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Millennial Travel: Who Knows About Kids These Days?

Evelyn Blumenberg, Brian D. Taylor

Millennials have replaced Gen Xers as the generational darlings of the media. From their collective obsession with smartphones and social media, to their perceived tendencies toward tolerance and concern for the environment, to their love of tattoos and avocado toast, millennials are portrayed as distinct in many ways from prior generations. Among the many traits thought to make millennials unique is their travel. They drive less, ride public transit and bicycles more, and have a stronger desire to live in walkable urban communities. Or so the story goes.

But why might their travel be so different? Many pundits have speculated about attitudinal, technological, geographic, economic, and policy explanations for how today's youth get around. To move beyond speculation, we examined data from the U.S. National Travel Surveys for 1990, 2001, and 2009. We analyzed a wide range of information on travel over time, detailed personal and household characteristics, and spatial information that allowed us to match respondents with the characteristics of their neighborhoods.

Our research examined the determinants of travel for people in their late teens and early 20s, the extent to which their travel differs from that of older adults, and whether youth today travel differently than previous generations.

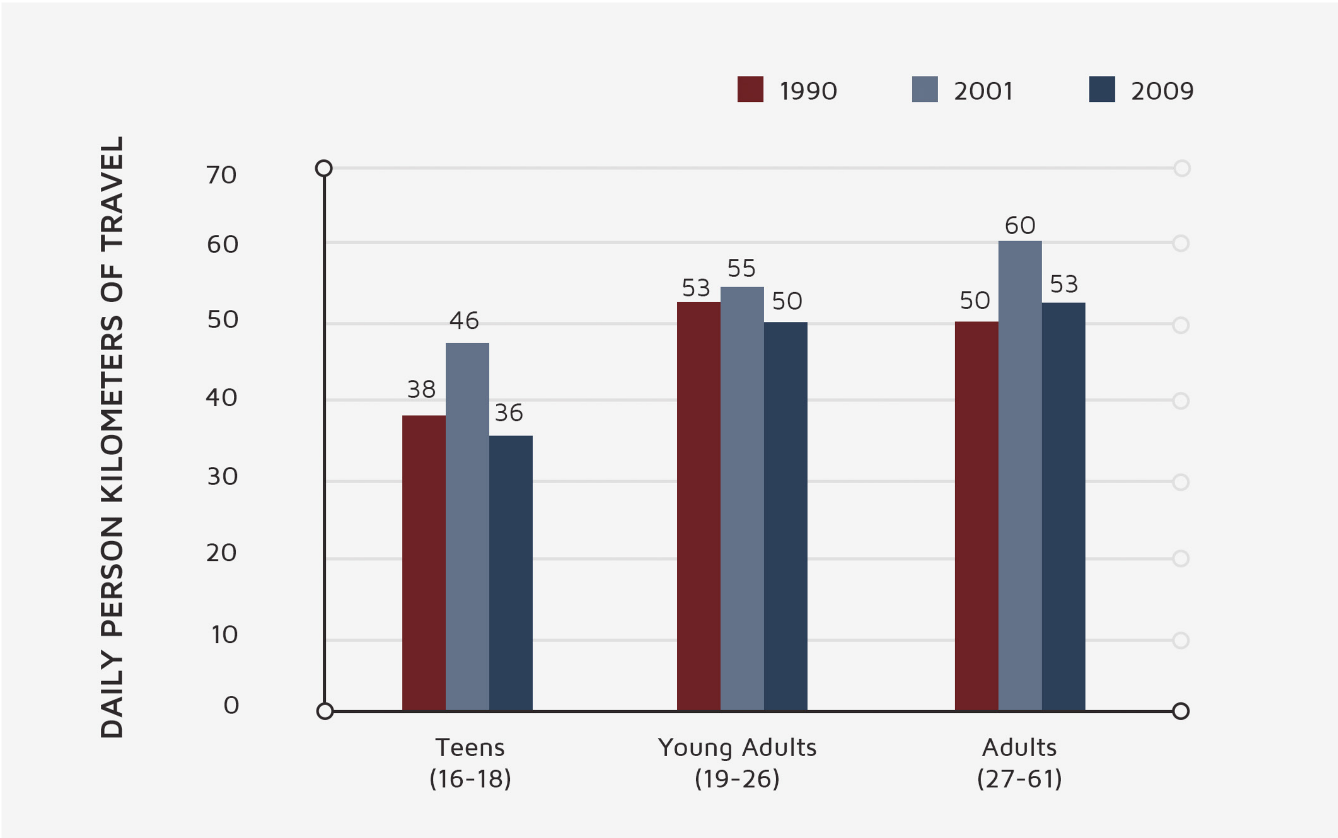
In a nutshell, we found little evidence of a substantial cultural turn by millennials away from cars and suburbs. We found some evidence of generation-specific declines in driving among millennials, but the effects were modest. So what did have the biggest effect on millennial travel? The economy. Most of the drop in driving was likely due to the effects of the Great Recession.

We also found that millennials were not so unique: Most of the factors influencing youth travel in the 1990s and 2000s similarly affected middle-aged and older adult travel as well. To explain these findings in more detail, we answer eight common questions about millennials and their travel.

Do millennials travel less and rely more on non-driving modes when they do?

Measured by person kilometers of travel, all age groups traveled less in the 2000s, but this trend was not due to a significant shift from driving to travel by other modes. Average daily travel

Figure 1. Daily person kilometers of travel by age group and year



increased among all age groups during the 1990s (see Figure 1), but had declined by the time the severe economic downturn reached its depths in 2009. The decline was steepest among teens, followed by young adults.

While average kilometers of travel rose and then fell during our two-decade study period, we found surprisingly little change in how people travel. Teens and young adults travel by means other than solo driving more than older adults, but the vast majority of all three groups traveled by car throughout the study period, and their likelihood of using other modes remained, by and large, unchanged.

Do millennials travel differently than youth of previous generations?

One theory is that large social and technological changes have fundamentally changed youth and their travel behavior. If this is the case, the travel patterns we see today may be the result of "cohort effects," traits that groups of similarly situated people continue to share over time. To estimate possible cohort effects, we combined all three surveys and examined the effect of birth decade on travel, taking into account the many other factors that affect travel (including the survey year).

Cohort models provide some evidence for moderate generational effects on travel behavior. All things equal, younger generations appear to travel fewer miles and make fewer trips than previous generations at the same stage in their lives. At the same time, however, younger workers drove alone to work more frequently than similarly aged workers of earlier generations. Millennials travel slightly differently than youth did in the past, but not in a way that abandons personal vehicles.

would reduce travel, with online communication, entertainment, and shopping replacing trips outside the home. Why travel to see a friend or client, the theory goes, when you can simply FaceTime with them instead?

However, scholars have generally found that these technologies serve as a modest complement to, rather than a substitute for, travel. It may be that being online provides so much information about and access to opportunities that it encourages as many or more new trips than it replaces.

Today's youth could be a special case. They are the first generation to have never known a world without instantaneous and nearly ubiquitous mobile device access. They also tend to be early adopters of new technologies. Yet despite the staggering increase in mobile device and web access and use, the effects of information and communication technologies on travel (albeit using imperfect measures available in the travel surveys) were small and tended to be associated with more and not less travel.

Do millennials travel less due to increasingly stringent state driver's licensing regulations?

The short answers are "yes" and "no." To improve teen driver safety, most states have adopted graduated driver's license (GDL) regulations that typically include a permit phase with adult supervision, an intermediate phase with restrictions on driving at night and/or with other young passengers, and finally an unrestricted permit phase. Such regulations may restrict teen mobility if they discourage teenagers from becoming drivers or if the nighttime and passenger restrictions limit their travel.

The U.S. Insurance Institute for Highway Safety has developed a point system for ranking GDL programs from low to high levels of stringency, which allowed us to examine states' uneven transitions from few or no GDL regulations in the early 1990s to universal and mostly strict graduated driver's licensing by the late 2000s.

Examining the stringency rankings over time, we found lower proportions of teen drivers in states with stricter regulations, as we expected. In 2009, 81 percent of teens in states with the least stringent license requirements were drivers, compared to just 68 percent in states with more stringent requirements. As a result, youth are now more likely to obtain driver's licenses in their late teens and early 20s, instead of starting to drive as early as they are allowed. While 16- and 17-year-olds now drive less, nearly all youth eventually get driver's licenses as they age and then travel about as much as similarly situated people from earlier generations. Thus, we find that the overall effect of changes in driver's licensing regulations on travel was surprisingly small.

Do millennials substitute technology for travel?

