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ABSTRACT

Pedestrians, bicyclists, drivers, and public transit users all desire similar roadway design features, at least according to findings from a recent intercept survey of 537 people along a major urban corridor in the San Francisco Bay Area. This research was sponsored by the California Department of Transportation to understand traveler preferences for street design that could increase perceived traffic safety, walkability, and bikability along urban arterials, as well as encourage economic vitality through increased patronage of local businesses.

In an open-ended question about street improvements to enhance perceived traffic safety, all respondent groups requested the same top five improvements. Bicycle lanes were ranked first by pedestrians, drivers, and bicyclists (fifth by public transit respondents), and improved pedestrian crossings were ranked second by pedestrians, drivers, and public transit users (third by bicyclists). The remaining top five elements, while the same for all groups, were ordered slightly differently among them: slowing traffic/improving driver behavior, installing more traffic lights, and increasing the amount of street lighting. Similar preference alignment was found in response to a question about street improvements to encourage more visits to the corridor.

These findings suggest that design features generally thought to benefit one user group, such as bicycle lanes, may have unmeasured benefits for other user groups. Moreover, they offer evidence that focusing solely on specific user groups in the design process may miss opportunities to benefit multiple user groups through prioritizing a few design ideas. Overall, the findings support the continued implementation of Caltrans' Complete Streets policy.

INTRODUCTION

A greater understanding of how roadside design features affect walkability and bikability could benefit California's efforts to increase non-motorized travel and improve health through increased physical activity, enhance mobility for those who cannot or do not drive, and decrease greenhouse gas emissions from the transport sector. However, despite Statewide goals of increasing walking and bicycling, rates have remained fairly stagnant over the last ten years. This pedestrian and bicyclist intercept survey was conducted to understand how landscaping and street design features currently or could potentially affect perceived traffic safety, economic vitality, and general satisfaction with a major urban arterial in the Bay Area. This is part of a larger project to develop performance measures for pedestrian and bicyclist safety and mobility for the California Department of Transportation ("Caltrans"). The project focuses on San Pablo Avenue, a State route acting as an arterial in six Bay Area cities, but the findings may be applicable to urban arterials in general.

Literature Review

Several studies have previously examined the factors affecting whether a person walks or bikes, including perceived and actual safety in various street environments and the role of street design features in enabling or thwarting non-motorized transportation. For pedestrian design, much of the research has analyzed the relationship between neighborhood and street characteristics and reported mobility and safety trends, rather than stated preferences. In contrast, several studies on bicycling patterns have focused on stated preferences in an attempt to understand how to encourage more bicycling. This discrepancy seems to be due in part to the type of data available for analysis for each mode—with many fewer cyclists in the U.S., revealed preference data has traditionally been less available than for pedestrians. The research highlighted in this section focuses on revealed and stated preferences for roadway design features. A more comprehensive literature review about pedestrian, bicyclist, and driver safety and mobility, can be found at http://www.uctc.net/research/papers/878.pdf. Due to the nature of this project, the findings summarized in this section apply specifically to urban arterials.

Numerous studies suggest that urban form and traffic patterns influence whether or not a community is considered walkable. Design elements found to be positively associated with walkability include street connectivity, the presence of sidewalks, street trees, and pedestrian pathways that are visually stimulating and scaled to pedestrians *(1-6)*. Research on pedestrian level of service (LOS) at signalized intersections and along arterials indicates that conflicts with turning vehicles, the volume and speed of perpendicular traffic, and width of driveway and intersections crossings have the most negative effect on pedestrians' perceptions of comfort *(7)*. High volumes of traffic may be especially problematic for pedestrians attempting to cross the street *(8)*, necessitating countermeasures like marked crosswalks paired with high-visibility treatments like in-pavement flashing lights, a HAWK signal, or a stutter flash *(9-12)*.

Research on bicycle LOS found that the presence or absence of a bicycle lane was the most commonly cited reason for giving a roadway a high or low score, respectively *(13)*. A study using GPS data from Portland, Oregon, found that cyclists riding for utilitarian purposes rode mainly on streets with bicycle infrastructure, and that nearly 30% of the travel occurred on streets with bicycle lanes *(14)*. The same study also found that bicyclists often go out of their way to use bicycle facilities, even when it lengthens trip time. Similar findings resulted from studies evaluating stated preferences using dynamic modeling to determine the balance between commute time and facility quality. The results revealed a clear willingness to travel several minutes longer to get to and ride in a bicycle lane in order to avoid riding in mixed traffic *(15-16)*. Several other surveys have documented that bicyclists strongly desire more bicycle lanes and trails *(17-20)*. An analysis of perceived cycling risk and route acceptability found that high amounts of auto traffic were associated with increased perceptions of cycling risk, which can be helped, but not completely alleviated, by the presence of bicycle lanes *(21)*.

