Where the Sidewalks End: Pedestrian Risk and Material Mismatch in the American Suburbs

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Abstract:
American suburbs designed in the twentieth century to house a growing middle class are experiencing escalating poverty. Utilizing a mixed-method social epidemiology, this study finds high pedestrian risk in these communities, where a high poverty rate coincides with high levels of suburban sprawl. In declining suburbs, those without access to an automobile navigate a landscape centered upon the private automobile. Suggesting the term ‘material mismatch’ to describe cases where the configuration of the built environment is incongruent with the needs of a growing population of residents, the study makes a contribution to mobility studies, environmental justice research, and urban sociology.

Keywords: transportation, mobility, pedestrian risk, sustainability, walkability, environmental justice, suburbs, urban sociology

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The United States is witnessing the ‘suburbanization of poverty’ (Kneebone 2010), as the suburbs contain a growing share of the nation’s poor (Jargowsky 2003; Madden 2003; Puentes and Warren 2006). In recent years, this process has surpassed an important statistical landmark: more than half of the people living below the poverty line in the United States now reside in suburban areas. Researchers have identified a diverse array of factors behind the increase in suburban poverty, including population loss and population aging (Orfield 1997), a decline in the value of postwar suburban housing (Bollens 1988; Lucy and Phillips 2000: 197-244), and most recently, a national recession driven by the collapse of housing markets, which has deepened unemployment and debt in many of the nation’s suburbs (Kneebone and Berube 2013). These proximate causes have taken effect against a backdrop of disinvestment in suburban areas, as capital is transferred to gentrifying urban centers. The ironic result of this ‘neoliberal spatial fix’ (Hackworth 2007: 95) has been increasing poverty in suburban communities that were developed for upwardly mobile, middle-class homebuyers in the mid-twentieth century.

Although the causes of suburban poverty are gradually coming into view, social scientists have been slow to investigate the challenges that poor residents face in suburban communities (Murphy 2007). An important, unanswered question raised by the suburbanization of poverty is how the health and wellbeing of low-income residents may be affected by the configuration of the suburban built environment. Specifically, it is unclear whether suburban spaces constructed for a growing middle-class in the twentieth century are suited to the needs of residents with limited financial and material resources. This study moves into this unexplored empirical territory, investigating a fundamental dimension of safety and wellbeing in the nation’s declining suburbs: pedestrian risk.

A sociological perspective on pedestrian risk in the United States is long overdue. The likelihood of being struck by a motor vehicle while on foot is a highly prevalent form of environmental risk that has been given scant attention by American urban sociologists or environmental justice researchers. Pedestrian accidents are the fourth most common
cause of fatal accidental injuries, which, in turn, constitute the leading cause of death for people under 45 years of age (Murphy 2012). More United States residents (typically, between 4,000 and 6,000 per year) die of pedestrian injury than of asthma, but in spite of its prevalence, pedestrian risk has never been treated as an environmental justice issue on par with proximity to sources of airborne toxins (Brulle and Pellow 2006; Bullard 1990a; Crowder and Downey 2010; Mohai and Bryant 1992; Weinberg 1998).

Not only is pedestrian risk prevalent, it is unequally distributed with regard to the socioeconomic composition and the built form of communities. People with limited financial resources are more likely to travel on foot, placing them at higher risk of being fatally struck by a motor vehicle (Loukaitou-Sideris, Liggett, and Sung 2007). Meanwhile, design features such as the size of roadways and the spacing of intersections affect the likelihood of being injured by a motor vehicle for those who travel on foot (Ewing et al. 2003). Unlike asthma and other respiratory illnesses disproportionately affecting the poor, which require basic proximity to a source of pollution as the mechanism of exposure, pedestrian risk implicates the design and engineering of the built environment as an important risk factor. For this reason, studying pedestrian risk focuses attention on the relationship between socioeconomic status and the configuration of built space, requiring a new theoretical perspective on risk and offering a meaningful contribution to urban and environmental justice research.

After briefly outlining the central argument advanced by this study and placing it in the context of prior research, I present the results of a national, ecological analysis, modeling county-level rates of pedestrian mortality as outcomes of socioeconomic composition and built space in urban and suburban counties. The empirical focus of the study is then sharpened, as spatial patterns of fatal incidents in two counties are examined in qualitative detail. Finally, narratives for a subset of fatal incidents are analyzed in order to move beyond ecological inference, revealing the people, places and human stories concealed within aggregate vital statistics.
The findings of this mixed-method inquiry are consistent, revealing that, contrary to popular accounts attributing fatal accidents to randomly distributed moments of technical malfunction or human error, pedestrian risk is sociospatially organized: a product of incongruence between the behavioral assumptions manifested in low-density suburban space and the needs of low-income suburban residents. If the concentration of poverty in American cities produced a ‘spatial mismatch’ between low-income urban communities and sources of potential employment in the second half of the last century (Kain 1968; Wilson 2012), I suggest that the current transition of poverty into suburban areas may be producing a material mismatch between sprawling suburban landscapes and the resources of low-income suburban residents.

**Sprawl, Poverty and Pedestrian Risk in Declining Suburbs**

As Gieryn (2002) notes, when architects, planners and engineers modify built space, they necessarily ‘theorize about society… (creating) a blueprint for human behavior and social structure…’ The built environment embodies assumptions regarding user traits and behaviors: sidewalk design standards require inferences concerning the volume and direction of foot traffic, while the design of a doorway embodies norms of privacy and functional assumptions concerning the size and strength of typical users. In the Science and Technology Studies (STS) literature, these behavioral assumptions embedded in material objects are referred to ‘programs’ (Lynch 1981: 154), ‘scripts’ (Akrich 1992) or ‘affordances’ (Costall 1995; Gibson 1977; Norman 1999).

