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ABSTRACT

The focus of this study is to quantify the sufficiency of “Flashing Don’t Walk” (FDW) intervals at signalized pedestrian crossings in the San Pablo Avenue (SPA) corridor in Northern California. Our goal is to determine if pedestrian signal intervals on the SPA corridor can be optimized in a way that makes the pedestrian crossing environment safer and more comfortable for all pedestrians without diminishing vehicular throughput. This study provides a corridor-wide as well as a city-by-city assessment of FDW intervals on the SPA corridor. We suggest a possible tool to assist traffic control jurisdictions in prioritizing intersections that may require adjustments of timing to pedestrian signals. The findings provide the agencies participating in the “SMART” corridor program a means to evaluate an aspect of pedestrian safety and comfort that has likely been adversely affected by placing a high priority on vehicular traffic through the corridor, without sufficiently considering pedestrian traffic.

INTRODUCTION

The time interval allowed for pedestrians to cross a given intersection is calculated by traffic engineers who often allocate an interval based on a single variable, such as average pedestrian walking speed. In allocating this interval, it is important to accommodate the vast majority of pedestrian users. The interval is based on design and operational guidelines such as the *American Association of State Highway and Transportation Officials (AASHTO Pedestrian) Guidebook (1)*, the *Traffic Engineering Handbook,* and other sources that prescribe standard values used in traffic engineering.

Pedestrian walking speeds tend to vary from about 2.5 to 5.0 feet per second (ft/s) (0.76 to 1.52 meters per second). The *Manual on Uniform Traffic Control Devices* (MUTCD) *(2)* recommends calculating intervals for pedestrian crossing signals using a normal walking speed of 4.0 f/s (1.22 m/s). Not surprisingly, studies have demonstrated that age and pedestrian mobility have an impact on average walking speeds; older pedestrians, young children, and pedestrians with physical impairments have slower average walking speeds. In areas with large populations of such pedestrians, a slower walking speed value may be used if substantiated by a local engineering report. For example, *special land-use areas,* such as those surrounding senior centers or elementary schools, may require a slower walking speed of 2.5 ft/s (.76 m/s) to be used in calculating pedestrian signal intervals.

This study uses two pedestrian walking speeds:–2.5 feet per second and 4.0 feet per second–to evaluate the extent to which signal intervals for pedestrians at intersection crossings on the San Pablo Avenue (SPA) corridor in California meet the standards prescribed by AASHTO and MUTCD. According to these standards, the minimum safe pedestrian crossing interval must be equal to or greater than the crossing distance divided by the walking speed.

There are two options for evaluating the sufficiency of pedestrian signal intervals for a given measured crossing distance. One option is the Total Pedestrian Interval (TPI), which is the sum of the “Walk” (W) interval plus the “Flashing Don't Walk” (FDW) interval. The other measure is a more conservative assessment, where the FDW interval is considered alone (also known as the “pedestrian-clearing interval”). This study places a greater emphasis on the FDW interval, which represents the minimum amount of time that a pedestrian can start and safely complete the crossing before the “Constant Don't Walk” (CDW) signal appears.

To an extent, pedestrian signal-timing sufficiency reflects the degree to which traffic-control jurisdictions place a higher priority on vehicular traffic compared to pedestrian ease of travel and pedestrian safety along and around a corridor. The goal of the SPA “SMART” Corridor Program [of the Alameda County Congestion Management Agency's (ACCMA)] is to facilitate vehicular traffic along SPA while also maintaining pedestrian safety. The primary goal of this study is to use observed actual pedestrian signal intervals at corridor intersections to evaluate how closely each meets traffic engineering standards.

We realize that other studies have evaluated pedestrian safety to identify countermeasures that would improve the physical or geometric environment for the pedestrian. This study assumes that planning and implementation of such geometric improvements would be costly and require a substantial investment of time, and involve strong advocacy from affected parties, such as neighborhood groups. This study takes an alternative approach by providing an overall inventory of existing pedestrian signal intervals at 295 signalized pedestrian crossings found on the SPA corridor. This approach offers a tool for comparing the relative sufficiency of the pedestrian signal interval based on 2.5 ft/s and 4.0 ft/s walking speeds, which then can be used to identify intersections of the corridor that might require more detailed studies on the pedestrian conditions.