Research examining how various roadside design features affect driver safety and behavior is fairly robust. As the most common mode in the U.S., driver safety and mobility have received much attention from the engineering field, resulting in recommendations about site lines for street trees and parking, speed limits, lane widths and configurations, etc. *(22-27)*. However, relatively few studies have asked auto drivers their preferences for roadway design in urban areas—a question worth asking assuming that some drivers may view roadways in urban areas differently than limited access highways on which throughput seems to be the top priority. The studies that do exist have been small and qualitative in nature, precluding general conclusions about driver preferences for roadway design in various contexts.

Whether or not a community has economic vitality has an important impact on local quality of life. Unfortunately, little research has investigated the relationships between street design elements and community economic vitality. The research that has been done underscores that, as prime commercial areas, urban arterials should provide access opportunities for all modes, as well as amenities such as street trees that enhance comfort and therefore encourage foot traffic. Research has shown that consumers prefer business districts that have landscaping and trees, including those along main street arterials *(28-29)*. In addition, several studies have found that pedestrians, transit users, and bicyclists routinely visit stores along commercial strips in urban areas more often and spend more money overall than do driving patrons *(30-32)*. These studies suggested that replacing parking with a bicycle lane or widened sidewalk could benefit the local businesses. Pedestrian improvements to a downtown business area were also found to be associated with both increased pedestrian traffic and increased property values *(33)*.

Area Information

While officially under Caltrans' jurisdiction, the roadside design features along San Pablo Avenue (State Route 123) are influenced by the six cities and two counties through which the urban arterial passes in the East San Francisco Bay Area. It has 181 intersections along its 9.5-mile (15.3 km) length, and the character of the street ranges from traditional "main street" with small building footprints and immediate street frontage, to big box superstores with large building footprints separated from the roadway by parking lots. The entirety of the street carries bidirectional traffic with at least two lanes in each direction. It also has nearly 100% bidirectional sidewalk coverage, but no on-street bicycle facilities.

In terms of traffic safety, Table 1 shows that, from 1997-2007, drivers were approximately 2.5 times more likely than pedestrians to be injured in a car crash along San Pablo Avenue, while pedestrians were approximately 1.5 times more likely than drivers to be killed. Injury and fatality rates for bicyclists were unable to be calculated due to a lack of exposure numbers.

TABLE 1 San Pablo Avenue 1997-2007 Traffic Injuries, Fatalities, and Volumes, by Mode

Party	Injuries[1]			Fatalities[1]		
	Total Number	**Range (per intersection)**	**Ave/Std Dev**	**Total Number**	**Range (per intersection)**	**Ave/Std Dev**
Pedestrians	246	0-10	1.46/2.14	9	0-1	0.05/0.23
Bicyclists	182	0-10	1.08/1.62	0	-	-
Drivers	1715	0-89	10.08/12.84	17	0-2	0.10/0.34

Mode	Range	Average Weekly Volume	Std Dev	Injury Rate Mean*	Fatality Rate Mean*
Pedestrians[2]	4,987-55,436	9,362	6,293	0.334	0.012
Vehicle traffic: SPA[3]	149,331-235,060	199,879	19,480	0.858	0.008
Vehicle traffic: other[3]	700-291,900	14,063	31,707		
Bicyclists		Unknown			

Data sources: [1]SWITRS, 1997-2007
[2]Modeled pedestrian data (using Schneider, et al., 2009 model)
[3]Caltrans TASAS data
*Data adjusted by 1,000,000 for ease of comparison

SURVEY METHODOLOGY

The survey included questions about trip purpose, frequency of visits to the area, perceptions of traffic safety under various conditions, preferences for various design amenities, and likelihood of walking or bicycling more under certain conditions. It was conducted by intercepting 537 randomly selected participants along the test corridor. The survey had a refusal rate of approximately 25%. The research team chose eight survey locations along San Pablo Avenue, attempting to include a variety of street design amenities and land uses in the analysis. Areas were chosen after each intersection was graded on pedestrian crash rate and "context sensitivity". Context sensitivity was determined by the presence of pedestrian-friendly features such as street trees, median trees, a raised median island, landscaping, public seating, and trash cans. The pedestrian crash rates and context sensitivity ratings were then divided into thirds, to represent low, medium, and high values. Intersections were chosen from the low and high areas in order to provide maximum possible differentiation in the circumstances. It should be noted that this process was informal and developed only to facilitate choosing a group of intersections for the survey. Future use of this process would require additional validation.