Although small urban spaces figure prominently in academic discourse on the socioeconomic implications of design (Davis 1990; Flusty 1994; Winner 1980), the built form of an entire residential or commercial landscape may, in similar fashion, have differential consequences for different classes of users. At this larger scale, utopian experiments aside, urban or suburban “design” is less the result of a coherent prescriptive
vision of social life than tumultuous market forces operating under federal, state and municipal regulatory regimes. Policy makers and developers in the postwar period pursued a ‘spatial fix’ (Harvey 1982) to absorb and redirect surplus capital, and the material result of this process was the drastic expansion of a built environment that reflected a burgeoning middle-class lifestyle. Supported by generous federal incentives for the construction and purchase of single-family homes, postwar developers sought to minimize construction costs, while promoting the association of suburban living with a broader program of material consumption centered around a set of consumer durable goods, at the center of which was the family car (Baxandall and Ewen 2000; Checkoway 2002; Cohen 2004; Harvey 1985; Harvey 2001; Hayden 2003).

As a result, large-scale residential development took place on former farmland or in open space, physically separated from existing commercial or industrial areas (Baxandall and Ewen 2000). Although older suburbs display broad physical variety (Hayden 2003), many suburban communities built in the ensuing decades within commuting distance of an urban center adhered to this model, including the linked set of spatial features that would later become associated with ‘suburban sprawl’ (Duany, Plater-Zyberk, and Speck 2000): an exclusive focus on single-family housing and an approach to street design and residential layout that discourages mass transit and prevents safe or convenient pedestrian access. As Hayden (2003: 185-257) observes, the resulting landscapes were not the result of intentional planning and design, but rather a lack thereof – an uncontrolled process in which the automobile figured as a default mode of transportation connecting far-flung residential, commercial and industrial developments.

Researchers have extensively documented the institutional mechanisms that excluded low-income and minority populations from American suburbs in the twentieth century (Logan, Alba, and Leung 1995; Cutler, Glaeser, and Vigdor 1997; Massey and Denton 1993; Gotham 2002); less commonly have they observed that, as a result of the processes described above, behavioral assumptions tied to socioeconomic class may have
been physically embedded in suburban space. As Urry (2007) has shown, modes of transport are woven into social and cultural institutions as well as built form. The ‘car system’ disseminated in the United States through the processes summarized above exacerbates social and economic inequality in ways that are not limited to questions of access. When compared to earlier ‘streetcar suburbs,’ or dense urban residential neighborhoods, low-density suburban neighborhoods place high material demands upon residents: basic requirements such as transportation and home maintenance are both less flexible and more expensive, requiring access to wealth and credit (Hayden 2003).

Public health research suggests that pedestrians may experience higher risk of injury in such communities because design, traffic engineering and land use regulations are oriented upon the needs of automobile traffic (Frumkin 2002; Sturm and Cohen 2004). The most rigorous nationwide examination of the relationship between sprawl and pedestrian risk was conducted by Ewing, Schieber et al. (2003), who created a county-level sprawl index measuring environmental factors such as population density and average block size, finding that high levels of sprawl were associated with high pedestrian fatality rates. In sprawling suburbs, blocks are large, intersections, sidewalks and crosswalks are relatively rare, and retail tends to be distributed in linear fashion along divided roadways rather than in dense, walkable commercial centers (Duany et al. 2000; Frumkin 2002). Traffic moves at faster speeds, with fewer traffic signals and other checks on driving behavior (Beck, Paulozzi, and Davidson 2007; Lucy 2003).

While low-density suburban development has long been regarded as unsustainable, principally due to the environmental externalities of petroleum-burning motorized travel, analysts have increasingly highlighted the social and socioeconomic dimensions of sustainability (Agyeman, Bullard, and Evans 2002; Gunder 2006). “Social sustainability” as an analytical lens, binds together both a concern for ecologically sustainable patterns of development and the principle embodied by the environmental justice movement that environmental benefits and costs be equitably borne (Vallance,
By these criteria, low-density suburban areas with low-income populations may be dually unsustainable: because low-income residents are more likely to rely upon walking as a mode of transportation, living and working in areas characterized by sprawl may be riskier for these residents, as they are forced to improvise walking routes along and across dangerous high-speed roadways (Frank, Engelke, and Schmid 2003). These insights suggest that pedestrian risk is likely to be particularly high in areas characterized by high levels of sprawl and high rates of poverty, where a built environment designed for automobile-owning households accommodates a large population that travels predominantly on foot. Potentially fatal pedestrian injury, in other words, is likely to be most common where a mismatch exists between the class-based assumptions embedded in built space and the needs of everyday users. Out of this literature, a single, straightforward hypothesis can be developed:

\[ H1: \text{Pedestrian risk will be highest in communities where high levels of suburban sprawl coincide with a large low-income population reliant on foot travel.} \]

**Ecological Analysis: County Level Patterns of Risk**

In a preliminary stage of analysis, quantitative methods were used to examine the relationship between suburban sprawl, poverty and pedestrian risk in urban and suburban communities. If low-density suburban communities designed for motor vehicle traffic present a particularly high risk of injury to low-income residents reliant on foot travel, this should be reflected in changes in the temporal and spatial patterning of pedestrian mortality rates in recent years.

National cause-specific mortality data from the Fatality Analysis Reporting System (FARS), a comprehensive database administered by the federal government, were analyzed to measure pedestrian mortality. To operationalize suburban sprawl, a county-level index developed by Ewing et. al. (2003) was replicated, measuring the degree to which the design and planning of local streets is geared toward motor vehicle rather than
pedestrian traffic. The crucial advantage of this index for the present analysis is that, in addition to three measures capturing low population densities consistent with sprawling residential development, the index includes two county-level measures of the ‘street accessibility’ of local neighborhoods (average block size in square miles and percentage of blocks less than .01 square mile in size, roughly the size of a traditional urban block), as well as three indicators of population density, all drawn from the geographic information files of the US Census: (1) persons per square mile; (2) percentage living at low suburban densities (between 101 and 1499 persons per square mile); and (3) percentage of the county population living at high urban densities (more than 12,500 persons per square mile). Following Ewing et. al. (2003), Principal component analysis (PCA) was used to extract the principle component of these five variables; this component accounted for 67.4% of the common variation among the variables. The extracted component (factor) was then logarithmically transformed and reversed, such that low-density counties with low walkability receive high, positive scores on the sprawl index, while counties dominated by high-density urban development receive low, negative scores. The sample for this quantitative analysis included 650 metropolitan counties categorized as ‘central’ in the 2000 Census, a designation intended to include the urban centers and primary suburbs of a metropolitan area. Non-metropolitan counties and counties categorized as ‘outlying’ primarily contain residents living at low, rural population densities, and were excluded.

