choose transit over driving alone, such as increased productivity during the commute, reduced stress from not driving, and cost savings on gas, parking, and reduced vehicle ownership. However, because employer-provided shuttles are running from many locations rather than just a few Caltrain stations, they clearly represent an accessibility increase around the locations in San Francisco at which they are provided, and combine many of the most attractive features of transit with the travel time of driving.

Survey results for shuttle riders

Of the valid survey responses, 130 indicated that an employer-provided shuttle was their primary commute mode between San Francisco and Silicon Valley. The shuttle riders reported employers from 13 cities in Silicon Valley.

Commute choice

Riders were asked to select up to three reasons for choosing to ride the shuttles. The most commonly cited reason was that it is free (57% of respondents). The next most commonly cited factors were increased work productivity (44%), avoiding traffic congestion (35%), and the amenities and comfort of the shuttle (33%).

TABLE 2 Shuttle Riders' Commute Choice: Reasons for Choosing the Shuttle

Factors	N	% of Total Riders
Shuttle is free	74	57%
Work productivity	57	44%
Avoid traffic congestion	45	35%
Shuttle amenities/comfort	43	33%
Reduce carbon footprint/environmental benefits	38	29%
Convenience of a shuttle stop	36	28%
Don't own a vehicle	35	27%
Other options are too slow	29	22%
Other	9	7%
Lack of parking	7	5%

Note: Riders were asked to select up to three factors for riding the shuttles.

To understand the commute mode impacts of the shuttles, respondents were also asked how they would get to work if shuttle service were discontinued. Among shuttle riders, 48% reported they would drive alone. This is similar to results from the SFCTA and SFMTA's Commuter Shuttles Policy and Pilot Program, which found that 49.5% of a larger sample of shuttle riders would drive alone if not for the shuttles (SFCTA Plans and Programs Committee 2012). Of the shuttle riders who have also commuted by driving alone in the past three months, nearly 70% said they would drive if there were no shuttle. Roughly a third of commuters would take alternative modes such as Caltrain (18%), other transit (2%), or carpooling (15%) if the shuttles were discontinued. These findings support the positive impacts of shuttles on environmental and congestion reduction goals, since they are reducing solo driving in a congested freeway corridor. However, they also suggest that the shuttles are reducing use of public transit. If the survey results can be generalized to the estimated 7,000 daily San Francisco-Silicon Valley shuttle riders, 20%, or about 1,400 daily riders, are lost to transit because of the shuttles.

TABLE 3 Shuttle Riders' Response if Shuttle Were Not Provided

Response	N	% of Total Riders
Drive alone	63	48%
Caltrain	23	18%
Carpool	19	15%
Resign or quit working there	13	10%
Other public transit	3	2%
Bike	2	2%
Other	2	2%
No response	5	4%
Total	130	100%

It is also notable that shuttle riders do not completely abandon other commute modes. Nearly half (48%) of all shuttle riders have also commuted by driving alone in the past three months. Shuttle riders have also carpooled (19%) or used Caltrain or other public transit (12% for both).

Residential location choice & household characteristics

As indicated in Table 3, if shuttle service were discontinued, ten percent of shuttle riders said they would leave their job. This underscores the value of the shuttles as a recruitment and retention strategy for companies, since a substantial minority of employees would be unwilling to undertake a long commute without shuttles.

Commuters could also respond to a discontinuation of shuttle service by changing their residential location. When asked if they would move if the shuttles were discontinued, 40% said they would move somewhere closer to their job. This finding suggests that the provision of shuttles does indeed enable a substantial portion of the sample to live in neighborhoods of San Francisco that are farther from their workplaces.

Shuttle riders were also asked about their current residential location choice. Approximately half (45%) of shuttle riders did not move homes since accepting their current job. However, 22% of shuttle riders had moved within the Bay Area to somewhere farther from their workplace since accepting their job while only 10% had moved closer, which suggests that shuttles enable individuals to live farther from work and closer to their personal preferences. All individuals who moved from outside the region to accept their job in Silicon Valley were aware of the shuttle benefit when choosing their home.