In two cases, the survey results from two different sites were combined and analyzed together. In one case a major intersection was treated as a separate site from the blocks next to it. However, the survey size for the major arterial was too small to analyze alone (n=7), so these results were combined with those of the neighboring blocks, assuming the population was likely to be similar in both places. In the second case, one of the sites proved too dangerous from a personal security standpoint for the survey team, so a site similar in design was found and used as a substitute. The results from the two sites were then combined and analyzed as one.

The survey team visited the sites from 9 am – 6 pm over five weekdays and three weekend days, in order to capture a wide variety of participants. There was no rain during the survey period, and temperature averaged approximately 75 degrees Fahrenheit (24 degrees Celsius). The data was entered into a Microsoft Excel spreadsheet, and then analyzed using the statistical software package STATA. The results presented in this article represent both descriptive statistics and statistically significant relationships between variables in the analysis.

FINDINGS

Survey Population

This section describes the basic data from the survey, including socio-demographic data, overall trip purpose, travel mode, and visit frequency.

Sociodemographic Characteristics

Table 2 shows the demographic data for the respondent population. The age range was broad and fairly well distributed, with about 43% of the population classified as female. The distribution of races and ethnicities was not as broad as would be expected for the Bay Area, and the survey population tended to be highly educated.

Travel Mode

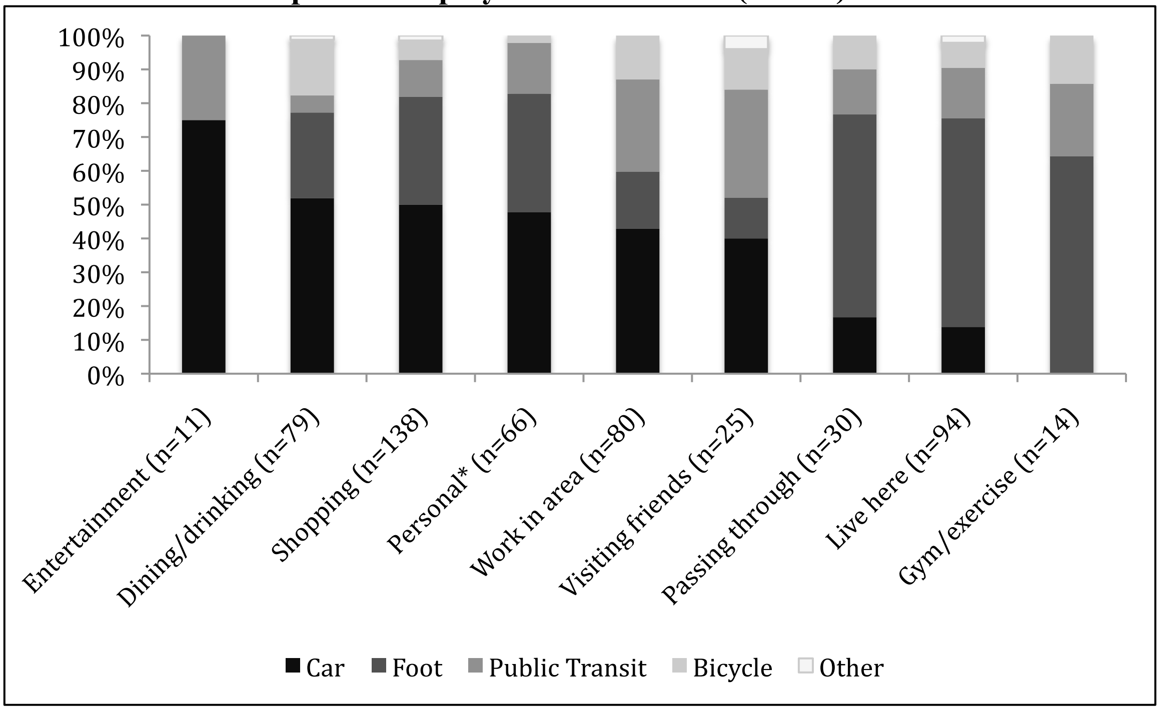
The two main traveler types to the San Pablo survey areas were drivers and pedestrians, at 39% (n=208) and 35% (n=190) of all respondents, respectively. Public transit users comprised another 16% (n=84), while bicyclists were 9% (n=49) of the survey group. Given the trip purposes cited by respondents, the high number of pedestrians and drivers is not surprising, as the main purpose of one's visit was statistically significantly ($p \leq 0.10$) related to how the person arrived. For example, Figure 1 shows that a higher percentage of pedestrians than any other mode were "just passing through" or lived in the area. In contrast, when drivers were asked why they drove to the area, 38% cited distance as the main reason, while 6% cited specifically needing a car to run their errand.