Changes in Poverty and Pedestrian Mortality in High Sprawl Counties

How have recent changes in the socioeconomic composition of high and low-sprawl counties affected pedestrian mortality? In order to describe changes in poverty rates and pedestrian mortality over time, county level pedestrian mortality rates in 1995 were subtracted from the 2010 rates to create an indicator of change in pedestrian mortality over the sixteen-year period of analysis. This indicator was graphed against
changes in poverty rates over the same period drawn from the U.S. Census Bureau’s ‘Small Area Income and Poverty Estimates’ program for 1995 and the 2010 Decennial Census. In Figure 1, separate scatterplots and bivariate regression lines are presented for counties scoring above and below the median on the sprawl index (i.e. ‘high and low sprawl counties’). [FIGURE 1 ABOUT HERE]

The results suggest that an increase in poverty over this sixteen-year period had no observable effect on pedestrian mortality in high-density counties with small, walkable blocks (i.e. low-sprawl counties). The coefficient for the bivariate regression is negative and insignificant (p > .05) among low-sprawl counties. In contrast, high-sprawl counties with lower population density and larger street blocks that experienced an increase of poverty during the period did see significant (p < .05) increases in pedestrian mortality. In other words, the relationship between poverty and pedestrian risk appears to be conditional on the built environment. Increasing poverty (and, by inference, a greater share of the population reliant on foot travel) only produces a significant increase in the risk of fatal injury in counties where the built environment is not designed to accommodate foot traffic. Pedestrian injury is a form of risk that appears to depend not on socioeconomic status or built space, but on the degree of congruence between the configuration of the built environment and the needs of users.

_Sprawl, Automobile Access, and Pedestrian Risk_

A central argument of this paper is that the design of low-density suburban space relies upon the assumption that users will have access to a private motor vehicle, and that high rates of pedestrian mortality may indicate an incongruence between the programming of the built environment and the actual resources of residents. For a further, cross-sectional, multivariate stage of quantitative analysis, the percentage of households lacking access to a motor vehicle was calculated from the Decennial 2000 Census long-form data, in order to test the hypothesis that the effect of income on pedestrian mortality
rates is mediated by lack of access to a private automobile or truck, forcing residents to travel on foot or via public transit.

For each county, an indicator of pedestrian risk was calculated by averaging the pedestrian mortality rate calculated from FARS data across a ten-year period (2000-2010) and taking the natural log of the resulting rate to ensure a linear relationship with independent variables. Conceiving of pedestrian risk in the way outlined above, as the result of a mismatch between the physical configuration of a community and the resources of its inhabitants, strongly suggests interaction terms as the theoretically appropriate statistical tools to test the hypothesis outlined above. Specifically, it was hypothesized that suburban communities characterized by a high level of sprawl and a large population without access to a motor vehicle would be focal points of pedestrian risk.

Interaction terms were created by calculating the product of the suburban sprawl index and the percentage of households without access to a motor vehicle. Bivariate regression and visual inspection of graphed interaction terms (available upon request) were consistent with the argument thus far, suggesting that a high level of sprawl increases the risk associated with lacking a motor vehicle.

A variety of control variables hypothesized to affect pedestrian risk were then added to the analysis. In unincorporated areas, several factors may lead to higher pedestrian mortality rates: the provision of sidewalks and crosswalks in such areas is governed by county and state transportation agencies rather than municipal code, a jurisdictional difference that may result in less extensive pedestrian infrastructure in areas outside of incorporated municipalities; emergency response times tend to be higher; and unincorporated areas are more likely to be rural areas with higher speed limits (McCarthy 1999). Counties where a relatively large percentage of the population lives in unincorporated areas were thus expected to have higher pedestrian mortality.
The percentage of the population above 64 years old and below 18 years old, respectively, were calculated using 2000 decennial census data and were included in the analysis, as children and seniors are at higher risk of death due to physical injury and are, furthermore, less likely to travel by automobile than individuals who fall between these age parameters. The percentage of the population identified as black and Hispanic, respectively, were likewise drawn from 2000 census estimates and included as control variables, as prior research has linked race and ethnicity with pedestrian risk (Beck, Dellinger, and O'Neil 2007; Loukaitou-Sideris et al. 2007). Finally, an indicator representing the log average household size in the county was incorporated, following Ewing et. al. (2003), who find that average household size to be correlated with higher levels of risk.

The possibility of unobserved spatial heterogeneity explaining variance at the level of the state and region suggested a multilevel analysis incorporating spatial fixed effects (Anselin, Gallo, and Jayet 2008). Accordingly, pedestrian risk was modeled as the result of an interaction between the socioeconomic composition and physical characteristics of central urban and suburban counties, with state-level fixed effects. Fixed effect regression models were then fitted to the data. The results are presented in Table 1.

In Model 1, log pedestrian mortality is regressed on suburban sprawl and the county poverty rate, expressed as a proportion, as well as the control variables. Pedestrian mortality is higher in counties with large populations of residents above 64 years-of-age, below 18 years-of-age, black residents, and residents living outside of incorporated areas, as anticipated. Mortality is high in counties with high poverty rates, as expected, and is lower in counties with high levels of sprawl. When the log percentage of households lacking access to an automobile is added, however, both effects wash out: poverty affects pedestrian mortality by increasing the volume of pedestrian traffic on county streets, resulting in higher pedestrian mortality; sprawl on the other hand reduces pedestrian
mortality by discouraging residents from walking when they have a choice; adding a measure of motor vehicle access to the model makes the effect of both variables insignificant. Finally, an interaction term, sprawl * log percent of households without access to a vehicle, is added in Model 3. The coefficient for the interaction term is positive and significant within a 95% confidence interval, suggesting that at higher levels of sprawl, a unit increase in the relative size of the population lacking access to a motor vehicle has a greater marginal effect in increasing the log pedestrian mortality rate than at lower levels of sprawl. These findings clarify and extend the previously presented analysis of changing pedestrian mortality in central counties, suggesting that pedestrian risk inheres neither solely in the built environment nor in poverty, but in the degree of congruence between the built form of a community and the socioeconomic profile of its residents.