LITERATURE REVIEW

We reviewed the professional literature on "walkability," as defined by the ease, comfort, and safety of walking from one location to another, with a focus on studies that evaluated the impact of optimizing pedestrian signal intervals at individual intersections. Kim and colleagues *(4)* evaluated whether resetting the pedestrian waiting time at pedestrian-activated crossings would improve service at individual intersections. Based on survey data on pedestrian perception time, pedestrian response time, and walking speeds, they generated categories of intersection zones based on surrounding land-use, pedestrian-signal intervals, and vehicle traffic congestion. Finally, they evaluated pedestrian signal sufficiency required to provide safe crossing intervals and then recommended increases in signal intervals at intersections that were judged insufficient for a safe crossing. These investigators advocated that pedestrian signal interval allocations include pedestrian safety and comfort as important factors.

A *Road Engineering Journal* article entitled "Designing Traffic Signals to Accommodate Pedestrian Travel" *(5)* indicated that signal optimization, as measured in the field, is a balance between pedestrian flow and vehicular flow. The distribution of time between the two sets of signal intervals is dependent on congestion and wait time at the signal either of pedestrian or of vehicular flow. The article also suggested that the allocation of signal timing between pedestrians and vehicles often exhibits a biased distribution towards providing more time to vehicular traffic. As a result, such decisions often fail to consider compromised walkability.

Campbell and colleagues (*6*) provided a detailed analysis of factors related to pedestrian safety, including vehicle crashes with pedestrians, measures of pedestrian exposure and hazard, and the effect of specific roadway features on pedestrian safety. They evaluated the efficacy of crosswalk designs, layouts, and pedestrian signal intervals as factors contributing to pedestrian safety. Campbell also suggested countermeasures for each factor that impeded walkability and pedestrian safety.

METHODOLOGY

Conceptual Framework

The purpose of this study is to quantify the sufficiency of FDW intervals at signalized pedestrian crossings in the San Pablo Avenue (SPA) corridor in Northern California. The SPA corridor is a "SMART" transportation corridor extending approximately 20 miles along the eastern shore of the San Francisco Bay, from downtown Oakland to the City of San Pablo, and passing through seven cities in total. This study uses the ACCMA's definition of the SPA corridor in order to select pedestrian crossings for measurement and evaluation. These definitions include:

a. all streets that intersect SPA between Richmond Parkway in the City of San Pablo and 17th Street in the City of Oakland;
b. arterials or roadways suitable for regional traffic that travel between the SPA corridor and Interstate-80 (as defined by ACCMA); which includes the Richmond Parkway, San Pablo Dam Road, Cutting Boulevard, Potrero Avenue, Central Avenue, Buchanan Street, Gilman Street, University Avenue, Powell Street, Ashby Avenue, and West Grand Avenue; and;

c. the roadways intersecting the arterial roadways named above.

This study addresses 113 signalized intersections on the SPA corridor which include 82 signalized intersections on SPA and 31 signalized intersections on the arterial roadways which are included in the ACCMA definition of the SPA corridor. The unit of analysis in this study is an individual signalized pedestrian crossing on the SPA corridor. This results in a total of 295 units of analysis.

We anticipated that there would be a wide range of pedestrian signal interval conditions, ranging from intersections with a high level of interval deficiency to intersections with a high level of interval excess. In either case, we believe that wide disparities in signal timing intervals introduce a degree of inefficiency that can be addressed by better coordinating the pedestrian signal timing intervals with the existing land-uses surrounding those intersections.

According to traffic engineering practice (MUTCD), pedestrian indications have the following meanings:

> ***WALK (W):*** *The constant WALK indication means that it is safe for a pedestrian to start crossing the street.*
>
> ***Flashing DON'T WALK (FDW):*** *The Flashing DON'T WALK indication means that it is unsafe to start crossing the street. Those already in the crosswalk, however, have sufficient time to safely complete their crossing.*
>
> ***Constant DON'T WALK (CDW):*** *The constant DON'T WALK indication means that it is unsafe for any pedestrians to be in the crosswalk.*

The *Traffic Engineering Handbook* does not provide much detailed guidelines on how to allocate time between the W and FDW intervals. Instead, the handbook explains the calculation of the G_p (pedestrian green signal) interval, which is actually the combination of the W and FDW intervals (referred to in this study as the TPI). The literature suggests that in standard traffic engineering practice, the FDW interval is usually set as the minimum time for pedestrians to safely clear the crossing once they have started crossing the intersection. Based on the Traffic Engineering Handbook's method for calculating the pedestrian interval, this study assumes that traffic engineers place a large emphasis on using the FDW interval as the fundamental unit on which to judge whether pedestrian signal intervals allocate sufficient time to meet the basic needs of pedestrian safety. This ambiguity about how to allocate time between the two intervals within the G_p interval provided the impetus for this study's evaluation of FDW sufficiency, which is considered to be the more conservative measure for pedestrian safety and comfort in crossing an intersection.