TABLE 2 Respondent Demographics by Mode of Arrival

	Respondent Population					
	Pedestrians (%)	Drivers (%)	Bicyclists (%)	Transit Users (%)	Other* (%)	*n*
Age						
18-24	34	22	17	27	0	77
25-34	38	38	13	11	1	125
35-44	31	51	11	7	1	91
45-54	36	39	9	17	0	90
55-70	36	43	1	18	3	119
71+	44	36	0	16	4	25
	Chi –square significant ($p \leq 0.001$)					
Sex						
Male	34	39	11	14	1	305
Female	38	38	6	18	1	232
	Fisher's exact not significant ($p > 0.10$)					
Race/Ethnicity						
Caucasian or White	34	43	13	10	1	272
Hispanic	28	38	9	22	3	32
African American or Black	40	29	5	24	1	156
Asian	27	48	4	19	2	48
Native American or Alaska Native	0	100	0	0	0	1
Other	46	39	4	11	0	28
	Chi –square significant ($p \leq 0.01$)					
Education						
Less than high school	39	17	11	28	6	18
High school graduate	38	31	7	23	1	84
Some college	34	34	9	22	1	125
College graduate	39	38	11	11	1	179
Graduate degree	28	55	8	8	1	116
Other	25	75	0	0	0	4
	Chi –square significant ($p \leq 0.001$)					

*Other included taxi and wheelchair

FIGURE 1 Main Purpose of Trip by Mode of Arrival (N=537).



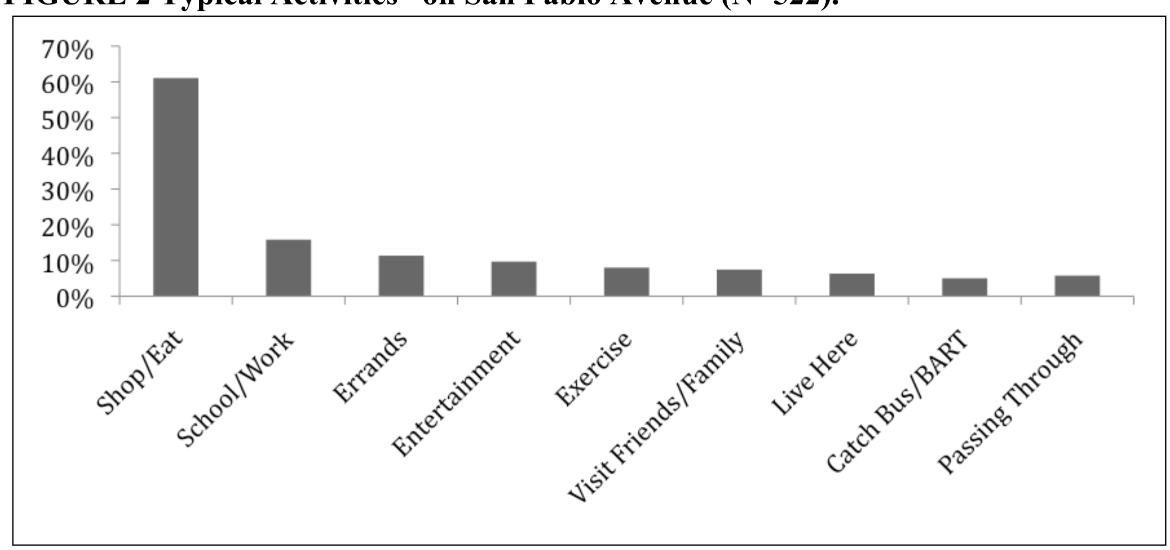
*The category "Personal" included errands, appointments, and site-seeing.

Trip Characteristics

Trip Purpose

Respondents were asked about their typical activities when visiting San Pablo Avenue. Figure 2 shows the responses to this question; shopping and/or eating was the clear dominant activity category, with 61% of respondents citing it as typical.

FIGURE 2 Typical Activities* on San Pablo Avenue (N=522).



*Respondents could name more than one activity; "other" and "don't know" excluded from figure.

Frequency of Visits
When asked how often they visit the survey area, 56% of respondents stated that they visit "all the time", while another 18% visit "fairly often." These numbers suggest that the survey responses are highly valid due to familiarity with the area. When frequency of visit is examined within each mode, the data shows that pedestrians visit the most often, with 72% reporting that they visit "all the time," compared to 42% for drivers, 49% for bicyclists, and 57% for transit users.