**Landscapes of Risk: Atlantic and Cumberland Counties, New Jersey**

The ecological analysis presented thus far supports the hypothesis that socioeconomic conditions and the configuration of the built environment interact in inner-ring suburban communities, producing higher levels of pedestrian risk in counties where residents without access to a motor vehicle inhabit a landscape characterized by low-density suburban sprawl. But ecological analysis has its limits, shedding little light on the neighborhoods, homes and street corners within the high-risk counties identified in this analysis or, for that matter, on the individual biographies hidden within aggregate mortality statistics.

In a second phase of research, I undertook an intensive, qualitative investigation into recent fatal pedestrian accidents in two New Jersey counties in order to situate risk in the context of complex biographical and situational circumstances, factors that are rendered invisible in a cross-sectional ecological design. Moreover, through case study
analysis, the sociological and theoretical implications of pedestrian risk may be more directly explored, as both the behavioral assumptions embedded in specific suburban spaces and the behavioral constraints imposed by socioeconomic status come into focus in individual cases of pedestrian injury. (For a spirited discussion of the trade-offs involved in place-based and case-based approaches to social epidemiology, see Duneier 2004 and Klinenberg 2006.)

In the past two decades, New Jersey suburbs have adhered to a pattern found in many other suburban communities throughout the nation, experiencing significant increases in poverty rates (Berube and Frey 2006; Kneebone 2010). The selection of two New Jersey counties for in-depth analysis was motivated by a combination of preexisting literature, convenience, and the desire for valuable analytical comparison. Atlantic and Cumberland counties, located next to one another in the southern third of the state, have roughly comparable levels of sprawl, and have both seen increases in poverty in recent decades, but differ from one another in pedestrian mortality: their divergence on this outcome variable invited a fine-grained research strategy sensitive to factors that may have been missed by the ecological analysis described above. New Jersey is also the home state of the author, lending familiarity with the selected counties and making repeated field visits possible.

I investigated the people, places and events involved in every pedestrian death that occurred over a four-year period (2005 – 2008) roughly at the midpoint of the period covered by the preceding quantitative analysis. The census of fatalities was generated through archival research and interviews with law enforcement personnel in the two counties, which were then compared to the raw statistics gathered by federal and state agencies. In several instances, detectives or sergeants covering injury-related deaths went case-by-case through their logbooks to help ensure that all fatal incidents were included and provide descriptive detail regarding individual incidents. These sources helped the author supplement the FARS and NFIRS data, generating a comprehensive list of 73
deaths occurring during the period of study. The precise location, date and time for every incident were identified, and locations were plotted using GIS software. Additional data consisted of photos and field notes from site visits to the locations of 38 of the cases, as well as local newspaper articles, which provided accounts of 65 of the incidents, many of which contributed a considerable amount of biographical detail on decedents. Descriptive statistics for Atlantic and Cumberland counties and summary data on pedestrian decedents and fatal incidents are presented in Table 2. [TABLE 2]

By examining these data, it was possible to identify 68 of the 73 decedents by name, age and sex. Autopsy reports were requested and obtained from the county medical examiners’ offices for a subset of 44 cases in which the author had remaining questions concerning the demographic characteristics of decedents or the circumstances directly precipitating the fatal incident. Review of these documents left only two cases out of 73 in which the circumstances surrounding a fatal incident were entirely unclear. From the data described above, I developed short narrative accounts of the incidents, including a description of the immediate location of the incident, biographical information on the victim, and an account of his or her activity at the time that the incident occurred. The data were examined inductively, drawing upon a variety of qualitative, quantitative and spatial analysis in order to identify patterns consistent with or contradictory to the argument thus far. The following section reports the results of this analysis.

*Vectors of Risk: The Black Horse Pike and the White Horse Pike*

On average, 9.5 pedestrians were killed on the streets of Atlantic County each year during the period of study, an annual death toll several times higher than Cumberland County’s (2.25). Neither the county characteristics nor the pedestrian characteristics presented in Table 2 explain this difference. Cumberland County is higher in sprawl and poverty, which runs counter to its lower pedestrian mortality. Meanwhile, Atlantic County has a slightly higher share of households lacking access to a motor
vehicle and a higher share of decedents aged 65 and over, but given the small magnitude of these statistical differences, they seem unlikely to account for an almost four-fold difference in pedestrian mortality.

A compelling partial explanation for Atlantic County’s high pedestrian risk is signaled in the incident characteristics described in Table 1. More than 80% of the fatal crashes in Atlantic City occurred in areas with speed limits 35 miles per hour or above, a speed that has been found to drastically increase the likelihood of a fatal injury when a pedestrian is struck (Ewing and Dumbaugh 2009). Moreover, fully half of the fatal crashes in Atlantic County occurred along two roads: the Black Horse Pike (Route 40/322) and the White Horse Pike (Route 30). As indicated in Figure 2, fatal incidents occurred in locations where these large arterial roads crossed through low-income census tracts. In contrast, Cumberland County lacks large arterial roadways, as the county’s major towns are linked by a web of two-lane country roads. [FIGURE 2 ABOUT HERE]