Shuttle riders are very likely to live close to their nearest stop. More than half (57%) of respondents live less than a 10-minute walk from their shuttle stop, and 76% are within a 15-minute walk. The majority (80%) walk to their stop.

Respondents were asked to rate the importance of a number of factors when choosing their current home, using a 1 to 5 scale, from “not at all important” to “extremely important.” The

most important factor was “ease of walking in neighborhood,” which received an average rating of 4.31. Shuttle riders also placed a high value on proximity to entertainment, culture, and amenities, proximity to transit, and living in an urban neighborhood. Proximity to a shuttle stop was the fifth-most influential characteristic, with an average rating of 3.90. Not surprisingly for a group whose residences were 30-80 km (19-50 mi) from work, proximity to work was relatively unimportant.

TABLE 4 Importance of Various Factors in Residential Location Choice

Factor	Mean	Std. Dev.
Ease of walking in neighborhood	4.31	0.72
Proximity to entertainment, culture, and amenities	4.16	0.77
Proximity to transit	4.06	0.80
Living in an urban neighborhood	4.05	0.97
Proximity to employer-provided commuter shuttle	3.90	1.27
Affordability	3.84	0.86
Ample living space	3.57	0.92
Proximity to friends	3.51	1.05
Proximity to work	2.71	1.13
Proximity to family	1.91	1.26
Quality of school district	1.45	0.89

The demographics of San Francisco shuttle riders are worth noting. Most are male (69%). Only 24% lived with a spouse, and only 3% had children. The average age of the shuttle riders was 31.6 years old and the median age was about 30. About 60% had at most a bachelor’s degree, 24% a master’s or professional degree, and 6% a doctorate. Only 2% earned less than \$50,000 and only 13% earned less than \$75,000, while 67% reported an income of \$100,000 or more. The majority (85%) rent their home. Shuttle riders placed the least importance on quality of school district, which is consistent with the shuttles’ young, single, childless demographic.

DISCUSSION

Does the provision of shuttles and knowledge of shuttle stop locations influence commute mode and residential location choice? In short – yes.

The travel time comparison and survey results highlight the value of shuttles to employees. Commuting to Silicon Valley from San Francisco on public transit takes about 30 percent longer than shuttles, which combine many of the most attractive features of transit with a travel time close to that of driving. Aside from savings in time and cost, commuters also place high value on amenities and increased productivity afforded by the shuttles. One shuttle rider comments:

“It gives me a calm, clean, quiet place to work with WiFi... 75% of the time I work on the shuttle, but I often use that time to work to organize my day – personal and professional... Caltrain is a faster, more efficient option for me, but

does not afford me the same environment to get things done. People respect the shuttle and co-commuters on the shuttle. When I do carpool every few months, the number of single drivers on the road astounds me and I really believe we are helping to minimize pollution and congestion by lowering our carbon footprint.”

The data shows that nearly half of current shuttle riders would drive alone if the shuttles were not provided, supporting the positive impacts of the shuttles on environmental and congestion reduction goals. On the other hand, since 20% say they would use public transit were the shuttles not available, the shuttles do have an impact on public transit ridership and finances.

With regards to residential choices, the data indicate that many are choosing to live farther away from their workplace than they otherwise would. Additionally, 22% of shuttle riders have already moved farther from their jobs since accepting their offer, suggesting that shuttles enable some commuters to live in San Francisco who would otherwise live closer to work.

The survey comments reflected these different experiences. One commuter writes, “I chose to live in San Francisco because of my employer-provided commute shuttles. I would otherwise have lived in [the South Bay], because I don't have a car and who the hell wants to drive that much anyway.” Another shuttle rider who is looking to move says, “the convenience of the employee shuttles makes the commute tolerable enough that I don't feel the need to move closer... within San Francisco I am restricting my apartment search to locations that are within walking distance of a shuttle stop.”

Shuttles enable individuals to live farther from work, and closer to their preferred neighborhoods. The importance of cultural amenities was evident in several comments. One commuter reflected that, “I would love to work in San Francisco, but I am personally (and financially) invested enough in my employer that I would not consider leaving... I lived in Sunnyvale my first year at my current job and hated it so much. I don't think I would ever live in the South Bay again. I felt very isolated there as a single, gay man.”