Perceived Traffic Safety on San Pablo Avenue
The survey participants were questioned about how safe they feel from traffic while walking or bicycling on and across San Pablo Avenue. It is clear from the responses shown in Table 3 that people generally feel much safer walking along San Pablo Avenue than they do bicycling. In addition, over 50% of respondents answered "not applicable" to questions about bicycling safety. While this half likely includes many respondents with no desire to ride a bicycle, it may also include people who would like to bicycle but do not consider it because of perceived danger. Perceived safety while walking or bicycling was not significantly related to survey area, arrival mode, or frequency of visit (other than in one instance explained below).

TABLE 3 Perceptions of Safety while Walking and Bicycling on San Pablo Avenue (N=537)

	Very safe	**Somewhat safe**	**Neutral**	**Somewhat unsafe**	**Very unsafe**	**N/A or Don't know**
When walking across the street	28%	20%	25%	15%	10%	2%
When walking on the sidewalk	57%	25%	10%	4%	2%	2%
When bicycling across the street	7%	8%	12%	10%	8%	**52%**
When bicycling on the roadway	4%	5%	9%	12%	15%	**53%**
When coming to the area after dark	18%	13%	15%	19%	20%	15%

The questions about perceived safety while walking revealed a fairly safe experience. Only 25% and 6% of respondents reported feeling unsafe while walking across and along San Pablo Avenue, respectively. There was a slight significant ($p \leq 0.10$) association between perceived traffic safety when crossing the street and the frequency of one's visits to San Pablo Avenue, although in an unexpected direction. It seems that the more someone visits, the less safe they feel, which may reflect a familiarity with certain dangers, or the fact that more visits means more exposure to perceived potential injury or harm.

The questions about bicycling safety revealed a much greater disparity in perceived safety. While only 18% and 27% of respondents reported feeling unsafe while bicycling across or along San Pablo Avenue, respectively, over 50% of respondents for both questions responded "not applicable". This large portion of not applicable responses is 10% higher than those who answered in another question that they were either unlikely to bicycle more with bicycle facilities (either because they already bicycle, or they will absolutely not bicycle), or that the question was not applicable. This suggests that there are respondents who would like to bicycle more, but feel unsafe doing so.

Nearly 39% of respondents feel "very" or "somewhat" unsafe from traffic when coming to the area after dark, with another 15% answering "not applicable", suggesting that they don't visit the area after dark. This is significantly different between areas, perhaps due to high-traffic intersections in the areas reported as least safe.

