Crime, New Housing, and Housing Incivilities in a First-Ring Suburb: Multilevel Relationships across Time

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Abstract

Concepts deriving from criminology, housing policy, and environmental psychology are integrated to test two ways that housing conditions could relate to crime in a declining first-ring suburb of Salt Lake City. For existing housing, we use a model to test whether housing incivilities, such as litter and unkempt lawns, are associated with later crime. For new housing, we test whether a new subdivision on a former brownfield creates spillover reductions in nearby crime and incivilities.

Police-reported crime rates were highest for residences near the brownfield and lowest for those farther away. After the subdivision was constructed, this linear decline disappeared, reflecting less crime adjacent to the new subdivision, but also more crime farther away. A multilevel analysis shows that incivilities, particularly litter and unkempt lawns on the block, predict unexpected increases in crime. Both brownfield redevelopment and reductions in incivilities may be important ways to improve declining suburban areas.

Keywords: Community development and revitalization; Crime; Urban policy

Introduction

Both large- and small-scale physical conditions may relate to crime and neighborhood viability. Criminology theory emphasizes how small-scale incivilities, such as bad lawns and litter, may invite crime problems later. Housing policy focuses on how large-scale conditions, such as a subdivision of new single-family detached homes, may improve neighborhood appearance and reduce crime. We examine both of these possibilities in the context of a newly constructed subdivision that replaced a brownfield in a declining first-ring suburb of Salt Lake City. We test whether living in a residence that looks unkempt or having block

neighbors who do so relates to future crime risk. Similarly, we examine whether blocks near the brownfield are at greater risk for crime and whether this risk diminishes when the new subdivision is built.

Despite the centrality of the problem of crime and fear of crime for urban residents, few articles discussing urban housing policy have addressed crime (for an exception, see Witte 1996). Yet fear of crime is "probably the biggest obstacle to attracting middle-class households back into declining cities or retaining those that are there now" (Downs 1997, 390). Recent advances in criminology, older concepts in environmental psychology, and current housing policies are converging in a way that might offer urban neighborhoods a two-pronged approach to dealing with crime and fear. Specifically, both the absence of small-scale incivilities on existing residential properties and blocks and the addition of a concentrated new investment in housing to replace a former brownfield are investigated as ways to reduce crime.

The first goal of this article is to describe how incivilities theory relates physical appearances to crime; we adapt this theory from its urban beginnings and apply it to a declining suburban residential context. Next, a rationale for revitalizing neighborhoods by building new middle-class housing in declining neighborhoods is articulated. The potential benefits of both housing production and a reduction in incivilities are tested with a longitudinal naturalistic examination of 58 residential blocks surrounding a brownfield that was later transformed into a subdivision of 84 single-family detached homes.

Incivilities and crime

In the original description of the incivilities thesis, Wilson and Kelling (1982) suggest that a "stable neighborhood of families who care for their homes" (32) can change over months or years to "an inhospitable jungle" (32):

> A piece of property is abandoned, weeds grow up, a window is smashed. Adults stop scolding rowdy children; the children, emboldened, become more rowdy. Families move out, unattached adults move in. Teenagers gather in front of the corner store. The merchant asks them to move; they refuse. Fights occur. Litter accumulates. People start drinking in front of the grocery; in time, an inebriate slumps to the sidewalk and is allowed to sleep it off. Pedestrians are approached by panhandlers. (32)

For some theorists, minor problems such as broken windows can continue to escalate, creating a downward spiral into major consequences,

such as social withdrawal by neighbors, crime, housing abandonment, and business collapse (Skogan 1990; Wilson and Kelling 1982).

Various studies and policies have addressed how problematic physical conditions relate to crime and/or neighborhood decline. Terms used to characterize these minor problems include "incivilities," "disorder," "signs of crime," "cues to danger," and "broken windows," among others (Hale 1996). "Incivilities" and "disorder" are the most commonly used terms. We use "incivilities," which emphasizes how environmental cues can detract from normative appearances. We avoid "disorder" because it often suggests, prematurely, that disorderly social conditions among residents cause the environmental cues. Incivilities may arise from many different conditions, such as overuse of the environment, the presence of very well-ordered gangs, or a variety of resident characteristics, such as old age, poor health, poverty, lack of upkeep skill, lack of time to maintain appearances, or lack of interest in doing so.