The relationship between shuttle stop locations and specific neighborhood choice within San Francisco is more complicated. Three quarters of respondents live within 15 minutes of a shuttle stop, with many explicitly using shuttle proximity as a criterion. Respondents wrote, “I relocated to San Francisco ... from Europe and picked my apartment and neighborhood for its proximity to the corporate shuttle stop,” and, “I moved specifically to be in a neighborhood that would allow me better access to a regular shuttle service.” However, other factors such as urban amenities were more influential overall than shuttle stop proximity. Moreover, employers plan shuttle routes to serve neighborhoods where employees live. Shuttle routes thus may follow tech employees to neighborhoods that people, tech employees or not, find desirable.

Additionally, nearly half of respondents would either move closer to their job or quit if shuttle service were discontinued. One shuttle rider writes, “If my employer didn't offer the shuttle, I would probably quit. I don't want to own a car and the train system sucks, so I would find a job in the city instead.”

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This research supports the importance of shuttles as one part of a suite of TDM strategies that helps San Francisco reach sustainability and environmental goals. The SFMTA's Commuter Shuttles Policy and Pilot Program is a crucial step in ensuring that the shuttles can fit coherently into San Francisco's transportation system by minimizing conflicts with Muni buses and other road users, and ensuring a safe transportation system. The program also provides a model to other cities and regions seeking a rational regulatory framework for private transportation providers.

However, it is also important to recognize that the shuttles may exacerbate jobs-housing imbalances by enabling people to live farther away from where they work and allowing Silicon Valley cities to avoid dealing with the consequences of their underproduction of high amenity urban neighborhoods. The following policy recommendations address both improved sustainability within existing land use patterns and better long-term regional transportation and land use planning.

Broader consideration of shuttle impacts

- The SFMTA's Commuter Shuttles Policy and Pilot Program currently focuses on operational conflicts between shuttles and Muni. The City can broaden this scope by measuring other impacts of shuttles, especially the effects on real estate markets.
- The potential of shuttles as a TDM strategy and their regional scope suggest the region should also study their impacts on transit operations and housing markets regionally. Their impacts are likely different in San Francisco and suburban communities.

Transportation improvements

- Muni and Caltrain operations should be improved to increase job accessibility throughout the city and region, and draw more commuters away from solo driving when shuttles are not available. Slow travel times on transit, particularly in San Francisco, have a severe impact on its attractiveness for Silicon Valley commuters.
- For corporate campuses and job centers located away from Caltrain stations, there are two possible ways of increasing alternative mode accessibility. A policy of strengthening last-mile connections from Caltrain, whether through private shuttles or through SamTrans and other Silicon Valley transit agencies, may be more supportive of regional transit. Alternatively, encouraging long-distance regional shuttles may be more compelling to commuters and thus more effective at reducing solo driving.

Land use and housing policies

- The city and region face daunting challenges in providing affordable housing, both at and below market rate. In pursuing affordable housing strategies, the city should be cognizant of shuttle locations and recognize that there are particular pressures on the real estate market there.
- Silicon Valley communities have an undersupply of housing and walkable neighborhoods demanded by many of the people who work there, placing a great burden on San Francisco's housing market. More and denser housing, at and below market rate, should be provided in transit-accessible locations in job-rich communities in Silicon Valley.

Further research

This research focused on the effects of shuttles on mode choice and residential location choice for Silicon Valley employees who commute from San Francisco. Further research should also be pursued more broadly on this topic. For example, the impact of regional shuttles on residential location choice in suburban settings or elsewhere in the Bay Area is not well understood. Additionally, this research has not examined employees who are offered shuttles but choose to drive alone, nor has it compared responses between people who commute to Silicon Valley by shuttle or by other alternative modes such as Caltrain. Lastly, new business models are emerging such as RidePal, which provides shared shuttles for commuters whose companies do not offer shuttles. There has not been substantial research into whether the impacts of these types of shuttles are different.

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