As people age and assume adult responsibilities such as living on their own or having children, their travel tends to increase. But millennials have been taking longer to establish independent lives than youth of previous generations, a trend that accelerated during the Great Recession. For example, young adults struggling to find work increasingly "boomerang" back home to live with parents after having lived independently, in order to take advantage of free or steeply discounted rent, groceries, and car access. Millennials also spend more time in school, contributing to delayed household and employment transitions. These delayed transitions to adulthood may postpone car ownership, and result in fewer work and household-supporting trips and less personal travel.

Our data allowed us to determine whether young adults live with at least one parent. Unfortunately this measure does not directly measure the "boomerang" concept, but we observed a substantial increase in the share of people aged 19 to 26 living with their parents in the 2000s — from 33 percent in 1990 to 58 percent in 2009. The share of 19-to-26-year-olds in school also increased from 14 percent in 1990 to 19 percent in 2009. But despite these sizeable changes in adulthood transitions, we did not find a statistically significant relationship between youth travel and living with one's parents or being in school.

Are millennials moving back to the city?

The cultural narrative around millennials casts them as less enamored of the suburban, car-oriented lifestyles their parents favor. Instead of space for kids, a yard, and a two-car garage, the latest generation of young adults is thought to prefer lively cities where they can get around more easily on foot, by bike, and on public transit.

Indeed, data show that millennials are more likely to live in dense, walkable urban areas than older adults. To test this, we classified the characteristics of the built environment and transportation infrastructure of nearly all U.S. neighborhoods into one of seven types (see below).

While a higher percentage of youth than adults live in neighborhoods that tend to be found in cities — Urban Residential, Old Urban, and Mixed Use — more than half of all youth live in the three suburban neighborhood types, suggesting that the suburbs are far from dead to millennials. Travel differences across the seven neighborhood types are surprisingly small, with one exception.

Residents in dense, transit-rich Old Urban neighborhoods tend to travel very differently: they make fewer trips, travel fewer miles, have lower rates of automobile ownership and licensing, are less likely to drive alone, and are much more likely to walk and take transit than are the residents of any other neighborhood type. The catch is that very few places are this dense and transit rich. Old Urban neighborhoods account for just 4 percent of U.S. neighborhoods, the vast majority of which are found in New York, Los Angeles, and a few other very large cities. Just 6 percent of all Americans aged 20 to 34 live in Old Urban neighborhoods.

Besides the relatively small number of Old Urban neighborhoods, residential location has

played only a small role in recent changes in millennial travel. Nor has there been much change in the percentage of youth living in urban areas over time. During the 2000s, the number of millennials living in urban neighborhoods increased by more than four million, yet any "back-to-the-city" movement was dwarfed by what might best be described as a much larger "out-to-the-suburbs" movement. The increase in the number of youth living in sprawling New Development suburbs was more than 50 percent greater than the increase in the youth population in all six other neighborhood types combined.

Can the economy explain the decline in millennial travel?

Today's teens and young adults came of age amidst the worst economic crisis since the 1930s. Between 2001 and 2009 youth unemployment more than doubled, from 4.2 to 9.3 percent. We found a strong and consistent positive relationship between employment and youth travel, which suggests that high youth unemployment rates were central to the decline in youth travel in the 2000s.

However, the economic downturn appears to have had an even larger effect on adult travel. The relationship between employment and personal travel was 32 percent greater among adults aged 27 to 61 than for those aged 20 to 26. Older working adults averaged 7.4 kilometers more per day than non-working adults, compared to 5.6 kilometers more for employed young adults. So while the economy clearly influenced millennial travel in the 2000s, it affected the travel of all working-age adults, not just youth.

So what was behind the decline in millennial travel in the 2000s, and what lessons can we draw?

After controlling for personal, household, locational, and travel factors, the effects of societal trends on personal travel are surprisingly muted — with the notable exception of employment. Many of the factors popularly associated with millennials are not unique to that generation; they appear to have a similar or, in some cases, even greater influence on the travel of older adults. Finally, for youth in particular, personal travel in 2009 was not significantly different from 1990. The outlier in our sample may have been 2001, a time when unemployment was near a historic low of 4.2 percent and personal travel was near an all-time high.

Some observers have used the recent dip in youth travel to argue that transportation investments should be refashioned to better support millennials in their desire for more urban, less car-centric lifestyles. However, our analysis shows that such sweeping conclusions about the location and travel desires of millennials may be premature and are surely too simplistic. Our findings suggest that the future of travel — for youth as well as adults — largely hinges on the state of the economy.

Data on U.S. vehicle kilometers traveled in the 2010s support this conclusion. As the economy has rebounded from the Great Recession, so too has vehicle travel, which is now at a historic high. Analysis of data from the recently-released 2017 National Household Travel Survey will shed some additional light on post-recession trends. In the meantime, while policy shifts away from cars are likely justified on the basis of both economic efficiency and environmental sustainability, there is little evidence that car travel is going the way of the print newspaper thanks to the shifting preferences of millennials.

This article is adapted from research funded by the Office of Transportation Policy Studies at the U.S. Federal Highway Administration and the University of California Transportation Center, conducted in close collaboration with an all-star team of (mostly millennial) research assistants (in alphabetical order): Anne Brown, Stephen Brumbaugh, Kelcie Ralph, Michael Smart, Carole Turley Voulgaris, and Madeline Wander.

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Faster than Walking, More Flexible than Biking: Skateboarding as a Real Mobility Mode

Kevin Fang

You might associate skateboarding with teenagers flying around the neighborhood skatepark. However, a growing number of people use skateboards for a more utilitarian purpose: travel. Skateboards are part of the suite of human-powered sustainable travel modes and a relatively popular form of mobility for younger people.

Yet while skateboards can be just another way people get around, in some places, commuting on a skateboard can result in a trip to a courthouse. Skateboard travel regulations are challenging — they can be colored by existing, often negative perceptions of teens at skateparks, and from a planning standpoint, skateboard travelers introduce another unique user into the competition for travel space between drivers, bicyclists, pedestrians, and transit users. These issues make skateboard travel an interesting test case of the bounds of the concept of "complete streets."

Measurable amounts of skateboarding

Travel surveys, from which we understand how, where, and how much people travel, often do not list skateboarding as a travel mode. But those that do have measured notable amounts of skateboard travel. In Los Angeles, transit riders use skateboards 30,000 times each day to get to and from bus stops and train stations. Observers in Portland, Oregon, found that at least one skateboarder passed through 79 percent of intersections. At one intersection, they counted 17 skateboarders — about one every seven minutes.

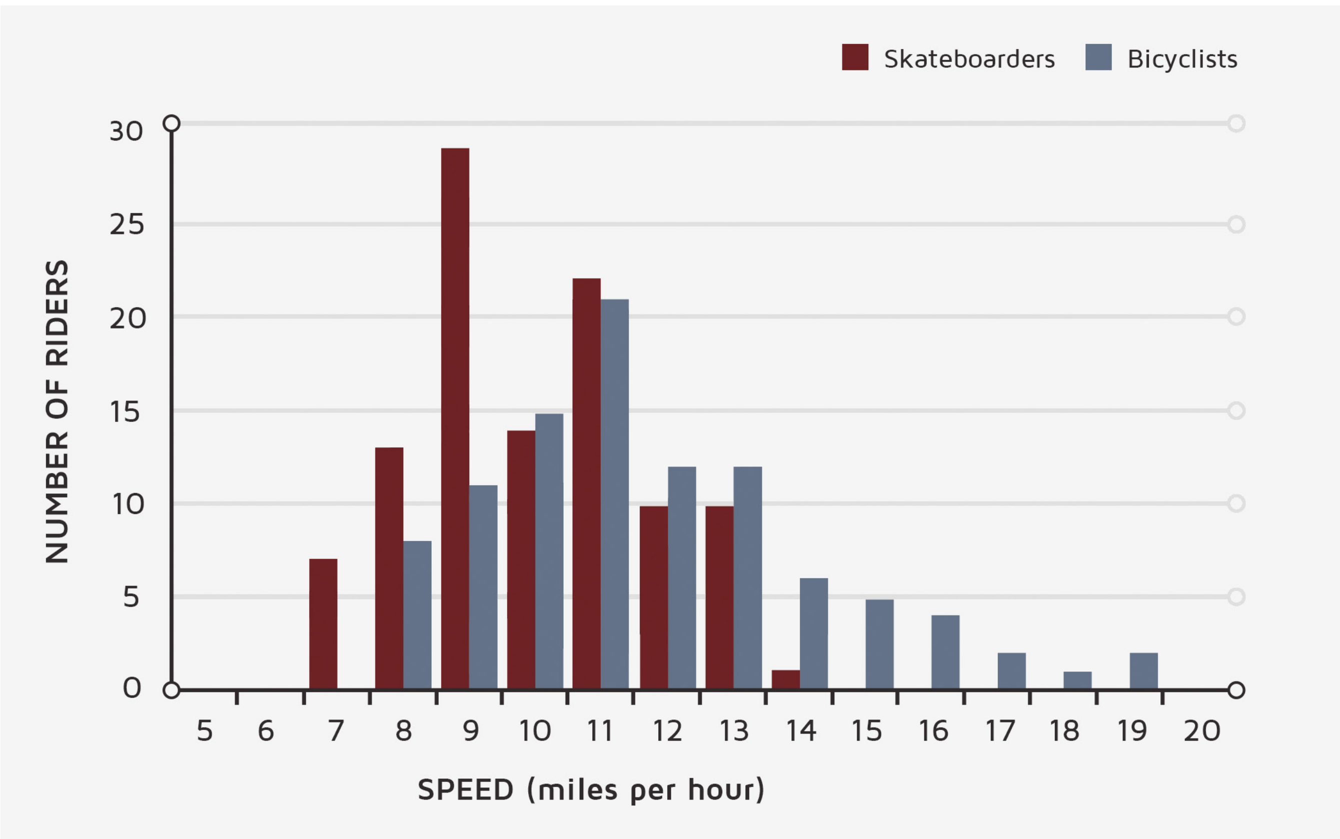
Skateboard commuters, and data about skateboard commuters, are particularly prevalent at college campuses. In 2016, skateboarding slightly eclipsed driving alone rates to campus among students at UC Santa Barbara, 8 percent versus 7 percent. At San Jose State University, skateboard commuting has increased by 3,500 percent since 2005. Skateboarders now outnumber motorcyclists — considered to be much more conventional travelers — by more than two-to-one. At Arizona State University, approximately 4 percent of students skate for intra-campus trips. In observations at San Diego State University, skateboarders made up 6 percent of people on one pathway despite the activity being illegal at the time.