Researchers sometimes investigate social incivilities, such as inebriates or unsupervised youth congregating in public areas. Our research, however, will focus on physical incivilities, which include physical evidence of decay, decline, or poor upkeep. Such incivilities can be temporary and fairly easy to remove, such as litter, or more enduring and difficult or expensive to improve, such as sagging roofs. Physical incivilities are more amenable to community development and housing interventions and less episodic than the presence of particular individuals.

The most publicized use of incivilities theory is to enact policing campaigns to curb minor problems, such as subway graffiti, in hopes of preventing major crime, fear, and decline (Kelling and Coles 1996). Sometimes police campaigns to reduce incivility have included controversial actions, such as overeager enforcement of minor crime ordinances. Our research does not deal with any of these policies, but concentrates instead on the effects of physical incivilities on crime. Although housing and community development professionals do not typically use the term "incivilities," we believe that reducing them is central to the efforts of many housing construction, rehabilitation, maintenance, and neighborhood revitalization efforts and that it constitutes a high priority among residents. Consequently, if physical incivilities relate to crime, policies to deal with them should go beyond policing to involve housing and zoning officials, community development professionals, neighborhood leaders, and residents. We believe this to be particularly true for suburban incivilities, which may differ from urban incivilities in cause and effects.

Urban incivilities

Although the dramatic transformation to neighborhood jungles portrayed by Wilson and Kelling (1982) may occur, their vignette involves distinctly urban conditions. Most notably, the spiral of decline they described takes root on public land near abandoned or commercial properties that may not exist in more suburban areas. Research confirms that public spaces are associated with incivilities such as vandalism and litter (Sampson and Raudenbush 1999; Sampson, Raudenbush, and Earls 1997), as well as police service calls (Kurtz, Koons, and Taylor 1998).

Incivilities may be more likely and troublesome on public or commercial property for a number of reasons. First, such properties are designed and managed to attract a wide variety of users, including those who may commit crimes (Cohen and Felson 1979). In addition, many users simply can erode a place more quickly (Kurtz, Koons, and Taylor 1998; Taylor et al. 1995). Although pedestrian and vehicular traffic can be good for businesses, it can also impede local informal caretakers from creating a network of mutual concern and recognition that may prevent crime (Appleyard and Lintell 1972; Brown and Altman 1981).

Second, as suggested by Wilson and Kellings' (1982) vignette, certain public or commercial properties can invite trouble. Alcohol sales, which involve the risk factors of ready cash flow and uninhibited drinkers, can invite crime (Roncek and Bell 1981; Roncek and Pravatiner 1989). Further, schools, which draw youths of crime-prone age, are also associated with higher levels of crime (Roncek and Faggiani 1985). Finally, storefronts, particularly abandoned ones, are related to litter, graffiti, and vandalism (Kurtz, Koons, and Taylor 1998). In sum, certain types of nonresidential properties have been implicated in greater vulnerability to crime (Kurtz, Koons, and Taylor 1998). Thus, converging lines of evidence suggest that incivilities associated with more urban and commercial areas may invite crime, but few studies examine the effects of incivilities in more private residential contexts.

Suburban incivilities and place attachment

Suburban homes, by contrast, have been studied as venues for territorial personalization or upkeep, with these processes serving largely positive social and psychological functions. Consider lawn maintenance, for example. Our neighbors who live in the high desert struggle to make Kentucky bluegrass flourish. Suburban lawns are important icons

symbolizing high neighborhood standards of upkeep as well as pride in place (Altman and Chemers 1980; Jackson 1985). When residents of poor neighborhoods can create well-tended landscapes, they also feel greater neighborhood safety (Kuo, Bacaicoa, and Sullivan 1998) and neighborhood commitment (Coley, Kuo, and Sullivan 1997), while also reducing crime (Kuo, Bacaicoa, and Sullivan 1998). In addition, personalization can signal cultural or ethnic group membership and pride of place (Arreola 1981; Greenbaum and Greenbaum 1981). Research demonstrates that residential personalization can create positive messages about individual and group identity and psychological and behavioral investment in the home and neighborhood.

Although personalization of suburban homes is a common technique for creating and conveying positive ties to place, few studies examine how incivilities in suburban areas might create or reflect more negative qualities. Of the 12 incivilities studies reviewed by Ross and Mirowsky (1999), for example, only one (Taylor and Hale 1986) included unkempt lawns as an important indicator. Graffiti and vandalism may exist in the suburbs as well as in urban areas, but unkempt lawns and homes in disrepair may constitute more pervasive and salient incivilities in the suburbs. Beyond unkempt lawns, these incivilities include peeling paint, sagging roofs, sidewalks in disrepair, litter, graffiti, broken windows or lights, and the absence of gardens. We will track both the levels and effects of suburban incivilities to see whether they predict future crime.