In addition, the balance between the W and FDW intervals has an important impact on the volume of pedestrians entering and safely completing the crossings. For example, if a proportionally large amount of time is allocated to the W interval and a smaller amount of time is allocated to the FDW interval, the likely effect is that an unsafe number of pedestrians would be allowed to enter the crossing, despite insufficient time in the FDW interval for all to complete the crossing. On the other hand, if excess time was allocated for the FDW interval and a lesser amount was allocated for the W interval, fewer pedestrians would be allowed to start the crossing than could clear the crossing during the FDW interval. One strategy is to evaluate the variables in a ratio form. For instance, if a FDW/W ratio is found to be less than 1.0, then the crossing interval allows more pedestrians to enter but not enough time for them to safely complete the crossing. Conversely, if the FDW/W ratio is greater than 1.0, then fewer pedestrians are allowed to enter, but pedestrians have sufficient or even more than sufficient amount of time to complete the crossing. One impact of the latter approach is increased delays to vehicles and their occupants.

By definition, at crossings where the FDW signals are deficient, the amount of time allotted to the *pedestrian clearing interval* is insufficient for pedestrians who have commenced crossing to completely do so in a safe environment. In such situations, pedestrians must accelerate their walking pace to avoid the oncoming vehicular traffic. This situation creates an unnecessarily risky environment for both able-pedestrians and pedestrians such as seniors and young children who generally walk at slower speeds. Slower walkers require accommodation for their slower than average walking speed, and calculating sufficient signal intervals at intersections with surrounding special land-use areas may require using a slower-than-average walking speed of 2.5 ft/s.

This study does not assign threshold values or minimum standards that pedestrian signals should meet as a tool to justify remedial action to adjust individual pedestrian signal intervals. Instead, the goal of the study is to compile a profile of the range of disparities from intersection to intersection along the SPA corridor. Further examination of each intersection may substantiate changes in pedestrian intervals at that intersection or a detailed engineering report may find that changes are not substantiated.

Data Collection

Data was collected for each of 295 signalized intersections containing “push-button” or manually-actuated pedestrian signals. Data was collected both on the crossing distance of each intersection, and of the time allowed by the Walk (W) and Flashing Don’t Walk (FDW) signals at those intersections.

Crossing distances across legs of each intersection were measured via remote-sensing software in place of “in-the-field” measurements. We estimated a margin of error by comparing remote-sensing measurements with field measurements using a roller tape measure tool at three intersections (Richmond Parkway, Central Avenue, and 17th Street). Based on this comparison, there is approximately a four percent estimated error.

Measured Crossing Distance (MCD) is the crossing distance from the curb of one side of the studied leg of an intersection to the middle of the lane in the last lane of the pedestrian crossing. This definition of MCD is based on traffic engineering assumptions that once a pedestrian reaches the middle of the last lane of the crossing, on-coming vehicular traffic will yield right-of-way to the pedestrian, even when the vehicle has been given the green traffic signal. Hence, the true length of each pedestrian crossing was reduced by six feet to generate MCD values.

The research team collected time data on the pedestrian signal intervals by activating the pedestrian signals at each of the crossings and recording the W interval and the FDW time intervals.

Variables and Indicators

A number of variables and indicators were standardized to measure and represent the FDW sufficiency of the pedestrian crossing intervals on the SPA corridor. Signal timing data was compiled from a number of pedestrian crossing “locating” variables and field measurements of the W and FDW time intervals. Several other variables were derived from these measurements. These included:

- *Ideal FDW*: calculated by dividing the MCD by the two walking speeds (4.0 ft/s, and 2.5 ft/s) for each intersection crossing;
- *Pace expected*: calculated by dividing the MCD by FDW;
- *Actual distance covered (ADC):* FDW multiplied by walking speed (4.0, 2.5 ft/s);
- *FDW sufficiency*: calculated by subtracting the measured FDW from the ideal FDW, with negative numbers indicating a deficient amount of time for pedestrians to complete the crossing .