The California Household Travel Survey found that 0.14 percent of all daily trips in California are taken on skateboards and similar devices. While that may seem small at first glance, it corresponds to nearly 50 million miles traveled the population of California, the number of trips people make, and an average trip length for skateboards and similar devices of about three-quarters of a mile. Over those millions of miles, skateboarders likely have hundreds of millions of encounters, interactions, and potential conflicts with other travelers.

The current popularity of skateboard travel appears to be at least partially an echo of the boom in recreational skateboarding seen in the 1990s and early 2000s. At the peak between 2003 and 2005, there were an estimated 13 million skateboarders in the United States.

Whether or not those individuals still skate, that experience means a significant number of people have the skill to ride.
Skill matters: Surveys of skateboard commuters at UC Davis found that most began skateboarding initially for recreation as teenagers or pre-teens. There are also indications of growing adoption of skateboard travel by those without past experience, particularly among women. A majority of female skateboarders at UC Davis reported less than two years of skateboarding experience while the majority of skateboarders as a whole had more than four years of previous experience.

Figure 1. Speed observations of 100 skateboarders and bicyclists at UC Davis



Not just for fun

Our research at UC Davis, which included in-depth interviews with skateboard commuters, questions in the annual campus travel survey, and general observations of skateboarders, suggests skateboard commuters enjoy skateboarding more than other types of travelers typically enjoy their modes. However, skateboarding is not just for fun, or to look cool, or to be part of a subculture. The mode's convenience is equally important.

This convenience manifests itself in different ways. Skateboarding is clearly faster than walking: Our observations at UC Davis found that skateboarders travel between 6 and 13 miles per hour, with an average of 9.7 miles per hour. At two- to four-times the speed of walking, skateboards can extend the range of destinations reachable under human power. Bicycles, of course, can provide that same benefit, at even greater speeds. But skateboarders are closer in speed than one might think. Bicyclists on the same facility traveled between 6 and 19 miles per hour, with an average of 11.6 miles per hour. Most skateboarders are faster than at least some bicyclists.

And while on average bicyclists are about two miles per hour faster than skateboarders, other conveniences of skateboarding can counter that advantage. Riders can easily carry their skateboards when not in use, allowing skateboarders to travel from door to door like pedestrians and take their skateboards inside their destinations. Skateboarders don't have to spend time diverting to bicycle parking racks, securing their locks, walking to their destination, and repeating the process when they leave. On relatively short trips, avoiding this routine can make up, at least in part, for the slower speed of skateboarding.

The ability to carry skateboards easily also makes them convenient for multimodal trips. Data from Los Angeles and some college campuses show that many skateboarders use their boards in combination with other modes rather than for entire trips. A rider can easily carry a skateboard onto a transit vehicle or car. Skateboarders need not worry about the availability of limited bicycle racks on the front of a bus or in a train, or prohibitions of bicycles on some transit systems during rush hours.

Skateboards also generally cost less than bicycles, with premium skateboards typically selling for a few hundred dollars, similar to low-to-mid-range bicycles. Skateboards can also have an advantage in terms of maintenance cost – they don't get flat tires and have relatively few parts. Additionally, the ability to carry skateboards into destinations allow skateboarders to avoid one of the primary downsides of bicycling: the potential for theft. In our interviews with skateboarders, we found that stolen bicycles were a common catalyst for a shift to skateboard travel.

Regulations as a barrier

The decision to travel via skateboard is not always a legal one. In California, about 90 percent of cities regulate skateboarding in some way, and most regulations either overtly or implicitly respond to negative perceptions of recreational skateboarding — that it is unsafe, damaging to property, noisy, or caters to an unseemly class of people. One California city goes so far as to call skateboarders "aggressive and abusive to the elderly" in its municipal code.

Some cities regulate what they consider undesirable skateboarding through restrictions on doing tricks or interacting with street furniture. This approach does not affect well-behaved travelers. However, jurisdictions more commonly prohibit skateboarding in various places or situations necessary for travel. Skateboarding is often prohibited on streets, on sidewalks, in business districts or other parts of a city, and at night. Such prohibitions can make skateboard travel to many destinations illegal in ways that travel using other modes are not. While not necessarily the target of regulations, skateboard travelers end up being restricted as a result. Skateboard travelers often sit in a legal black hole, restricted by regulations even as regulators rarely recognize their mode of travel.

Yet even in places where policymakers know that skateboards are used for travel, they commonly justify prohibitions out of concern that skateboard travelers could be injured or injure other people. While concern for safety is certainly understandable, blanket prohibitions are not how governments regulate any other mode of travel. Cities do not ban all cars, for example, until it is demonstrated that cars will never hurt or kill anyone — even though cars are involved in thousands of fatal collisions every year.

Most campuses in the California State University system ban skateboarding, a policy that dates back to the late 1980s when a professor was struck and injured by a bicyclist. While many CSU campuses banned skateboarding in response, many did not similarly ban bicycling.

Several of the campuses have re-legalized skateboarding over the last few years, but not without running into the same negative perceptions seen in cities. At San Diego State University, the university police chief likened skateboarding to a gateway drug, telling the student newspaper that "riding a skateboard is a low priority crime, but it escalates."

Table 1. Fatality rates from motor vehicle collisions in California

	Fatalities	Mode Share	Trips per Year (millions)	Average Trip Length (miles)	Annual Miles Traveled (millions)	Fatalities per 10 Million Trips	Fatalities per 100 Million Miles Traveled
Motor Vehicle Occupants	5,897	82%	39,628	5.8	229,841	1.5	2.6
Pedestrians	655	16%	7,808	0.3	2,342	0.8	28
Bicyclists	125	1.5%	738	1.5	1,107	1.7	11.3
Skateboarders/ Scooter Riders	10-11	0.14%	68	0.7	48	1.6	22
Overall	6,731	100%	48,296	4.8	231,822	1.4	2.9

How serious are safety concerns?

Are regulations that restrict skateboarding in the interest of safety justified? Many perceive recreational skateboarding as an "extreme sport" and thus dangerous. California's healthy and safety code even defines skateboarding as a "hazardous recreational activity," although this counterintuitively enables recreational skateboarding by limiting civil liability in public skateparks.

Fears that skateboard travelers engage in dangerous tricks that could injure bystanders appear to be unfounded. Our observations found that skateboard travelers almost always move forward in simple straight lines while they travel. Most ride "longboards" or other variants designed for cruising, which makes tricks difficult if not impossible. Only about one-quarter of skateboarders we observed on the UC Davis campus ride the same type of skateboards used in recreational trick riding. Even those riding trick skateboards often make modifications, such as installing larger and softer wheels, that facilitate cruising at the expense of performing tricks.