The spatial patterning of deaths in the two counties suggests the roadway as an important unit of analysis, suggesting further attention to the design of built space, and, by extension, the historical processes that account for the present physical form of Atlantic County’s most dangerous sites for pedestrians. The two roads that account for more than half of Atlantic County’s recent pedestrian fatalities were built during the first automobile-fed wave of suburban expansion, which reached its peak during the 1920s, and exemplify the uncontrolled, incremental process behind many areas of automobile-centered suburban sprawl. The White Horse and Black Horse Pikes were first intended as high-speed conduits to Atlantic City that would both encourage tourism by automobile owning residents of Philadelphia and its suburbs. (Following the success of the White Horse Pike in this regard, the Black Horse Pike was billed as ‘the second White Horse Pike to the shore’ (Maser 2008)). An additional benefit to developers was the potential for the roads to open up acres of southern New Jersey farmland and forest for residential development (Maser 2005).
The function of the two roads shifted after the construction of the Atlantic City Expressway rendered them redundant as conduits to the Jersey Shore. Now used for commercial access, the landscapes of the White Horse and Black Horse Pikes remain focused upon an automobile-owning suburban middle class capable of driving to the stores, service providers, and restaurants distributed in linear fashion along the two roads. Atlantic City Expressway accommodates far more automobiles (i.e. has higher traffic volume) than either of the Pikes, but is a controlled-access highway intended exclusively for high-speed travel over relatively long distances, and thus has no pedestrian activity. In contrast, White Horse and Black Horse Pikes are spaces where automobile-oriented development has supplanted the social and economic functions of dense, walkable commercial centers, offering miles of retail establishments, primarily chain stores, hotels, filling stations and strip malls, connected only by four-lane divided roadways with typical speed limits of 45 to 55 miles per hour. Sidewalks are virtually non-existent and crosswalks infrequent along the two roadways. Although no single developer, government planner or public agency is responsible for the Pikes’ evolution from country road to high-speed arterial roadways lined with commercial buildings, the roads have come to reflect a behavioral program tied to socioeconomic class, manifesting the assumption that users will travel by private motor vehicle. The clustering of pedestrian fatalities on these roadways, far from idiosyncratic or unsociological, points to behavioral imperatives embedded in material design, the legacies not of a coherent vision but of an incremental, path-dependent process of unregulated development.

Following the pattern evident in aging, inner-ring suburbs in the Northeast, this landscape has accommodated a growing population of low-income suburbanites in recent decades. According to American Community Survey estimates for 2007 and Decennial Census estimates for 1990, the census tracts surrounding two particularly dangerous stretches of the White Horse and Black Horse Pikes (where these roadways pass through the towns of Pleasantville and Mays Landing) saw poverty rates increase three-fold and
five-fold, respectively (U.S. Census Bureau 2007; U.S. Census Bureau 1990). Transportation patterns have changed accordingly, as a growing share of residents in these neighborhoods rely on transportation other than private motor vehicle (U.S. Census Bureau 2007; U.S. Census Bureau 1990).

Close inspection of the geographic patterning of fatal accidents suggested areas directly adjacent to shopping centers as particularly dangerous places, and bus stops as focal points of violence. An estimated 24% of the 38 pedestrians killed in Atlantic County during the period of study were killed while walking to a bus stop or immediately after exiting a bus close to a shopping center, a statistic that supports the inference that many of the victims lacked access to a motor vehicle. Heavily represented among the fatalities were service workers: at least eight construction workers were killed in the two counties (none while working), making construction laborers the most common occupational category among male victims. The occupations of the female victims were also largely service sector jobs: casino workers, waitresses, department store cashiers, nursing students, and a post office clerk. In general, medical examiners’ records and obituaries painted a consistent picture of the pedestrians as “working poor” residents employed in low-wage occupations that provided enough income to sustain a residential arrangement in private suburban housing, but not enough to afford a private automobile.

Repeated visits to the Black Horse and White Horse pikes revealed extensive pedestrian traffic occurring in an environment of tangible, physical hostility. Navigating this landscape on foot requires a combination of improvisation and sacrifice. On a humid evening in July, an elderly man carrying a shopping bag reported wearing a white jacket, in spite of the heat, to avoid being hit during his twice-daily trip to the bus stop, a twenty-minute walk down the shoulder of the Black Horse Pike. Such pedestrian activity occurs irrespective of weather conditions or time of day. Another field visit to White Horse Pike in the early twilight of a winter afternoon revealed a team of four hotel maids in uniforms climbing a three-foot tall cement barrier and hurrying across four windswept lanes of
high-speed traffic to move from one place of part-time employment, a budget motel, to another, an auto dealership.

Physical signs testify to attempts to adapt the built environment to pedestrian needs. Several miles from the location where the cleaning women cross the road, the state transportation agency installed a six-foot fence on top of the cement barrier to prevent such crossings, thus reinforcing the behavioral programming of built space in the face of pedestrian noncompliance. At a spot between two distant intersections, someone has cut an irregular opening in the fence with pliers, permitting the author (along with a construction worker walking home from work) to step through the hole and cross from a shopping area on one side of the road to a gas station and convenience store on the other. In the grassy fringes of commercial lots adjacent to the shoulder of the White Horse Pike, pedestrians have worn a dusty path, creating a sidewalk where neither private developers nor state transportation officials have regarded one as necessary.

In general, however, the landscape is resistant to such modification. In most areas along White Horse Pike, pedestrians are denied even these peripheral spaces along the road, and instead occupy the asphalt shoulders of the highway, walking amongst pieces of shredded tire rubber and pieces of broken safety glass and plastic taillight, remnants of the quotidian violence that accompanies high-speed automobile traffic. While formal and informal transportation systems – specifically, several public bus lines as well as informal ride sharing arrangements – permit residents without automobiles to travel safely through many areas of Atlantic County, the built space of these roadways meets pedestrians with near complete inflexibility, forcing users to sacrifice ease of movement, or physical safety, or both.

Indeed, participant observation revealed that the people who move through this landscape on foot experience a recurrent blurring of the boundary between inconvenience and risk. In low-density landscapes, autonomy relies upon private motor vehicle ownership. Workers pay for their lack of this resource in precious time; several clerks at
big box department and hardware stores reported waiting more than an hour before or after a work shift due to the difference between work schedules and the schedules of public bus lines nearby. At a micro-behavioral level, risk may be traded for such inconvenience. When half-a-mile (roughly three-quarters of a kilometer) separates two pedestrian crosswalks, the peril of crossing a divided highway to reach a business or a bus stop on the opposite side is counterbalanced by the distance required to make the crossing safely.