We felt that displaying the FDW sufficiency outcomes as discrete interval-ratio data did not permit efficient management of the indicators; hence we collapsed the FDW sufficiency variables into four ordinal categories to include: *Very Deficient* (-10.00 seconds or more), *Deficient* (-9.99 seconds to -5.00 seconds), *Mildly Deficient* (-4.99 seconds to 0.00 seconds), and *Excess* (0.01 seconds or more). We considered displaying a “Sufficient” category ranging from +.5 seconds to -.5 seconds; however, we felt it more important to evaluate signal ***deficiencies*** at a finer level of detail, and thus gave more weight to considering the deficient intervals. All non-deficient signal intervals were therefore grouped into the *Excess* category.

RESULTS

Flashing Don’t Walk (FDW) Sufficiency, Corridor-Wide

While it may be useful for a city's traffic control department to have an inventory of FDW intervals of their crosswalks, it might be even more useful for all traffic control departments collaborating in the “SMART” corridor program to assess and allocate pedestrian intervals on a system-wide basis that takes into consideration vehicular and pedestrian flow patterns along the whole corridor. To this end, our study provides both a city-by-city as well as a corridor-wide assessment of FDW time intervals on the SPA corridor.

We found that when a 4.0 ft/s (1.22 m/s) walking speed was used to calculate FDW sufficiency, the mean FDW interval across the entire corridor was -0.9 seconds (that is, 0.9 seconds too short) from the ideal crossing time, and 60% of FDW intervals were rated as at least mildly deficient in signal timing (Table 1). The FDW intervals ranged from 24 seconds deficient to 12 seconds in excess of the ideal FDW interval.

Alternatively, when we used a 2.5 ft/s (.76 m/s) walking speed to calculate FDW sufficiency, we found the mean was 9.9 seconds deficient from the ideal FDW, and that 95% of the FDW intervals are at least mildly deficient in signal timing. Under the slower average walking speed, the individual FDW intervals ranged from 48 seconds deficient to 12 seconds in excess (Table 1). The implications of this finding are that the many intersections across the corridor allocate insufficient time for pedestrians to complete the crossing once they have commenced.

TABLE 1 Corridor-wide FDW Condition Based on 4.0 ft/s and 2.5 ft/s Walking Speeds

FDW Category	Based on 4.0 ft/s	Based on 2.5 ft/s
Crossings with deficient interval length	60%	95%
Crossings with excess interval length	40%	5%
Mean FDW sufficiency	-0.9 seconds	-9.9 seconds
Range of sufficiencies	-24.0 to +12 seconds	-48.0 to +12 seconds

Total Pedestrian Interval (TPI), Corridor-Wide

The TPI combines the W and the FDW signal intervals, and is therefore considered to be a more "buffered" measure of pedestrian signal interval sufficiency compared to the FDW interval alone. TPI assumes that the pedestrian usually commences crossing the intersection within the W interval, but fails to consider pedestrians who commence crossing within the FDW interval and not during the W interval. Because of this, using the TPI is likely to underestimate the level of pedestrian signal interval sufficiency. Realizing that the TPI is a less restrictive measure, this study anticipated that if the TPI was used, most of the crossing intervals would appear to meet the sufficiency criteria.

To demonstrate the disparity in findings when TPI vs. FDW is applied in the in the signal interval calculation, we assessed interval sufficiency based on the TPI as well. As expected, our evaluation of pedestrian signal sufficiency based on the TPI shows that with a 4.0 ft/s walking speed, 94% of all crossings allow for an ***excess*** amount of time for pedestrians to cross, while only 6% of all the crossings are deficient. When a slower average walking speed of 2.5 ft/s is used, we found that 52% of the crossings are deficient (Table 2). Overall, we found a mean value of 10 seconds in excess of the ideal TPI for the 4.0 ft/s walking speed, and a mean value of 8 seconds in excess for the 2.5 ft/s walking speed.

TABLE 2 FDW and TPI Conditions at 4.0 ft/s and 2.5 ft/s

	4.0 ft/s		**2.5 ft/s**	
	FDW # of crossings (%)	TPI # of crossings (%)	FDW # of crossings (%)	TPI # of crossings (%)
Deficient	177 (60%)	19 (6%)	279 (95%)	152 (52%)
Excess	118 (40%)	276 (94%)	16 (5%)	143 (48%)
Total	295 (100%)	295 (100%)	295 (100%)	295 (100%)

FDW Sufficiency, by City

We also evaluated FDW pedestrian intervals on a city-by-city basis. This evaluation enables a comparison of FDW sufficiency between cities, and provides greater detail for local transportation jurisdictions or neighborhood groups that might be interested in "walkability" issues. The results are presented in Table 3 and summarized below:

- Oakland, the largest among the cities studied, also had the largest mean FDW deficiency. On average, the crossings were deficient by 3.0 seconds.
- Oakland also had the widest range of FDW sufficiency times, ranging from a deficiency of 24 seconds to intersections to an excess of 10 seconds.
- Berkeley had the smallest mean FDW sufficiency with a mean deficiency of .03 seconds and with signal intervals that ranged from a deficiency of 7.3 seconds to an excess of 11.8 seconds.
- Richmond had the largest number of crossings (78), while Albany has the fewest (21).

In terms of FDW interval sufficiency, crossings in Oakland performed worst among the seven cities. Assuming that the majority of the population walks at the 4.0 ft/s speed, Oakland had the largest percentage of FDW intervals that were either moderately deficient or very deficient; 17% of crossings did not allow sufficient time for pedestrians to clear the intersection if they were to commence crossing at the beginning of the FDW signal. In contrast, Albany and El Cerrito each had only 3% and 4%, respectively, of FDW intervals which are deficient for safe pedestrian crossing. By contrast, 11% of the crossing intervals in the city of Richmond had an excess amount of time allocated to the FDW intervals, suggesting that a reduction in time allocated to FDW intervals might improve vehicular throughput without compromising pedestrian comfort and safety.

TABLE 3 FDW Sufficiency by City

	FDW Sufficiency in each city based on 4.0 ft/s walking speed						
	Albany	Berkeley	El Cerrito	Emeryville	Oakland	Richmond	San Pablo
Very Deficient	0%	0%	0%	0%	7%	3%	0%
Deficient	5%	12%	6%	18%	25%	8%	15%
Mildly Deficient	33%	37%	59%	50%	41%	47%	44%
Excess	62%	51%	35%	32%	26%	42%	41%

TPI, by City
As previously discussed, the TPI is a less conservative measure of pedestrian safety and comfort. The data presented in Table 4 confirms that if the TPI is used to judge adequacy of the interval for pedestrian crossing, most crossings would be judged to have sufficient intervals for pedestrians to complete the crossing. This supports our contention that the FDW interval is a more appropriate interval to use in calculating the sufficiency of the intersection crossing in this study.

TABLE 4 TPI Sufficiency by City

	TPI Sufficiency based on 4.0 ft/s walking speed						
	Albany	Berkeley	El Cerrito	Emeryville	Oakland	Richmond	San Pablo
Very Deficient	0%	0%	0%	0%	4%	0%	0%
Deficient	0%	0%	0%	0%	0%	1%	0%
Mildly Deficient	0%	2%	0%	0%	12%	5%	6%
Excess	100%	98%	100%	100%	84%	94%	94%

FDW Sufficiency of Crossing Orientation in Reference to the Primary Street
Ideally, pedestrians should be given more time to cross a wide primary street, such as San Pablo Avenue, and less time to cross a narrower secondary street. We evaluated whether or not this observation was applied in the SPA corridor. As shown in Table 5, we found that only 32% of the FDW signal intervals crossing the wider primary street (SPA) had an “Excess” amount of time allocated to them, whereas 48% of the FDW signal intervals for the crossings over the relatively narrower secondary streets had an “Excess” amount of time allocated to them. This finding indicates that, in general, a proportionately greater time has not been given to pedestrians crossing primary streets in the San Pablo corridor. The finding runs counter to our expectation that more time, and possibly even a buffer period of time (manifested as the "Excess" amount of time in our study) should be allocated towards crossings a wider street. Although this area of study is particularly interesting, further analysis and measurements are necessary for a better understanding of this phenomenon.

TABLE 5 FDW Sufficiency Relative to the SPA Corridor

	Pedestrian Crossing Relative to SPA	
FDW Sufficiency at 4.0 ft/s	Crossing SPA	Crossing Secondary Street
Very Deficient	1%	3%
Deficient	16%	12%
Mildly Deficient	50%	37%
Excess	32%	48%
Total	100%	100%

DISCUSSION

The aim of this study is to provide an assessment of field observations of pedestrian signal intervals on the SPA corridor and to compare the sufficiency of pedestrian signal intervals for the seven cities that are connected by the corridor. This comparison can be used as an initial guide for further investigation of selected intersections or zones along the corridor for identifying deficiencies in the pedestrian signal intervals and for evaluating whether remedial actions are warranted. Such actions may include adding time to pedestrian signal intervals at the deficient locations following a detailed engineering report at the selected intersections.