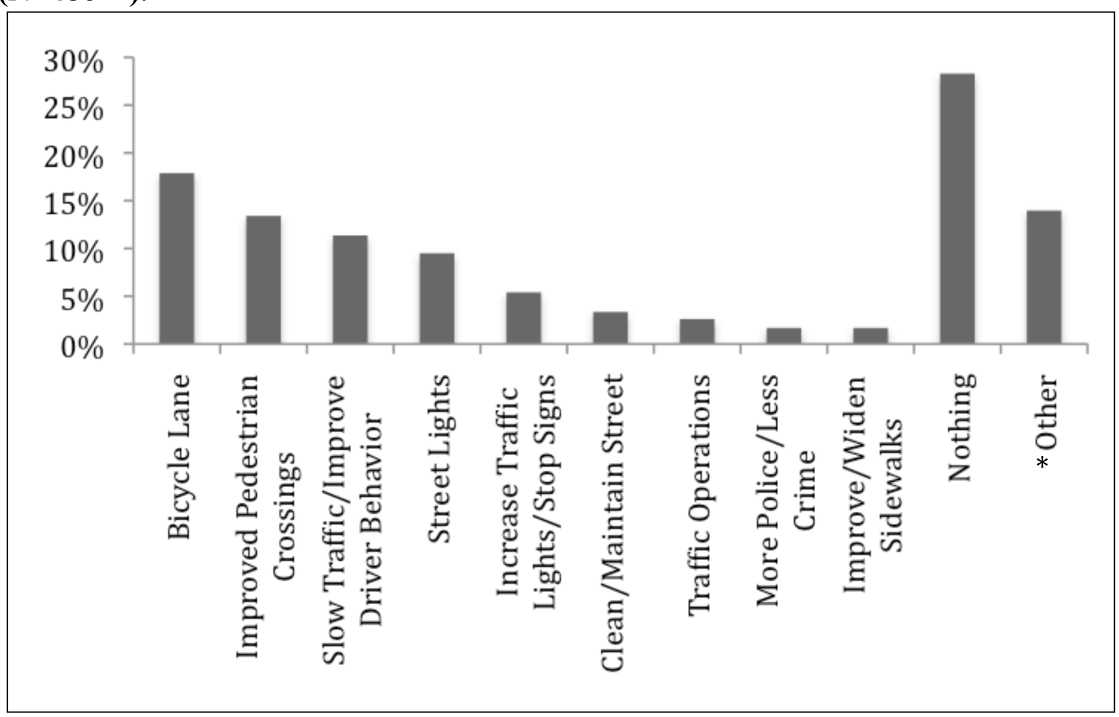
Encounters with Motor Vehicles

The survey also asked about respondents' encounters with cars. Nearly 38% of respondents reported having almost been hit by a vehicle while walking or biking along San Pablo Avenue. Over 50% of respondents have had a motor vehicle come too close to them while walking or bicycling along the corridor. Finally, nearly 17% of respondents had almost been hit by a car door while walking/biking along the corridor, although fewer than 3% were injured as a result.

Street Improvements that Would Increase Perceived Traffic Safety

Respondents were then asked to name the various types of street improvements they thought would improve traffic safety. The question was open-response, so respondents could name as many things as they wanted, and many respondents named more than one street improvement. As Figure 3 shows, a bicycle lane was the most requested addition, followed by elements that could improve pedestrian crossings, such as lighted crosswalks and longer crossing times. The types of street improvements that would contribute to traffic safety were significantly related ($p \leq 0.10$) to area, how the respondent arrived, and how frequently the respondent visits the area. Table 4 shows the modal breakdown for the most requested traffic safety improvements.

FIGURE 3 Requested Street Improvements to Increase Perceived Traffic Safety (N=486).**



* "Other" includes responses for which the percentage was less than 2%.

** Figure does not include responses for "don't know"

TABLE 4 Respondents' Top Five Street Improvements to Increase Perceptions of Traffic Safety, by Mode (N=531)

	All Users (N=531)	Pedestrian (n=190)	Driver (n=208)	Bicyclist (n=49)**	Transit User (n=84)
Improvement* **	Rank [% of responses]	Rank [%]	Rank [%]	Rank [%]	Rank [%]
Bike Lane	1 [18]	1 [16]	1 [14]	1 [63]	5 [6]
Improve Pedestrian Crossings	2 [13]	2 [15]	2* [13]	3 [8]	2 [13]
Slow traffic/ Improve Driver Behavior	3 [12]	3 [12]	4 [10]	4 [6]	1 [18]
Traffic lights	4 [9]	4 [8]	5 [4]	5* [4]	3 [11]
Street lighting	5 [7]	5 [5]	2* [13]	2 [10]	4 [10]
Nothing#	[27]	[27]	[31]	[14]	[25]
Chi –square significant ($p \leq 0.10$)					

* Indicates a tie in percentages
** Bicyclists tied landscaping with traffic lights for their fifth and sixth priorities. Landscaping is not in the table because its overall ranking among all user groups was low.
*** Listed in order of overall ranking among survey participants
\# "Nothing" response not ranked; present for comparison purposes

Table 4 shows that all users requested the same top five street improvements, although in different order, even when the preferences were weighted by mode and by individual respondent. This may reflect the fact that many users are multimodal—for example, drivers, transit users, and bicyclists are all pedestrians at some point in their trip, while pedestrians likely use other modes at different times.

These complimentary preferences may also reflect the benefits of various roadway design features to users other than the primary group for whom they are intended. For example, pedestrians, drivers, and bicyclists all requested a bicycle lane in high numbers to improve traffic safety. While this may result from some pedestrians and drivers bicycling at other times, it may also reflect benefits to the pedestrians and drivers from having a bicycle lane for bicycle traffic. A bicycle lane may increase predictability for drivers in terms of bicyclists' actions, and it may encourage more bicyclists to ride on the roadway instead of the sidewalk, thus improving pedestrian comfort and safety on the sidewalk. Similar mutual benefits may be gained from the other improvements listed above.

Attractions and Attributes of San Pablo Avenue

The data showed that the survey respondents tended to enjoy similar things about the survey areas. Dining and shopping were clearly the most popular activities for each survey area, although some areas seemed to have more diverse offerings than others. The attributes people liked most and least about San Pablo Avenue also seemed fairly similar between user groups. These findings are elaborated upon below.