Rich biographical and contextual data gathered through the methods outlined above permitted a more detailed picture of these people and the physical environment they inhabit. The short narratives that I compiled based on the data opened a window onto the interface between economic constraint and built environment that leads to material mismatch and mortal risk. The following narratives are illustrative of observed patterns in the socioeconomic and material conditions that precipitated fatal accidents in the 32 pedestrian deaths in Atlantic County during the period of study. [FIGURE 3 HERE]

Emily Spencer and Juan Rodriguez

During a two-month period in late 2005 and early 2006, two pedestrians were killed in the same short stretch of the Black Horse Pike – a location where four other fatal accidents had occurred between 1998 and 2005. The Black Horse Pike in this location consists of four lanes separated by a wide cement and dirt median. A dimly lit bus stop sits on the eastbound side of the road, which leads to Atlantic City. Directly across the street is the Pleasantville Shopping Center, a medium-sized shopping mall containing a Kmart, a Family Dollar discount store, a Dunkin Donuts and the Asia Supermarket, a grocery store specializing in Chinese and Korean products.

At 7:30 pm on a Saturday in late fall of 2005, Emily Spencer, a 48 year-old cashier at the Kmart, got off work. Spencer lived approximately 10 miles away, in
Galloway Township. By crossing the Black Horse Pike and waiting at the public bus stop across from the shopping center, Spencer could catch a public bus into Pleasantville, where she could connect to another bus to the neighborhood where she lived. Leaving work on the early winter night, Spencer was wearing dark clothes as she attempted to cross the westbound lanes to get to the bus stop. The driver of an SUV with New York plates did not see Spencer and knocked her 100 feet down the road where, according to police reports, she was hit by at least two other vehicles. Spencer was pronounced dead at the scene. [FIGURE 4 ABOUT HERE]

At 6:45 pm on a Tuesday evening approximately 40 days later, Juan Rodriguez, a construction worker by occupation, was crossing the same stretch of road after having dinner at a Mexican restaurant. Rodriguez, 42, had immigrated to the United States from Mexico, obtained citizenship and moved to Atlantic City with his wife, with whom he had children and subsequently separated. The location of the accident suggests that Rodriguez, like Spencer, was trying to get to the Atlantic City-bound bus stop. A 62 year-old male driver from nearby Egg Harbor Township had just passed a green light when Rodriguez attempted to cross the road. The automobile knocked Rodriguez forward and then swerved to avoid striking him a second time, but according to the police report Rodriguez was likely to have died upon impact.

As these brief narratives suggest, Spencer and Rodriguez appear to have had little in common, beyond their use of a stretch of pavement separating retail outlets and restaurants – spaces of employment and consumption – from a public bus stop. The closest crosswalks to the bus stop are several hundred yards in either direction. The speed limit is 45 mph in this stretch of roadway, and street lamps are infrequent. Spencer, Rodriguez, and other pedestrian users of the Blackhorse and Whitehorse Pikes inhabit a landscape that, in its focus on motorized travel, embeds behavioral assumptions related to socioeconomic class in asphalt, concrete and steel. Violating these assumptions is sufficient to bring the human users of this landscape into harm’s way.
Following Gieryn’s (2000) argument that visual evidence is vital to the sociological understanding of place, Figures 3 - 6 present illustrative photographs taken during a field visit in June 2010. These images, representative of the ground-level physical and behavioral environment found along White Horse and Black Horse Pike, show in clearest terms what ecological, cross-sectional analysis cannot. While county-level poverty rates and indices of sprawl increase the risk of pedestrian mortality, they failed to capture a fine-grained spatial patterning of fatal incidents that indicated the roadway as a vector of pedestrian risk. Zooming in further, I found overtly menacing spaces such as those depicted in the photographs; unprotected areas exposed to high-speed traffic that pedestrians do not navigate by choice, but by necessity. In spite of their attempts to adapt the environment to their needs and improvise ways of moving through this landscape safely, but the safest behavior, avoiding the roads completely, comes at a high cost in convenience for low-income residents and workers. A mismatch between the built environment and the needs of these pedestrian users – readily visible in figures 3-6 – turns a necessary and quotidian form of mobility into a high-risk enterprise. [FIGURE 5 HERE]

Conclusion: The Sociospatial Organization of Physical Risk

The findings presented here suggest that risk of accidental injury does not inhere solely in the characteristics of social actors or in the characteristics of their environments, but rather, in the match between the needs of users and a physical landscape embedded with sets of behavioral assumptions. As urban sociologists and theorists working in the field of STS have suggested, buildings, streetscapes and, for that matter, all manners of everyday objects contain and convey implicit models of human behavior (Akrich 1992; Gieryn 2002; Latour 1992). The key insight supported by this study is that moments of socioeconomic or demographic change may produce large-scale disjunction between these assumptions, as manifested in the built environment, and the behavior of current
residents. Although the behavioral presuppositions embedded in the built environment resist observation under normal circumstances, at moments when conflict arises, due to the nonconforming needs and behaviors of some class of residents, they emerge clearly into sight. Indeed, the daily risk of injury faced by residents and workers on Black Horse Pike and White Horse Pike is only understandable in light of the historical programming of those spaces by traffic engineers, planners and architects during the prior century.

This kind of empirical exercise – the investigation and revelation of the societal ramifications of physical environments – is well-traveled ground for scholars who study aging or physical disability. The needs of the elderly, the blind and the physically disabled have often been ignored in the planning of public spaces (Butler and Bowlby 1997; Hahn 1986). Indeed, the recognition that much of the urban built environment presented hardships to physically disabled residents prompted both the Americans with Disabilities Act and a design movement oriented on inclusiveness, universality and flexibility (Goldsmith 1997; Goldsmith 2000). But rarely, if ever, has this insight been applied to socioeconomic class, and never has it been applied at the regional or national level. I have introduced the term material mismatch in order to describe the direct consequences of such situations, which may range from inequitably borne outcomes that are relatively minor, such as temporary confusion or public embarrassment, to the serious public health risk analyzed in this particular study.