It is also important to assess the social psychological processes that might underlie incivilities and risk of crime in residential environments. One relevant process is place attachment, the positive affective, cognitive, and behavioral bonding with places and people associated with a setting (Brown and Perkins 1992). Place attachment may relate directly or indirectly to risk of crime in a number of ways. Residents with greater attachments may be more vigilant territorial guardians of their own and neighboring properties. Those with strong attachments to home may also spend more time there (Fuhrer, Kaiser, and Hartig 1993), becoming more effective guardians against crime. When residents alter their properties as an expression of pride and attachment, the alterations, such as fences or shrubs (Brown and Altman 1983; Taylor, Gottfredson, and Brower 1984) or address or name markers (Brown and Altman 1983), have been associated with a lower risk of crime. Place attachment may help inspire residents to mobilize against community crime problems, such as abandonment of property by landlords (Saegert 1989). Personalization and upkeep of home and yard can create occasions for neighborhood interaction and elicit or reinforce bonds

of neighborly cohesion or watchfulness (Brown 1987; Brown and Werner 1985; Werner, Peterson-Lewis, and Brown 1989).

Both resident activity and environmental upkeep send messages to potential offenders that the residence is well guarded and cared for. Indeed burglars can infer, just by looking at a house, whether residents have neighbors who would react to the burglar's presence; if so, the house is judged to be a poor target (Brown and Bentley 1993). Similarly, lay observers can detect, by looking at photographs of homes, which residents have strong place attachments to their home or block (Harris and Brown 1996). Finally, place attachment and observed incivilities were associated with lower risk of subsequent crime in the target neighborhood five years ago (Brown, Perkins, and Brown 2004); this merits a follow-up longitudinal investigation.

Measurement of incivilities and crime-related consequences

Unlike most other studies of incivilities, this one focuses on how levels of physical incivilities noted by trained observers can predict subsequent official crime reports to the police. These measures are chosen because they are conceptually central to an incivilities theory, methodologically sound, and of great interest to community development and housing officials. All theories assume that troublesome incivilities start with their actual presence in the environment, yet most empirical studies focus on "perceived incivilities," that is, resident reports. In many studies, residents who report more incivilities in their neighborhoods also report more fear of crime (see the studies cited by Hale 1996, Perkins and Taylor 1996, and Taylor 1999b). In a few studies, residents who report more incivilities in their neighborhoods also report more crime victimization (Borooah and Carcach 1997; Rountree, Land, and Miethe 1994; Skogan 1990, for robbery).

Residents' perceptions. Although residents' perceptions were initially believed to be valid indicators of incivilities in the environment (Skogan 1990), subsequent research has shown that this is not always true. Especially at the individual level, resident perceptions of incivilities are only modestly related to ratings of neighborhood conditions by trained observers (McGuire 1997; Perkins et al. 1993). Nevertheless, perceived and observed incivilities independently predict fear of crime (Box, Hale, and Andrews 1988; Covington and Taylor 1991), so both measures could be distinct but useful indicators of crime-related problems. Taylor and colleagues believe that residents with heightened environmental reactivity or proneness to complain might express those qualities by

perceiving more incivilities and reporting more crime problems than their neighbors (Covington and Taylor 1991; Taylor 1997a, 1999b). Also, the common practice of asking about incivilities and crime in the same interview does not allow researchers to determine whether perceived incivilities precede crime. In our research, we overcome both weaknesses: We assess observed incivilities by using trained raters, and we rely on police reports of crimes occurring after interviews with residents. Of the two forms of police reports—initial calls for service and final reports—we chose the latter, which indicate that the police agree that there is evidence of a crime. They therefore represent a measure with some convergence across resident and police assessments of crime.