Attributes Respondents Liked Most and Least about San Pablo Avenue

The survey asked respondents to name the attributes of San Pablo Avenue they liked most and least. Because these were open-response questions, respondents could name more than one answer. The analysis found that the attributes and characteristics that respondents liked best about San Pablo Avenue were related to their typical activities, for example the shopping and restaurant venues, convenience, and vibe of the area. As most of these attributes were not directly related to street design, results are not presented here.

Many of the attributes respondents liked least were more clearly related to street design. These include the amount of traffic, an unkempt appearance, and an impression that the area is "bad for walking." In contrast to the things that people liked best about San Pablo Avenue, those that they liked least were not significantly related to area, arrival mode, or frequency of visit, suggesting agreement among users about what could be improved.

Street Improvements that Would Encourage More Visits

Respondents were then asked to name the various street improvements that could encourage them to more frequently visit the area. Table 5 demonstrates that, similar to preferences for traffic safety, there was alignment between the modal groups for the most requested street improvements to encourage more visits. In this case, however, there is more differentiation between user group preferences. These improvements were significantly related to arrival mode, but not to survey area or frequency of visit. The figures in this section include responses that are not street improvements under Caltrans' purview, such as increasing shops and restaurants. These responses were left in to allow comparability between users' overall priorities, and to show the complexity of creating attractive environments.

Note that in this case, a bicycle lane was requested to encourage more visits by fewer people than requested it to improve traffic safety (n=35 versus 96, respectively), further supporting a hypothesis that the bicycle lane may have previously unrecognized traffic safety benefits for users other than bicyclists.

TABLE 5 Respondents' Top Five Street Improvements to Encourage More Frequent Visits, by Arrival Mode (N=531)

	All Users (N=531)	**Pedestrian (n=190)**	**Driver (n=208)**	**Bicyclist (n=49)****	**Transit User (n=84)****
Improvement***	Rank [% of Responses]	Rank [%]	Rank [%]	Rank [%]	Rank [%]
Trees & landscaping	1 [15]	1 [22]	1* [11]	4 [12]	2 [11]
Retail, food, entertainment	2 [13]	2 [15]	1* [11]	1* [20]	3* [8]
Clean area/more trash cans	3 [8]	4* [8]	4 [6]	6 [8]	1 [14]
Street lighting	4 [8]	3 [11]	5* [6]	7 [4]	3* [8]
Bike Lane	5* [7]	7 [4]	3 [8]	1* [20]	8* [2]
Art/beautification	5* [7]	4* [8]	5* [6]	5 [10]	7 [4]
Nothing#	[43]	[61]	[37]	[24]	[27]
Chi –square significant ($p \leq 0.10$)					

* Indicates a tie in percentages
** Bicyclists ranked parks/playgrounds as their third priority, and transit users tied a clean/maintained street and increased seating for their fifth and sixth priorities. These features do not appear in the table because their overall rankings among all user groups were low.
*** Listed in order of overall ranking among survey participants
# "Nothing" response not ranked; present for comparison purposes

Likelihood of Walking or Bicycling More Given Various Improvements

The analysis found that there is no significant difference between areas regarding the general likelihood to walk more than one block along San Pablo Avenue. Overall, nearly 65% of people are "very" or "somewhat" likely to walk more than one block. However, there is a significant connection ($p \leq 0.10$) between how often the respondent visits the area and their likelihood of walking more than one block. For example, those who visit "all the time" are much more likely to walk more than one block than those who visit occasionally or rarely. There is also a significant relationship ($p \leq 0.10$) between how someone arrived to the area and the likelihood of walking more than one block. Those who arrived on foot or by public transportation are much more likely to walk more than one block than those who drove or even those who bicycled.

The survey also asked about the likelihood of walking or bicycling more given certain street improvements. Around 50-60% of respondents report being at least "somewhat likely" to walk or bicycle more given an increase in most of the suggested street improvements. The lowest-scoring elements were medians, curb extensions, and decorative pavement, all of which had an approximately 40% likelihood. However, the "unlikelihood" number does not indicate that people do not want these treatments, just that they are unlikely to walk or bike *more* if these treatments are installed.