Viewing the built environment in this way has clear ramifications for how sociologists understand the determinants of environmental risk. Roadways constructed without pedestrians in mind may present higher levels of risk to low-income residents in much the same way that environmental pollutants emitted by a cement manufacturing plant, a stockyard, or a power station serving an urban community tend to be borne by the politically or economically disempowered (Bullard 1990b; Pastor, Sadd, and Hipp 2001; Schnaiberg and Gould 1994). The ‘politics’ of everyday objects (Winner 1980) – their ability to physically distribute opportunities and constraints – should be central to any
assessment of the sociological impact of architecture, design or planning. This insight, in turn, suggests a possible expansion of the environment justice paradigm to include not just environmental externalities such as air or water pollution, but the behavioral imperatives embedded in design choices and the regulatory contexts that guide these choices. [FIGURE 6 HERE]

The second contribution made by this study is linked to its empirical setting: the declining inner-ring suburbs of the United States, where demographic and economic changes have produced a growing population of suburban poor. In spite of accumulating evidence of suburban economic decline, ground level accounts of low-income suburbs are virtually nonexistent. This study provides a window into the everyday hardship experienced by a population at odds with the built environment. Urban sociology has long been focused on the urban poor and the thriving social life of sidewalks (Duneier and Carter 1999) and other ‘small urban spaces’ (Whyte 1980). As the majority of the country’s poor now live in suburban areas, it will be increasingly important to examine the constraints facing low-income residents of the suburbs. An important part of this task will be to investigate inequalities in access to safe, walkable built space. The enhancement of pedestrian and bicycle infrastructure has become a central component of post-industrial urban growth strategies geared toward attracting and retaining a professional class that has rediscovered the appeal of dense, urban environments. As poverty shifts to the suburbs and wealth continues to flow into gentrifying urban centers, it remains unclear which public authorities or market forces might endeavor to invest in the wellbeing of increasingly impoverished communities outside of urban centers that lack the most basic urban amenity, available in even many low-income city neighborhoods – density. In this context, analysts will have to turn their gaze from the social life of the urban sidewalk to places where there are no sidewalks: a land of strip malls and divided highways, where poverty imposes an entirely different set of issues.
Finally, in practical terms, the results presented here suggest that a new set of challenges face suburban officials and practitioners of suburban design, architecture and planning. The theoretical insights summarized above clearly imply that these actors face political decisions in their choice of a response to the conditions described in this study. One obvious possibility is to rectify material mismatch by using legal or material interventions that reinforce the codes of behavior embedded in suburban design. Fences can be (and often are) erected along cement medians, in order to physically prohibit dangerous street crossings by pedestrians. But such responses only reinforce the institutional and material legacy of a twentieth century transportation regime that linked private automobile ownership with an ostensibly desirable middle-class lifestyle. The incongruences caused by this old regime may require a new ‘mobility regime’ to solve (Sheller 2011). Other material measures by local planners, officials, and engineers, such as the installation of pedestrian overpasses, painted crosswalks and timed traffic signals, seek to ameliorate the consequences of material mismatch by adapting the built environment instead of engineering behavior through legal means. Such measures stand to modify the politics of local artifacts by rendering suburban space more flexible and more inclusive, with an eye toward universality of access and use.
Acknowledgements:

I am indebted to Paul DiMaggio, Harvey Molotch, Hana Shepherd, Doug Massey, Katherine Newman, Alex Murphy and Eric Klinenberg for offering helpful responses to earlier drafts, presentations, or discussions pertaining to this work. All errors are mine. The research presented in this paper was partially funded by the Princeton University Center for Health and Wellbeing.
References


FARS offers a national, annual census of pedestrian deaths, as all traffic fatalities are required by law to be reported by local officials to the federal government. Using the FARS dataset, all pedestrian fatalities (person code = 5) occurring during the period of study were identified and annual fatality counts were generated for each county and each year covered by the analysis. The log pedestrian mortality rate (per 100,000 persons per year) were derived by calculating the mortality rates for each of the years in the period of analysis using county population estimates from the Census Bureau’s annual population estimates program.

The author would also like to thank an anonymous reviewer for suggesting the inclusion of this variable.

Poisson, zero-inflated Poisson and negative binomial regression models were fit as well, using counts of fatalities rather than population-adjusted rates as the outcome variable, and including county population as a control variable measuring exposure. Results (available upon request) were identical in terms of the direction and significance of the key variables of interest. The log mortality rate analysis is presented here because this model does the best job predicting risk among outliers that produced overdispersion and zero-inflation in count-based models.

When two continuous variables are used to construct an interaction term, the effects of constituent terms become virtually meaningless when the interaction is included. For this reason, the lower order effect of sprawl is only of interest when the interaction term is omitted, and even then, its effect is only of passing interest, given the clear significance of the interaction term. Put differently, the interaction term suggests that it is only possible to accurately interpret the effect of sprawl by interacting sprawl with income. (See Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. "Understanding interaction models: Improving empirical analyses." Political analysis 14:63-82. for an insightful discussion of the interpretation of interactions effects.)