At least 147 skateboarders were killed in the United States between 2011 and 2015. Only one fatality occurred at a skate park; virtually all the rest were on transportation facilities, and three-quarters involved motor vehicle collisions. While we were not always able to ascertain the purpose of these fatal trips, in those where the purpose was clear, almost two-thirds of victims were traveling rather than recreating.

While these fatalities are certainly tragic, on the whole, skateboard travel does not appear to be unusually dangerous. In California in 2012, people on all modes experienced 1.4 fatalities per 10 million trips. Skateboarders and scooter riders (similarly classified and not separable in data) experienced 1.6 fatalities per 10 million trips, just below bicyclists at 1.7 fatalities. Per distance traveled, non-motorized travelers experienced 22.6 fatalities per 100 million miles traveled. Skateboarders and scooter riders experienced between 20.9 and 23.0 fatalities.

Skateboarders and planning

Regulations that prohibit skateboard travel because of negative perceptions of recreational skateboarding, or that hold skateboarders to higher standards than other travelers, raise fundamental questions of fairness. How can cities respect skateboarders' freedom of choice while balancing other facility management concerns?

In some states like California, skateboarders fit under the state vehicle code definition of a pedestrian, which includes people on human-powered devices other than bicycles. That gives skateboarders at least a default legal standing. For example, drivers should yield to skateboarders in crosswalks since they are pedestrians, too. However, it also means that a skateboarder traveling along a road can be cited as a pedestrian outside a crosswalk, as happened to one person we interviewed. Other states, such as Oregon, define pedestrians more narrowly as people who are "afoot." This definition makes the relationship between skateboarders and other users much murkier.

A starting point may be to ask, where should skateboarders ride? Given that skateboarders travel in a similar range of speeds as bicyclists, bike facilities seem like a reasonable choice, and our surveys of skateboarders find that they are very comfortable in such facilities. Since skateboarders are slower than bicyclists on average, bicyclists may not be that enthused about sharing space with slower travelers. But efforts to increase rates of bicycling often seek to encourage new, less-skilled, or less confident bicyclists to ride more, and these groups are likely slower than current bicyclists, too. Adding skateboarders to bike paths might not be all that different than adding new bicyclists. And on shared-use paths, skateboarders are at least as compatible with pedestrians as bicyclists given their comparable speeds.

In the majority of locations without bicycle facilities, human-powered travel is primarily limited to roads and sidewalks. Quiet neighborhood streets with little vehicle traffic would present few conflicts for skateboarders. In city centers, skateboarders might share roads with more vehicle traffic, but flowing at low speeds. Sidewalks in those same city centers may be problematic given limited room to maneuver and the possibility of conflicts with numerous slower pedestrians. However, most parts of the United States are dominated by low density, auto-oriented landscapes where there are few pedestrians, and sidewalks, if they exist, are usually empty. In these areas, skateboarders could take advantage of underutilized sidewalks that connect destinations too far apart for walking.

As roads and sidewalks shift between more and less conducive to skateboarding in different situations, picking facilities where skateboarders should always or never ride is probably the wrong approach. Instead, policymakers should ask, how should skateboarders ride? How should skateboarders act around others? How should others act around skateboarders?
A few universities use these questions to shape skateboard policy. San Jose State University's "Common Courtesy" rules and a package of rules at UC Riverside specify when skateboarders should yield or slow down around pedestrians, and restrict skateboarding on places like railings and benches where tricks rather than travel are likely to occur.

Conclusion

While skateboarding is probably not on its way to becoming a dominant mode of travel, skateboard travelers are out there, enjoying the unique combination of benefits that skateboarding provides and demonstrating that not every innovation in transportation requires new technology. Legality is a roadblock in many places, reinforced by perceptions of recreational skateboarding and policies inconsistent with how other modes are treated. For cities following the complete streets framework of accommodating all users, such unequal treatment is problematic.

Planners and regulators must always grapple with the question of how to incorporate new modes, and skateboards might just be the leading edge of a wave of emerging micro-mobility devices that attempt to fill in a niche between walking and bicycling. As new individual transportation options such as electric skateboards, electric scooters, e-unicycles, and hoverboards roll onto the scene, the future of multimodal transportation is only becoming more complex, and will require fair consideration for all travelers.

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Walking on the Wild Side: Distracted Pedestrians and Traffic Safety

Brendan J. Russo, Emmanuel James, Christopher Y. Aguilar, Edward J. Smaglik

Every time a driver is distracted, including by their cellphone, the risk of a traffic crash increases. And almost every driver owns a cellphone — 95 percent of American adults owned one in 2016, with 77 percent owning a smartphone. An analysis of 33 studies showed that cellphone use slows mean reaction time by 0.25 seconds, enough time to make a distracted driver extremely dangerous for others on the road.

But do cellphones make walking more dangerous as well? Distracted drivers clearly endanger pedestrians, but the impact of distracted pedestrians on traffic safety has not been extensively studied. A recent report from the National Highway Traffic Safety Administration concluded that "a very limited number of studies have investigated the effect of electronic device use by pedestrians" and that "there is a need to conduct naturalistic observations of the effect of electronic device use on pedestrian distraction and safety." The issue is in the public eye, after cities including Honolulu, Rexburg, Idaho, and Montclair, California, passed legislation to fine any pedestrian using their cellphones when crossing the street.

Distracted walking could cause people to walk outside the crosswalk, against the pedestrian signal, or in other ways that decrease safety. Drivers may not expect to see pedestrians outside of a crosswalk as they turn, leading to more collisions with pedestrians violating the signal. If a distraction makes people walk slower, their decreased speed may mean people are still in the crosswalk while drivers attempt riskier turning maneuvers to get through the intersection as the light changes.

In order to minimize risk and design infrastructure that is safe for everyone, practitioners must know as much as possible about the behavior of pedestrians and drivers. If they don't know who is distracted while walking (or driving for that matter), they cannot target educational, enforcement, or design strategies at the people most at risk for these types of behavior. We investigated elements of pedestrian behavior at signalized intersections through an observational field study, focused on the person- and site-specific factors associated with pedestrian distraction, violations, and walking speeds.

Study methods

We obtained our data at one signalized intersection in New York City and three signalized intersections in Flagstaff, Arizona (see Figure 1). Pedestrians were observed using high-definition field-mounted video cameras during

during the spring and summer of 2017. We sorted each of the 3,038 pedestrians observed across all four study sites into one of five distraction categories: no distraction, talking on cellphone, texting on cellphone, listening to headphones, or other (distractions not involving a cellphone, such as reading a newspaper or looking in a purse). We also noted several other factors for each pedestrian.

- Gender and estimated age
- Total number of fellow crossing pedestrians
- Average walking speed in feet per second, calculated by the time at the start and end of crossing combined with crosswalk length
- Signal indication at the start and end of crossing ("Walk," flashing "Don't Walk," or "Don't Walk")
- Whether they stepped outside of the marked crosswalk during their crossing
- Whether they were crossing with or against adjacent roadway traffic

Figure 1. Pedestrian crossings in New York City and Flagstaff, Arizona.