TABLE 6 Likelihood of Walking or Bicycling More if More of the Following Design Amenities (N=537)

	Likely	**Neutral**	**Unlikely**	**N/A**	**Total**
Bicycle lanes [+]	72%*	5%*	23%*	(25%)	100%
Bicycle parking [+]	66%*	8%*	27%*	(26%)	100%
Outdoor seating areas [+x]	65%	8%	23%	-	100%
Sidewalk lighting [#]	63%	7%	25%	-	100%
Landscaping [x]	55%	9%	35%	-	100%
Shade Trees [# + x]	50%	8%	38%	-	100%
Art/decorated trash bins [+]	47%	11%	40%	-	100%
Curb extensions [#]	43%	8%	40%	-	100%
Medians	37%	9%	44%	-	100%
Decorative pavement [#+x]	36%	10%	49%	-	100%
	Chi –square significant ($p \leq 0.10$)				

Significantly related to frequency of visit [#]
Significantly related to arrival mode [+]
Significantly related to survey area [x]
*Adjusted after "not applicable" answers removed
- Indicates a lack of response

LIMITATIONS

Some limitations of the survey methodology should be noted. First, drivers, transit users, and some bicyclists were intercepted on foot, instead of in their mode of arrival to the corridor. Thus, their answers may have reflected their preferences as a pedestrian more than their preferences as a driver, transit user, or bicyclist. Likewise, pedestrians and bicyclists may have different preferences as drivers and transit users than were reflected in their answers. There is no way to measure those possible differences from this data. A second limitation to the survey is that the open-response questions did not give users a choice set from which to select responses.

While this has the benefit of not leading the respondent to a certain answer, the disadvantage is that all users may not have the same knowledge or ideas about what street improvements are possible. A third limitation is that some items that could have been named to improve perceived traffic safety or encourage more visits, such as landscaping, may not have been named because they already existed along the area of San Pablo Avenue where the survey response was captured; in a different circumstance, different answers may have arisen.

Finally, several questions resulted in a percentage of respondents answering "nothing"—for example, that "nothing" could improve perceived traffic safety. This "nothing" is difficult to interpret, as it could mean that nothing could make it better because it is already great—or that nothing could possibly help such a terrible situation. Regardless of the possible interpretation, however, it is notable that only 14% of bicyclists did not request any improvements for traffic safety, suggesting that there is a lot that could improve perceived bicycling traffic safety along the roadway. In fact, less than one-third of all groups had no suggestions for improving traffic safety, suggesting that this is an important subject area to be addressed in the future.

DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

Data-driven planning and investments in transportation are becoming increasingly important. The findings presented in this paper suggest that planning for various modes should be a collaborative practice. This is contrary to the traditional tendency to view various user groups as having distinct needs requiring distinct strategies. As a result, user groups are often prioritized in some way, with the ensuing roadway design reflecting the community's and/or transportation agency's priorities for throughput, walkability, bikability, economic activity, etc. However, the findings from this survey suggest that such a process may miss opportunities for more holistic roadway design that could benefit multiple user groups simultaneously, rather than subjugating the needs of one to those of another. Furthermore, as multi-modal and active transportation goals become more of a priority among local and state transportation agencies, it will become increasingly important to understand how to best prioritize limited transportation dollars to benefit all road users.

Perhaps the most salient findings are the preferences for design features that could improve traffic safety and that could encourage more visits to the area. In both categories, the responses, although distinct between categories, were aligned between user groups. This was illustrated best in the findings that showed 1) general agreement about design elements to improve traffic safety, with bicycle lanes and improved pedestrian crossings being highly requested among all user groups, and 2) general agreement about design elements that could encourage more frequent visits, with landscaping/street trees, street lighting, and area cleanliness being preferred by all user groups. These findings strongly suggest that traditional ideas of nuanced planning for user groups may miss opportunities to create an urban street environment that is pleasing to all users. Based on these findings, Caltrans may have the opportunity to broadly benefit users and communities while only focusing its resources in a few select areas.

Another purpose of this survey was to understand how to contribute to greater economic vitality of Caltrans' partner communities. It is clear from these survey results that the factors that ultimately encourage economic vitality are many and complex. The survey respondents indicated that street design does have a role to play in further encouraging visits to an area, such as through beautification and landscaping, but that the opportunity to shop, dine, and run errands is crucial to encouraging visits. At the same time, reducing the amount of crime and increasing feelings of personal security are also critical. These may be helped by increasing the amount of sidewalk lighting, for example, but must be complemented by enforcement programs and police presence in some cases.

Transportation agencies throughout the U.S. face the complicated tasks of decreasing congestion and greenhouse gas emissions, increasing road user safety and active transportation, and staying under budget. Traditionally, these goals have been prioritized and addressed individually. However, the findings from this survey suggest the potential to meet multiple goals for multiple user groups by focusing on a select group of actions. The similar preferences among all user groups for street design elements to improve traffic safety and encourage more visits offers transportation agencies an opportunity to simultaneously work toward multiple goals and become better partners to the communities they serve.

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