Although freely available from public sources, the names of victims have been changed out of respect for the privacy of their families.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Household Size</td>
<td>-.854†</td>
<td>.144</td>
<td>.048</td>
</tr>
<tr>
<td></td>
<td>(.497)</td>
<td>(.531)</td>
<td>(.502)</td>
</tr>
<tr>
<td>Percent Age 65 and Older</td>
<td>.013*</td>
<td>.010†</td>
<td>.008</td>
</tr>
<tr>
<td></td>
<td>(.006)</td>
<td>(.007)</td>
<td>(.007)</td>
</tr>
<tr>
<td>Percent Age 17 and Younger</td>
<td>.046*</td>
<td>.038†</td>
<td>.029</td>
</tr>
<tr>
<td></td>
<td>(.027)</td>
<td>(.027)</td>
<td>(.024)</td>
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<tr>
<td>Percent Black (non-Hispanic)</td>
<td>.015***</td>
<td>.012***</td>
<td>.011***</td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
<td>(.003)</td>
<td>(.003)</td>
</tr>
<tr>
<td>Percent Hispanic</td>
<td>.007†</td>
<td>.005</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>(.005)</td>
<td>(.004)</td>
<td>(.004)</td>
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<tr>
<td>Percent Living in Unincorporated Areas</td>
<td>.434***</td>
<td>.439***</td>
<td>.495***</td>
</tr>
<tr>
<td></td>
<td>(.095)</td>
<td>(.090)</td>
<td>(.104)</td>
</tr>
<tr>
<td>Poverty Rate</td>
<td>1.768***</td>
<td>-.693</td>
<td>-.407</td>
</tr>
<tr>
<td></td>
<td>(.982)</td>
<td>(1.156)</td>
<td>(1.220)</td>
</tr>
<tr>
<td>Suburban Sprawl Index</td>
<td>-.044***</td>
<td>-.010</td>
<td>.056*</td>
</tr>
<tr>
<td></td>
<td>(.014)</td>
<td>(.018)</td>
<td>(.025)</td>
</tr>
<tr>
<td>Log Percent Carless Households (LPCH)</td>
<td>.425***</td>
<td>.038</td>
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</tr>
<tr>
<td></td>
<td>(.105)</td>
<td>(.143)</td>
<td></td>
</tr>
<tr>
<td>Sprawl * LPCH</td>
<td></td>
<td>.037***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.07)</td>
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<tr>
<td>Constant</td>
<td>-.318</td>
<td>-1.176*</td>
<td>-.162</td>
</tr>
<tr>
<td></td>
<td>(.411)</td>
<td>(.600)</td>
<td>(.679)</td>
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</tbody>
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Within-State R²                 | .26     | .27     | .29     |

N = 650 Central Metropolitan Counties.
Dependent variable represents log pedestrian mortality per 100,000 residents per year.
All models control for state-level fixed effects (not shown). Standard errors in parentheses.
† P<.1; * P < .05; ** P<.01; ***P<.001. One-tailed tests of significance.
### Table 2. Pedestrian Mortality: Atlantic and Cumberland Counties, New Jersey, 2005-2008

<table>
<thead>
<tr>
<th>County</th>
<th>Atlantic</th>
<th>Cumberland</th>
<th>New Jersey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty Rate (^a)</td>
<td>9.2</td>
<td>15.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Per Capita Income ($)(^a)</td>
<td>26,140</td>
<td>19,722</td>
<td>31,877</td>
</tr>
<tr>
<td>% Households Without Vehicle</td>
<td>15.5</td>
<td>11.7</td>
<td>11.0</td>
</tr>
<tr>
<td>Sprawl Index</td>
<td>10.1</td>
<td>13.4</td>
<td>9.3</td>
</tr>
<tr>
<td>Pedestrian Fatalities</td>
<td>38</td>
<td>9</td>
<td>556</td>
</tr>
<tr>
<td>Pedestrian Mortality Rate (per 100,000 residents per year)</td>
<td>3.76</td>
<td>1.20</td>
<td>1.48</td>
</tr>
</tbody>
</table>

### Pedestrian (Decedent) Characteristics:\(^b\)

<table>
<thead>
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<th></th>
<th>Atlantic</th>
<th>Cumberland</th>
<th>New Jersey</th>
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</thead>
<tbody>
<tr>
<td>% Age 65 or Above</td>
<td>21.1</td>
<td>11.1</td>
<td>23.9</td>
</tr>
<tr>
<td>% White</td>
<td>84.2</td>
<td>100</td>
<td>27.2</td>
</tr>
<tr>
<td>% Hispanic(^c)</td>
<td>26.3</td>
<td>33.3</td>
<td>-</td>
</tr>
</tbody>
</table>

### Incident Characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Atlantic</th>
<th>Cumberland</th>
<th>New Jersey</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Suspected Drunk Driver(^d)</td>
<td>39.5</td>
<td>77.8</td>
<td>33.7</td>
</tr>
<tr>
<td>% Speed Limit &gt; 35mph</td>
<td>81.6</td>
<td>66.7</td>
<td>52.7</td>
</tr>
<tr>
<td>% Occurring on Top Two Roads</td>
<td>50.0</td>
<td>11.1</td>
<td>-</td>
</tr>
<tr>
<td>% Crosswalk Not Available</td>
<td>44.7</td>
<td>44.4</td>
<td>28.0</td>
</tr>
</tbody>
</table>

\(^a\) American Community Survey, 2006

\(^b\) Pedestrian and incident characteristics drawn from police reports, medical examiners investigation summaries, toxicology and autopsy reports, and newspaper articles, which were corroborated by the analyst through spatial mapping of incidents and site visits. For example, 'Crosswalk Not Available' is a field that reporting officers complete in incident reports, which was corrected or supplemented by the analyst during field visits to the locations of fatal incidents.

\(^c\) Because ethnicity was inconsistently reported in official records and journalistic accounts, Hispanic ethnicity was imputed based on the surname of the decedent.

\(^d\) Police reports and medical examiners reports include a blood alcohol content (BAC) indicator if a BAC test was administered to the driver following the incident, as well as an additional field indicating the reporting officer’s inference of inebriation in cases where a BAC test was not feasible (e.g. in a hit-and-run). In the case data analyzed here, an incident was recorded as involving a suspected drunk driver if either of these indicators suggested that driver intoxication may have been a factor.
Figure 1. Changes in Poverty and Pedestrian Mortality, by Level of Suburban Sprawl: 1995-2010

n = 650 central metropolitan counties

High-sprawl counties scored above the median on the suburban sprawl index calculated by the author.

*Coefficient for high-sprawl counties significant at p<0.05 (one-tailed). Coefficient for low-sprawl counties insignificant.

Data: County-level pedestrian mortality rates (per 100,000 population) from the Fatality Analysis Reporting System (FARS).

Poverty rates for 1995 calculated from the U.S. Census Bureau’s Small Area Income and Poverty Estimates program; poverty rates for 2010 calculated from 2010 Decennial Census.
Figure 2: Pedestrian Fatalities, 2005-2008, Cumberland and Atlantic Counties
Figure 3. White Horse Pike, Atlantic County, New Jersey, 2009
Figure 4. Black Horse Pike, Atlantic County, New Jersey, 2009
Figure 5. Black Horse Pike, Atlantic County, New Jersey, 2010
Figure 6. Black Horse Pike, Atlantic County, New Jersey, 2010