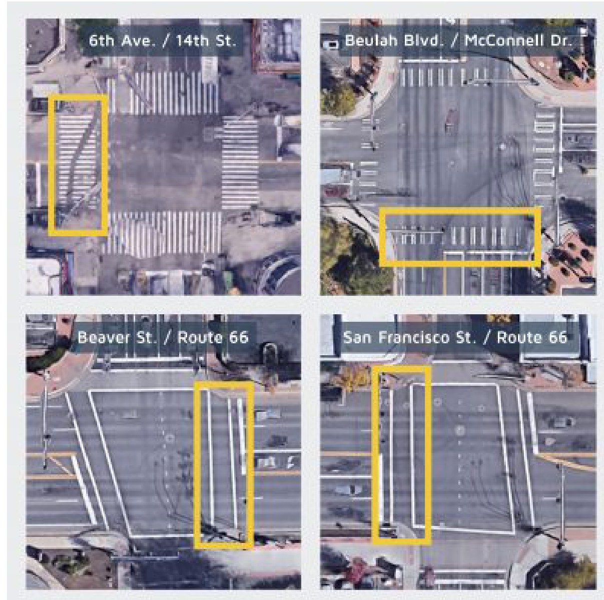
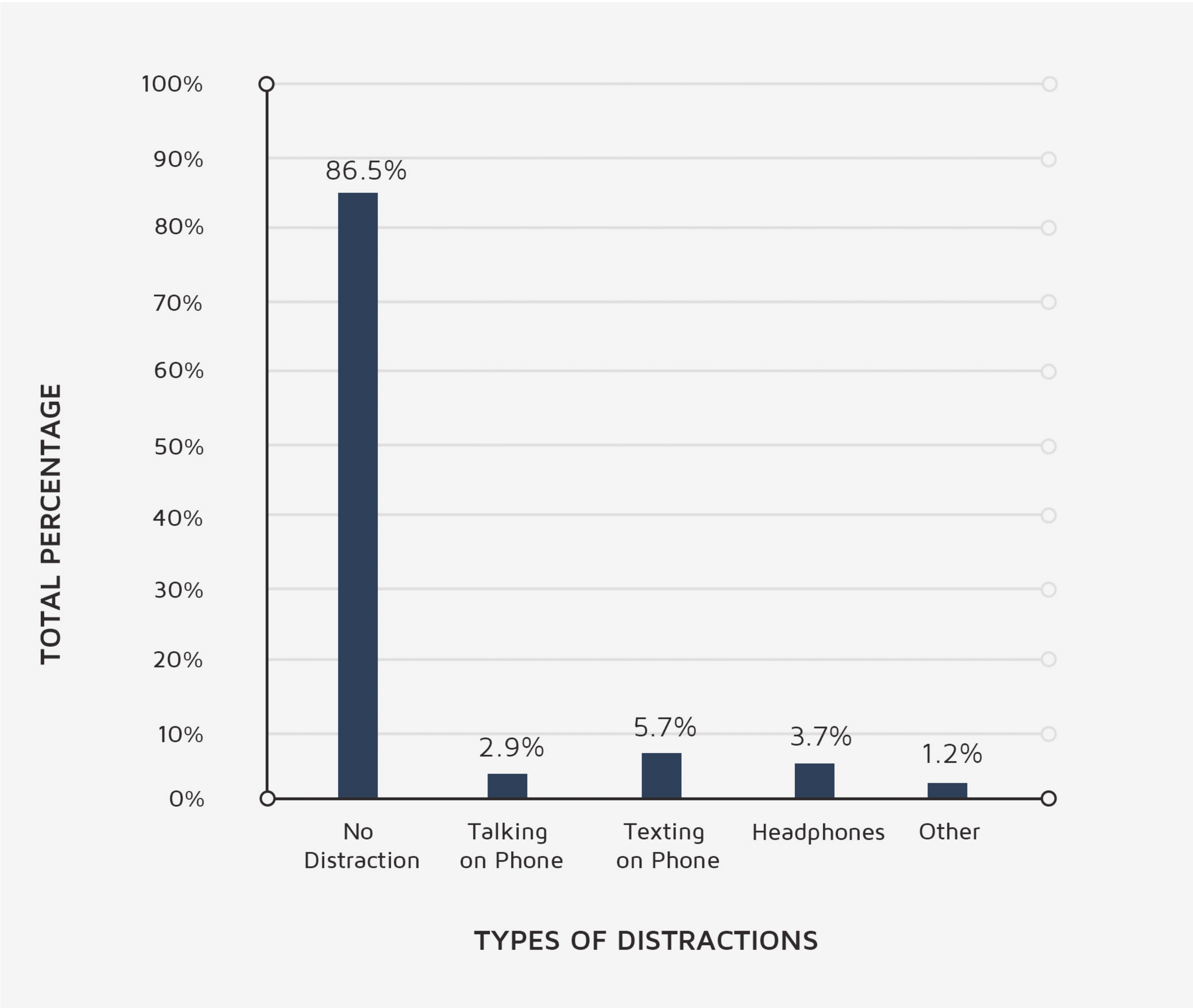


Table 1. Summary of study site characteristics

Intersection	Total Ped. Observations	Walk Time (sec.)	Flashing "Don't Walk" Time (sec.)	Cycle Length (sec.)	Crossing Length (ft.)	Posted Speed Limit (mph)	Ped. Push Button Equipped?
6th Ave./ 14th St. New York, NY	1,398	32	14	90	52.3	25	No
Beulah Blvd./ McConnell Dr. Flagstaff, AZ	120	4	24	60	91.3	35	Yes
Beaver St./ Route 66 Flagstaff, AZ	530	7	18	110	63.4	30	Yes
San Francisco St./ Route 66 Flagstaff, AZ	990	7	20	110	63.5	30	Yes

Who's distracted?

Most pedestrians are not distracted as they cross the street. Overall, we observed just 14 percent of pedestrians talking, texting, wearing headphones, or otherwise using their phones as they crossed. The demographics of distraction are varied. None of the age groups were statistically significant predictors of talking on a cell phone, but men were significantly less likely than women to talk on the phone while walking. Additionally, pedestrians who crossed alone and those who crossed outside of the crosswalk were more likely to be talking on the phone. People aged 16 to 29 and people walking alone were the likeliest to be observed texting while

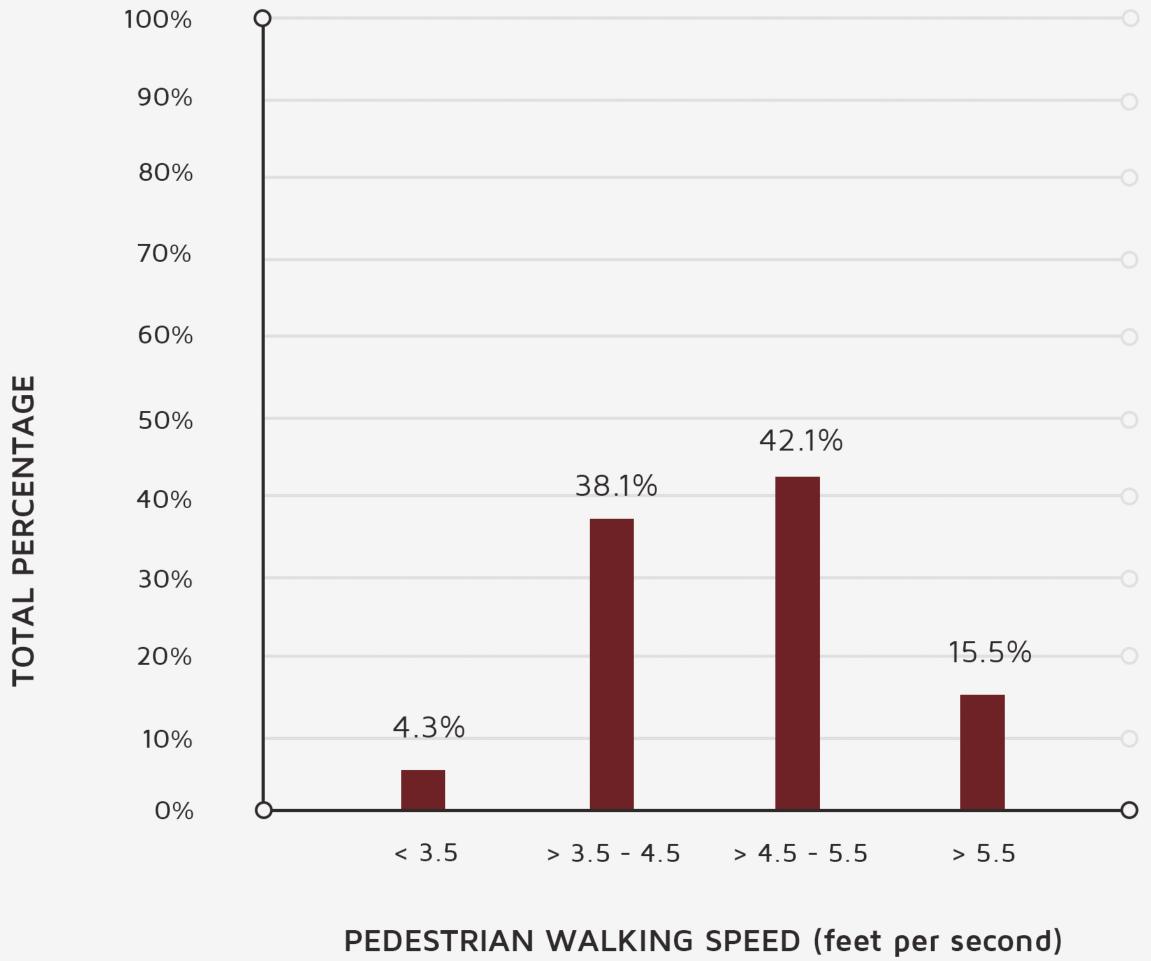


walking. Headphone use was most common among people aged 16 to 29, men, solitary walkers, those who had to wait for a walk signal, and those who walked faster than four-and-a-half feet per second.