Observed incivilities and police reports of crime. The few studies that include both observed incivilities and reports of crime deserve special review, given their relevance to neighborhood policies on incivilities and housing conditions. Across 66 Baltimore neighborhoods, observed neighborhood decay, nonresidential uses of land, and vacancies all correlated with an index of serious crime reports (Taylor, Shumaker, and Gottfredson 1985). Neighborhood incivilities observed on Chicago streets and sidewalks can predict increases in robbery and homicide, but not burglary (Sampson and Raudenbush 1999); observed incivilities in Baltimore predict increased homicides, but not robbery, assault, or rape (Taylor 2001). Observed litter on residential blocks relates to an index of quality-of-life crimes (drug dealing, harassment), but not serious crimes (Perkins et al. 1993). Graffiti and litter on public areas of inner-city Philadelphia blocks relate to robbery and an index of quality of life crimes, but not six other types of crime. Vandalism was related to three types of police reports (service calls, burglary, and physical incivility crimes), but not five others (Kurtz, Koons, and Taylor 1998). These results demonstrate some relationship between physical incivilities and official crime reports, particularly in large crime-prone cities and for crime indexes rather than single crimes. However, these results do not give enough attention to inner-suburban areas, which are threatened with decline in many areas of the country (Orfield 2002).

In sum, our study tests whether observed physical incivilities and residents' expressed place attachments predict police-reported crime in a declining first-ring suburb of Salt Lake City. An earlier multilevel study of the same blocks indicated that block-level attachments to home reported by residents and block- and property-level housing incivilities observed by raters were both associated with crime (Brown, Perkins, and Brown 2004); the present study allows a longitudinal test of whether earlier block conditions predict later crime.

The block and home as units of analysis

In choosing the units of analysis for a study of incivilities, Taylor and colleagues (Perkins and Taylor 1996; Taylor 1988, 1997b; Taylor, Gottfredson, and Brower 1984) have argued that street blocks are important natural units for the social, environmental, and psychological processes relevant to community development and crime prevention. Compared with more distant neighbors, neighbors on the same block are most likely to develop commitments to the block on the basis of simple repeated exposure to one another, casual surveillance of people and property, and shared norms relating to appearances and permitted activities. Blocks also have different patterns of stability, design, land use, and traffic, which can affect resident behavior and sentiment (Taylor 1997b). Housing conditions on one's own property and on surrounding properties on the block, rather than more distant conditions in the neighborhood, might be especially important in terms of signals to encourage mutual upkeep (Quercia and Galster 1999). Finally, if blocks vary in risk of crime, then prevention efforts could be targeted block by block, in keeping with the capacities and philosophy of many local community development agencies.

We believe that criminals do not randomly pick sites on a block to victimize, but rather use physical appearances to select properties that look least protected by residents or their neighbors (Brown and Altman 1981). Consequently, we will examine how incivilities could make individual properties more subject to crime. According to past research, burglars pick targets that look less personalized than neighboring houses (Brown and Altman 1983) and places where they believe neighbors will not act as guardians of the property (Brown and Bentley 1993). Indeed, recent research has begun to focus on crime "hot spots," which can be particularly crime-prone buildings or parts of blocks (Eck 1997). Thus, unlike other studies of incivilities in public spaces (Kurtz, Koons, and Taylor 1998; Sampson and Raudenbush 1999), we examine the effects of incivilities on private properties.

A focus on individual properties is also apt because suburban incivilities are especially likely to result from resident action or inaction. In more urban settings, incivilities appeared as a result of outside forces, not internal neighborhood dynamics. For example, incivilities have been attributed to panhandlers or inebriates frequenting corner stores (Wilson and Kelling 1982) or absentee landlords neglecting their large rental properties (Saegert 1989). In the suburban context, we predict that residents with more physical incivilities on their property or less attachment to their homes may be more at risk of crime. Hierarchical linear models (HLMs) will be used to provide appropriate and separate

tests for individual- and block-level predictors of household crime victimization.

Crime and housing construction on brownfields

If small-scale incivilities predict crime, can large-scale improvements and removal of incivilities reduce crime? If so, current housing policies may provide a tool for larger neighborhood crime prevention. Current policies to improve urban neighborhoods are driven by the idea that concentration of poverty is harmful, but they offer different deconcentration strategies. One option is to support poor people's moves to wealthier neighborhoods. Moving to Opportunity (or Section 8 vouchers or scattered site public housing) are expected to help residents gain not only better housing, but also neighborhoods with better job opportunities, education, and other benefits (Rosenbaum 1997). However, building new housing for poor people in good neighborhoods typically invites objections from neighbors over such issues as traffic, housing and site design, and growth (Pendall 1999). Indeed, new affordable housing, if built in large numbers, can sometimes drag down the value of nearby property (Galster, Tatian, and Smith 1999). For these and other reasons, cities may have limited opportunities to improve neighborhood quality by giving poor people the ability to profit from the better opportunities provided by wealthier neighborhoods.