Cumulatively, a comparison of pedestrian signal interval sufficiency along an entire corridor helps identify particular zones for focused attention and thus provide a more efficient application of resources. Engineering studies require a relatively large allocation of resources and also require individual action from individual traffic control jurisdictions. Consequently, there is often much inertia regarding changing pedestrian-crossing intervals. An inventory of the pedestrian signal intervals as they exist in the field offers a tool to more efficiently concentrate pedestrian safety countermeasures where they are most needed. While this study can be used as a focusing tool, we note that individual FDW intervals should still be carefully assessed by a local engineering report prior to making changes to the FDW intervals deemed to be deficient in this study.

Further investigation related to the sufficiency of pedestrian intervals along the SPA corridor should include a GIS cluster analysis of vehicle-pedestrian collision locations. The cluster analysis of collision densities could then be compared to the clusters of deficiency conditions. If higher densities of collisions are clustered in locations similar to where the "Very Deficient" pedestrian signals are located, this could provide additional evidence that countermeasures should add signal time to those pedestrian crossings. A further assessment could also be done in the area of GIS analysis of special land-use areas, such as senior centers and elementary schools, as these areas overlap with HCLs and areas with high levels of FDW deficient signal intervals, under the 2.5 ft/s walking speed.

Additionally, a possible next step towards a system-wide analysis of the corridor could be to integrate GIS spatial analysis to demonstrate overlaps and adjacencies in a variety of pedestrian and vehicular traffic interactions. This analysis could demonstrate that in cases where pedestrian crossings overlap with quarter-mile walk-sheds of special land-use areas, then an average walking speed of 2.5 ft/s should be used instead of the 4.0 ft/s walking speed. This method could provide a tool to prioritize interventions such as adjustments in signal timing.

CONCLUSION

The literature reviewed suggests that traffic engineering often places a higher emphasis on facilitating vehicular throughput over pedestrian safety and comfort. The ACCMA classifies SPA as a "SMART" corridor. Under this classification, the SPA corridor's highest priority is to provide an alternative route for vehicles when the traffic conditions on Interstate-80 are congested, hence considerations for pedestrian friendliness or "walkability" along and across the corridor are prone to being overlooked.

This study assesses the sufficiency of pedestrian signal intervals on the SPA corridor. We suggest a possible tool to assist traffic control jurisdictions in prioritizing intersections which may need adjustments to pedestrian signal intervals. The findings provide the agencies participating in the "SMART" corridor program a means to evaluate an aspect of pedestrian safety and comfort that has likely been affected by the very act of placing a high priority on vehicular traffic through the corridor without adequately considering pedestrian traffic. We hope that this study serves as a component for evaluating how well pedestrian signals provide for pedestrian comfort and safety at signalized intersections.

The most striking finding in this study is that when an average walking speed of 4.0 ft/s is used in calculating pedestrian signal interval conditions, 60% of the intervals are deficient to some degree. In reality, if a slower walking speed such as 3.8 ft/s (1.16 m/s), as suggested by the Gates article, is used to calculate pedestrian signal intervals, an even larger percentage of the intersections would be found to be deficient. Furthermore, there are a variety of demographic shifts and behavioral trends that tend to slow the average walking speeds of much of the pedestrian population. The Myers article suggests that in California, there is a historically large number of persons aged 65 or older and this age group will continue to expand to an even greater degree as the baby-boomers age into this cohort. In addition to demographic shifts, other factors including pedestrian distractions such as cell phones, iPods and Blackberries, declines in physical fitness, and record-high obesity rates would also contribute to a slower average walking speed. Such evidence points to the necessity of using a slower average walking speed for most intersections and not just intersections in special land-use areas. Cumulatively, a slower average walking speed for the general population would serve to bolster our finding that 60% of the pedestrian clearance intervals in the SPA corridor do not allow sufficient amount of time for pedestrians to safely cross intersections.

Ultimately, a systematic evaluation of pedestrian signal interval sufficiency on the SPA corridor could prove helpful to ACCMA in planning and implementing pedestrian-friendly mode-share alternatives. Ideally, pedestrian signal intervals in the SPA corridor can be adjusted in a way that makes the pedestrian crossing environment safer and more comfortable for all pedestrians while having minimal impact on vehicular traffic patterns as envisioned by the ACCMA under the "SMART" corridor program.

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