Who's slowing down?

Among the number of pedestrians we deemed as distracted, we found that talking or texting did not cause a statistically significant impact on walking speed. While a previous observational study did find that phone use tended to slow pedestrians down, cellphone and especially smartphone use has increased substantially since then. Pedestrians may now be more accustomed to walking with their phones and better able to talk or text while maintaining their usual pace.

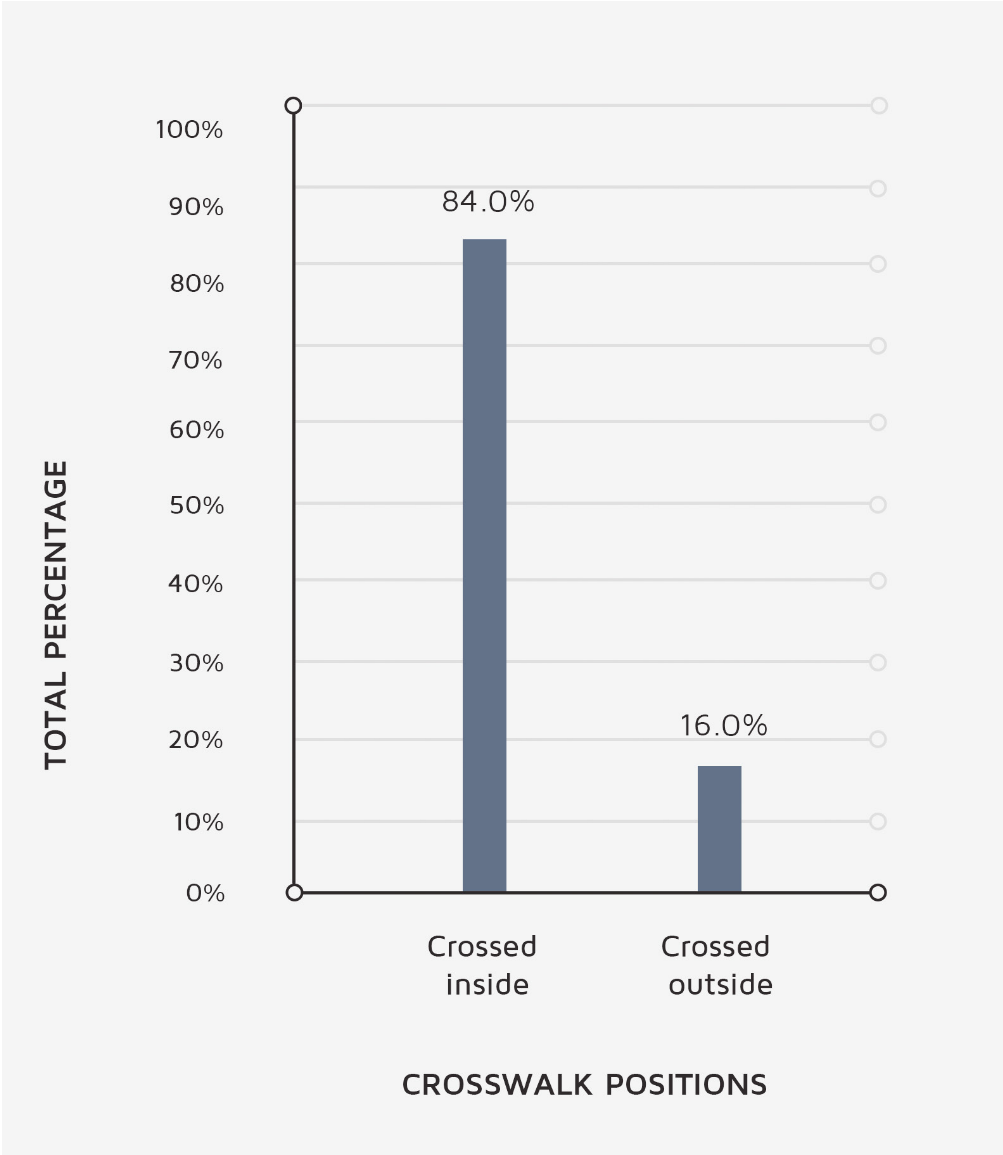
Walking speeds differed based on the type of distraction and the person's individual characteristics. People using headphones tended to cross faster than "undistracted" walkers, and pedestrians in the "other" distraction category tended to walk slower, a result that is consistent with past research. As expected, pedestrians estimated to be 60 or older exhibited the slowest walking speeds, while those estimated to be in the 16-to-29 age range exhibited the fastest.



Men tended to walk slightly faster than women, regardless of distraction.

Site-specific factors appear to influence walking speeds rather than phone use. The fewer pedestrians, the faster the crossing — those crossing alone or with one other person walked faster than those crossing in groups of three or more. This suggests that intersections where large numbers of pedestrians cross during each cycle experience overall slower walking speeds. Furthermore, pedestrians crossing in the same direction as adjacent roadway traffic exhibited slower walking speeds than those crossing against. This may be the result of caution toward potential vehicles turning from behind, outside of their immediate field of view. And people who committed crosswalk violations also walked faster than those who crossed correctly.

Pedestrians beginning to cross as the signal flashed or displayed "Don't Walk" exhibited significantly higher speeds than those who started to cross during the walk signal, just as people who walked outside the crosswalk for at least a portion of the intersection also crossed more quickly.



Who's in violation?

Sixteen percent of the observed pedestrians committed a violation by crossing outside the marked crosswalk, while about 23 percent crossed against the signal (i.e. started crossing during "Don't Walk" or flashing "Don't Walk" pedestrian signal indications). Aside from male pedestrians being more likely to commit a crosswalk violation, none of the other demographic variables were statistically significant in predicting pedestrian violation behavior.

Pedestrians in groups of five or more were more likely to commit a signal violation, indicating this behavior may be deemed more acceptable when done with a group. Pedestrians in groups of three or more were more likely to walk outside the crosswalk, which may be a result of crowding in the crosswalk when larger groups are crossing.

Pedestrians who were texting while walking were more likely to cross outside the crosswalk, likely because their vision is focused on the phone and not the street markings. Slower pedestrians — those walking less than three-and-a-half feet per second — were more likely to stay inside the crosswalk.

Conclusion

Crosswalks are shared spaces used by both pedestrians and vehicles, and are inherently designed to be conflict zones: There is no red light to stop every driver from entering every crosswalk when there is a pedestrian in it. Even when "walk" signals are activated, there are typically vehicles turning from multiple directions that can legally enter that shared space. A safe outcome depends on all parties being attentive to their situation.

Our findings offer some direction for improving crosswalk safety through policy and planning strategies. Because talking and texting while walking are not statistically significantly associated with walking speed, engineers may not need to redesign pedestrian signal timing in order to accommodate distracted pedestrians as cell phone and smartphone use continues to increase. Instead, policymakers may look to engineering solutions such as restricting drivers from turning right on red lights at locations that more prone to pedestrian distraction. Educational or enforcement campaigns aimed at certain demographics, such as the 16-to-29 age range, could promote attentive walking among the people more likely to be distracted.

Pedestrian distraction, even by 14 percent of people crossing at an intersection, presents a public safety problem — especially because pedestrians must stay alert due to the dangers posed by distracted drivers. Given the increased attention to safety campaigns aimed at eliminating all traffic-related fatalities, such as Vision Zero in cities around the country, policymakers should consider and address the behavior of all road users, including pedestrians crossing the street legally at signalized intersections.

This article is adapted from Russo, B.J., James, E., Aguilar, C.Y., and E. Smaglik, "Pedestrian Behavior at Signalized Intersection Crosswalks: An Observational Study of Factors Associated with Distracted Walking, Pedestrian Violations, and Walking Speed," Transportation Research Record: Journal of the Transportation Research Board, Transportation Research Board of the National Academies, Washington, D.C., 2018.

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Optimal Pricing of Public Parking Garages

Gregory Pierce, Hank Willson, Donald Shoup

Cities are coming around to the idea that on-street parking should be managed and priced based on the demand for the space. San Francisco, for example, created SF*park*, a program that adjusts the prices of 7,000 parking meters to achieve a target occupancy rate for on-street spaces, and received much praise among transportation policymakers and professionals.

Yet as on-street parking management programs garner attention, cities routinely build off-street parking garages at great cost with scant public scrutiny. Other than recovering the cost of building and maintaining the garages, cities commonly fail to set clear goals for managing their off-street parking supply. This is not the case, however, in San Francisco, where SF*park* also implements demand-based pricing for public parking garages. The program has experimented with adjusting the prices of 11,500 off-street parking spaces in 14 city-owned parking garages, and is a model for pricing public garages to improve parking efficiency and reduce traffic.

Effective parking management presents a challenge. Like airline seats and hotel rooms, parking spaces are perishable goods that cannot be stored and are wasted if they are not used. Effective management of a perishable good has two essential components. First, the wasted time when an airline seat, hotel room, or parking space goes unused cannot be resold later. Second, perishable goods are optimally managed by charging different prices at different times or for different people. In the private parking industry, price differentiation is already common practice as shown by the lower hourly rates offered to early birds or by validated parking for nearby shop customers.

Cities should treat their public garages like hotels for cars, and parking prices should resemble hotel prices that vary based on demand. Hotel prices vary according to the size of rooms, the day of the week, the season, and other factors, and so can parking prices. Hotels that operated without variable prices would quickly generate the same kinds of complaints often heard about parking.

Effective parking management requires reasonable revenue goals. For off-street parking, cities commonly set revenue goals based on the cost to build and operate garages. A 2014 study in 12 U.S. cities found that construction costs averaged $24,000 per space for aboveground parking structures and $34,000 per space for underground garages. Low parking prices may not recoup construction costs and can lead to a financial loss, but prices high enough to recoup construction costs can leave substantial vacancies.

In public garages, cities must also balance the competing goals of reliable availability and high occupancy. Low occupancy means parking spaces are readily available, but the garage brings few visitors to adjacent businesses, schools, and other amenities. High occupancy means the lot maximizes parking space use but may deny service to new customers. The greater the variation in demand during a time period, the more difficult it is to balance the two goals. In order to achieve a balance, a driver's probability of finding an open space upon arrival is a key guide to setting prices.

A city should have three goals when setting garage occupancy targets:

- Ready availability
- High occupancy
- Revenue

By relying on a single target, such as revenue, cities leave the other two goals unfulfilled. No evidence suggests the weight that cities should assign to each of these goals, but local policymakers should manage their parking garages based on explicit concern for all three.

SF*park*'s innovations in off-street space management

Unlike most other cities, San Francisco controls a substantial portion of its off-street parking supply. City-managed garages account for about 60 percent of the publicly available off-street parking spaces in some neighborhoods, and about 16 percent of the city's total off-street supply.

Before SF*park*, the SFMTA set parking prices in garages to cover costs rather than to manage occupancy, and charged drivers more to park off-street than on-street. This pricing system encouraged drivers to circle blocks hoping to find a free or cheap on-street space, rather than park off-street. On-street metered parking was usually scarce, while garages had many available spaces most of the time.

SF*park* adjusts off-street parking prices every three months based on the parking demand at each garage during five different daily time intervals. The city aims for each garage to have an average occupancy no lower than 40 percent and no higher than 80 percent. If expected garage occupancy exceeds 80 percent for a particular time period, SFMTA raises the hourly rate for that time period by $0.50. If garage occupancy is below 40 percent during a time period, the hourly rate is lowered by $0.50 for the subsequent quarter. SF*park*'s rate-setting policies for both on- and off-street parking have brought garage hourly rates equal to — or in many cases below — nearby parking meter rates, giving drivers a financial incentive to go straight to the garages rather than cruise for on-street parking.

In addition to varying hourly prices based on demand, SF*park*'s garage policy also addresses non-price factors. For instance, rush-hour queues at garage entrances and exits cause drivers to lose time. In response, SF*park* offers off-peak discounts for drivers who arrive before the morning peak or depart after the evening peak to lessen the congestion in and near garages at rush hour. As a result, fewer cars now enter during the morning rush and exit during the evening rush.

SF*park* has not, however, simplified the hourly rates for parking prices. Pricing based on the time of day and on the level of demand has actually made hourly rates more complicated. The hourly price, and thus the total parking charge, now depends on when the drivers arrive, not simply on how long they stay. Drivers may also pay at multiple rates depending on when they park. For instance, a driver might pay a daytime hourly rate for the first portion of a parking session, and a lower evening rate for the remainder of the stay.

Varied parking rates, price maximums, discounts, and validations make calculating drivers' responses to price changes difficult. Parkers each pay different prices and no one price fully describes how much any particular driver might pay.

Table 1. SF*park* off-street parking rate variations

Hourly rates	Based on demand, vary over five time periods: • 12 a.m. to 9 a.m. • 9 a.m. to 12 p.m. • 12 p.m. to 3 p.m. • 3 p.m. to 6 p.m. • 6 p.m. to 12 a.m.
Off-peak discounts	For drivers who enter the garage before the morning rush hour (8:30 a.m.), commonly called "early birds," or those who leave after the evening rush hour (6:30 p.m.)
Monthly rates	Vary depending on whether a space is reserved or used for carpooling
Daily maximum rates	Charged for 24 hours of parking
Merchant validations	Reduces or entirely covers a driver's parking cost

SF*park* results: Price, occupancy, and revenue

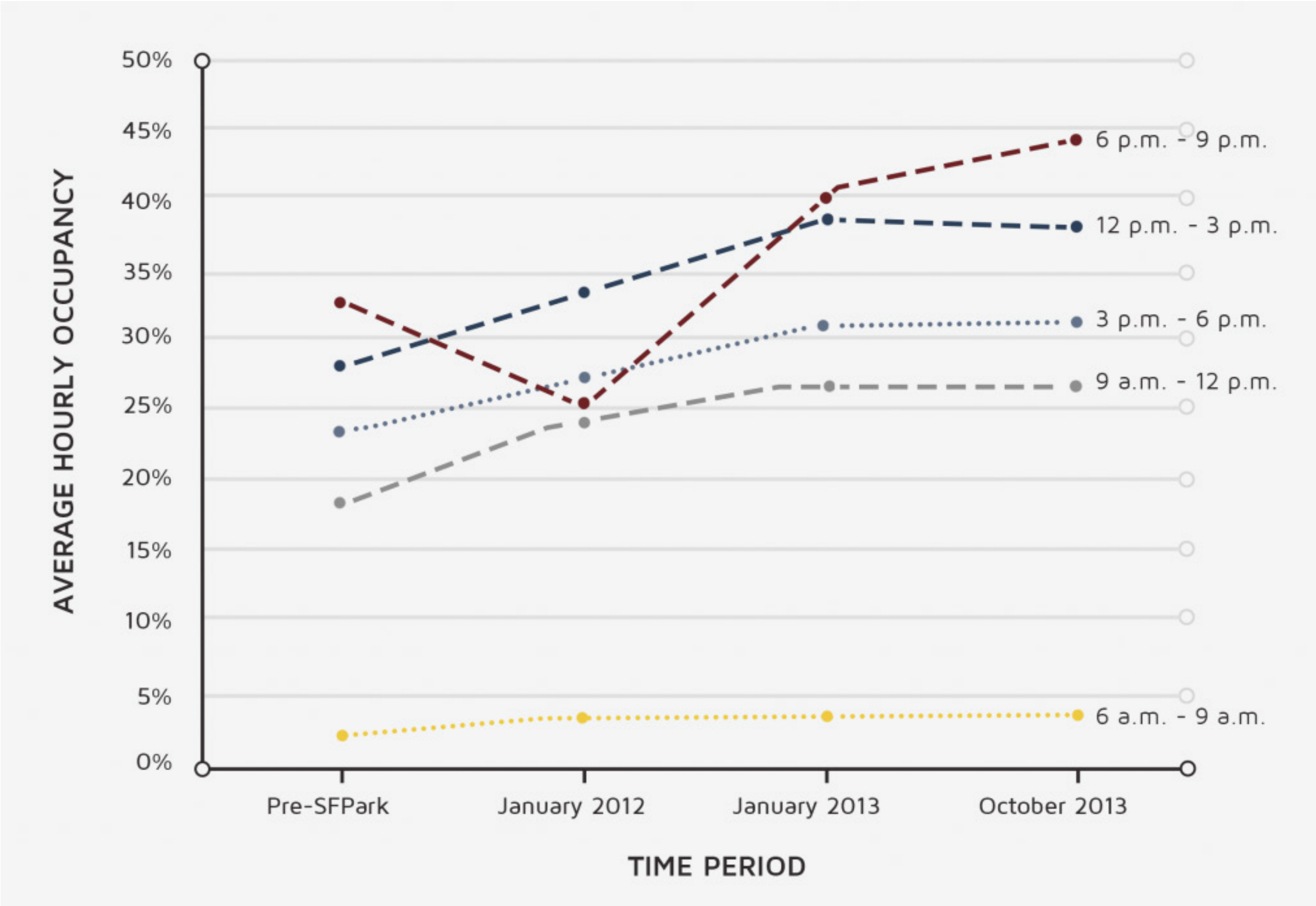
Similar to findings for on-street parking under SF*park*, hourly parking prices in individual garages varied widely in response to local demand. Planners will never be able to accurately predict the prices needed to achieve the target occupancy for every garage at every time period. Instead, the best way to achieve a target occupancy goal is to continue what SF*park* already does: adjust prices in response to the observed occupancy based on trial and error. Because most garages initially had many vacant spaces on most days and at most times, the average hourly price of parking across all garages fell by 20 percent during the program's first year. During the program's second year, the average daytime hourly prices at SF*park* garages rose, but still remained lower than the average price before the program started.

While prices fell modestly, average weekday occupancy for hourly parkers rose by 38 percent in the first two years of the program. As Figure 1 shows, this positive trend remained remarkably consistent across normal working hours, with more erratic responses during the early morning and late evening periods.

The SF*park* program presented a large revenue risk for the SFMTA. Total revenue across garages dipped at the outset of the program, but recovered and surpassed pre-program revenue by the end of fiscal year 2013. By comparison, revenue from the municipal garages outside the pilot program remained steady throughout the period. In the end, the SFMTA's experiment clearly paid off.

After the SFMTA's first two years of dynamic pricing in municipal garages, drivers paid lower hourly prices. Not surprisingly, drivers facing lower prices are more eager to park in garages, leading to higher occupancy. As a result, San Francisco has slightly increased its revenue yield from the garages with demand-responsive pricing. In other words, everyone wins under SF*park*. Focusing on the combination of lower

Figure 1. Average hourly occupancy in SF*park* garages



prices, higher occupancy, and more revenue, rather than just one of these goals, benefits drivers, businesses, and the city.

SFpark's positive effects are best illustrated by looking more closely at the Performing Arts Garage, which is located downtown near the Civic Center neighborhood. Before the SFpark program, garage daytime rates were set uniformly at $2.50 per hour, and peak weekday hourly occupancy averaged only about 25 percent. Under SFpark, low occupancy rates resulted in repeated hourly price reductions every three months. By January 2013, hourly rates for the Performing Arts Center had dropped to the statutory minimum of $1 per hour. As prices dropped, the garage's peak weekday occupancy rose to about 85 percent and total revenue increased more than 10 percent.

Improving SF*park*'s off-street program

Despite SF*park*'s success in improving off-street parking management, the program can make several further improvements. Garage prices are not reduced unless occupancy falls below 40 percent and are not increased unless occupancy rises above 80 percent. The SFMTA reasons that maintaining such a wide range will help to avoid peak occupancy above 95 percent. But since peak occupancy rarely, if ever, exceeds 95 percent in any garage,

SF*park* should set the minimum target range at 60 percent occupancy or higher to optimize use. Price changes should also be more transparent. SF*park* maintains explicit crite ria for adjusting prices based on observed occupancy, but in practice, it does not always follow these guidelines when there is political resistance to price increases. Refraining from rule-based price changes distorts the off-street parking market and invites criticism from skeptics. The SFMTA should, at a minimum, publicly explain its rationale if it sets prices to achieve alternative objectives.

The principles of performance-based pricing for municipal garages can also be applied to parking assets managed by other public entities. For instance, universities located in dense urban areas often maintain parking lots and garages on their campuses. These spaces are occupied during the day primarily by those with permits, and many remain vacant in the evening. Reducing the price of parking in the evening to increase occupancy of the garages can increase attendance at cultural events, improve the sense of community, enhance safety by filling otherwise dark and empty garages, and relieve parking congestion on nearby residential streets.

SFpark reduced parking prices in the municipal garages, increased garage occupancy, and increased parking revenue. The program's results show that cities can more effectively manage their parking assets to maximize public benefits by setting occupancy, rather than revenue, targets. Thus, small changes to management practices can produce large benefits for cities.

This article is adapted from Gregory Pierce, Hank Willson, and Donald Shoup. 2015. "Optimizing the Use of Public Garages: Pricing Parking by Demand." Transport Policy, Vol.44, November, pp. 89-95.

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Enough with the "D's" Already — Let's Get Back to "A"

Susan Handy

When Robert Cervero and Kara Kockelman published their highly-cited article "Travel demand and the 3Ds: Density, diversity, and design" in 1997, they seemingly changed the transportation planning discourse forever. The idea of characterizing the built environment using three measures that happen to start with the letter D was catchy, and catch on it did.

By 2010, the 3Ds had grown to seven with the addition of "destination accessibility" (what I would call regional accessibility), "distance to transit," "demand management," and "demographics" (a category of control variables, not a characteristic of the built environment). I have heard rumors of an additional D or two since then.The Ds now prevail in the academic literature on the effect of the built environment on travel behavior. I do not consider this a good thing.

At a minimum, the terminology is confusing. "Diversity" means the mix of land uses in a given area, but one could easily mistake it to mean the socio-demographic mix of residents of the area, which falls instead under "demographics." "Design" is usually measured as the connectivity of the street network, not as the aesthetic qualities of the street environment that the word generally implies. The Ds are a catchy shorthand, but not an especially clear one.

Another problem is that researchers treat the D characteristics as independent, when in fact they are interdependent. Researchers are usually careful to test for "multicollinearity," the situation in which variables are highly correlated with each other, making it difficult to estimate the effect of any one of them on another. Most studies show that the D characteristics are not as correlated as one might think. It is possible, for example, to have a good mix of land uses in an area with a low level of street connectivity.

But certain values of the D characteristics do often go together, reflecting the era when a particular neighborhood came into being. For example, pre-World War II neighborhoods are more likely to have both grid street networks ("design") and neighborhood-scale shopping within walking distance ("diversity").

The Ds also tend to go together because they influence each other. Density in particular has a strong effect on other D characteristics: Higher densities support better transit service ("distance to transit") and a closer proximity of retail and services ("diversity"). Greater land use "diversity," coupled with better street connectivity ("design"), produces shorter distances to destinations and thus better "destination accessibility."

Treating the Ds as independent of each other creates the risk of overestimating their influence. It also creates the risk of underestimating their influence. If two or more characteristics together have synergistic effects, they produce a total effect greater than the sum of each independent effect.

Rarely do researchers discuss these relationships, let alone account for them in their analyses. Particularly troubling is the use of density as a predictor of travel behavior without an explanation of how density influences behavior. Density influences the other D characteristics that more directly determine the choices available to travelers and thus more directly shape their travel choices. Researchers too often justify their reliance on density and the other Ds by citing other researchers' reliance on the same measures. Even a minimal attempt to justify the Ds based on behavioral theory rather than accepted practice would be an improvement.

What if we changed the framework altogether?

Let's start by taking the perspective of a traveler and how she thinks about her travel choices. Travel behavior researchers generally assume that individuals make choices about their daily travel that maximize their utility, provide the most benefit for cost, or, more simply, make the most sense personally.

The built environment plays a role in determining the choices available to the individual. Most fundamentally, built environment characteristics such as density, land-use mix, and street connectivity determine how far an individual is from her destinations, and it is the cost of overcoming this distance that influences where she can go, by what mode, and how frequently. If the goal is to understand the choices that travelers make, what better way to characterize the built environment than in terms of the choices it provides?

The concept of accessibility provides a perfect way to do this. As usually defined, the level of accessibility from a given place reflects the distribution of destinations around it, the ease with which those destinations can be reached by various modes, and the amount and character of activity found there. It tells us something about the choices that the built environment offers to travelers.

Studies show strong connections between accessibility and travel behavior. In one study, we found that the distance to the nearest store was a strong predictor of walking there. In another, having more stores within a half-mile was associated with more frequent walking to the store. In a third study, we showed that moving into a neighborhood with access to shops within walking distance and good transit led to a decrease in vehicle miles driven. These results all make perfect sense behaviorally speaking.

Accessibility is not only a better measure from a research standpoint. It is also a better measure from a practice standpoint. What matters to people is how easy it is for them to get to where they need to be, and how easy it is to access the services they need or want.

Cities don't promote density for its own sake — they promote density to increase accessibility. Using accessibility as the performance measure by which we assess current conditions and proposed policies could shift the public debate away from the scary idea of density, which often provokes hostile responses.

The Germans have a simple (albeit difficult to pronounce) phrase for the goal of good accessibility: ein stadt de kuerzen wegen, a city of short distances. It's a goal that almost everyone can agree on, and it opens doors to a host of strategies that could reduce auto dependence and improve quality of life.

Accessibility may not be as catchy as the Ds, but it makes more sense for researchers, practitioners, and the public alike. It is time to be done with the Ds and get back to A.

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