A different approach is to attract wealthier people into poorer neighborhoods by constructing good-quality housing. The HOPE VI program replaces severely distressed public housing developments with lower-density, mixed-income housing that, when designed and built in the right circumstances, attracts middle-income residents. HOPE VI redevelopment has been criticized because it does not mandate a one-for-one replacement of public housing units. Consequently, a better strategy would be to provide new housing that produces a net increase in the housing supply.

Reclaiming vacant or contaminated brownfields for housing can avoid displacing former residents. In a New Jersey study of 100 brownfields, for example, most were near residential areas, and their redevelopment into housing could provide 6 percent to 29 percent of the area's five-year housing demand (Greenberg et al. 2001). The United States has over 500,000 brownfields, many of which could be remediated for housing or other types of redevelopment (Haughey 2001). Under the Homeownership Zone program, incentives were provided to developers willing to build housing on formerly vacant or blighted land, often brownfields with contamination from defunct industries. This program

helped fund site preparation and construction of large housing developments, identified in the policy as 300 units or more (U.S. Department of Housing and Urban Development [HUD] 1996). Other federal, state, and city policies also help redevelop neglected sites through land donation, liability reduction, tax increment financing, and other mechanisms (Haughey 2001; U.S. Environmental Protection Agency 2000). These strategies may elicit less neighborhood resistance than building in existing residential areas, given that they lead to visible improvements in areas that had been abandoned or contaminated.

We examine a brownfield remediation that provided new housing without displacing current residents. The target neighborhood was an older, declining inner suburb west of downtown Salt Lake City. Although single-family detached homes predominated, rental conversions, poverty, and ethnic diversity increased between the 1980 and 1990 censuses. The new 84-unit subdivision replaced an abandoned school with a crumbling parking lot, a defunct florist/nursery, and a garbage-strewn field. To attract a private developer, a HUD demonstration grant was used to take care of environmental cleanup (from pesticide contamination by the former floral property and building contaminants from the razed school), floodplain mitigation, and infrastructure (new roads, sewers, etc.). The resulting homes are identical to middle-income subdivisions provided by the same builder in other neighborhoods. Although the city hoped to attract middle-income residents, special loans were also available to enable at least 20 percent of the buyers to have lower incomes (80 percent or less of the area median income).

Those who study neighborhood revitalization hope that such visible neighborhood improvements inspire "incumbent upgrading," the improvement of private properties by residents who do not receive direct benefits from revitalization (Clay 1983). The theory is that residents see improvements and believe that their new neighbors will care about appearances. They will also feel better about staying in the neighborhood and investing their own money in needed maintenance or property improvement. However, Varady (1986) found that scattered-site rehabilitation did not inspire surrounding residents to improve their own properties, although he speculated that more concentrated efforts, such as a new subdivision, might have more beneficial spillover results for the neighborhood. Some research does indicate that more concentrated efforts in the form of new housing construction can elevate nearby property values (i.e., from one block to 1,000 feet away—Ellen et al. 2001; Lee, Culhane, and Wachter 1999; Simons, Quercia, and Maric 1998).

Other studies involve high-profile demonstration projects, such as the South Bronx or Baltimore's Sandtown-Winchester neighborhoods,

where over $60 million in investment and many social services were funneled into neighborhood revitalization in the first year of a multi-year effort (Goetz 1997; Schorr 1997). These studies often focus on important outcomes such as housing production numbers or increased property values, but omit other important outcomes, such as spillover reduction of incivilities and crime.

Although the target subdivision in our study was strongly supported by the leaders of the community council, a larger random survey of residents (Brown and Perkins 2002) showed that few believed it would reduce crime and many believed it would entail some costs to the neighborhood. Over half (52 percent) thought it would have no effect on area crime rates, and fully 36 percent thought it would increase them. Moreover, many believed the new development would increase housing costs (70 percent) and property taxes (73 percent), and most (70 percent) thought it would increase traffic. If residents do benefit from spillover reductions in crime, greater awareness of this benefit among housing professionals could ease negotiations with suspicious neighborhoods.

On the basis of an extension and adaptation of an incivilities theory, we hypothesized that if new housing is sold successfully, it can reduce crime and incivilities. A new subdivision represents the reverse of what is typically encountered in incivilities research. Here is an infusion of a large-scale "civility," new and attractive homes replacing a neighborhood eyesore. The new residents may have higher incomes than other in-movers to the neighborhood, providing human resources to oppose decline. An area that had been hidden from surveillance by residents is now populated with resident guardians; both features have been implicated in preventing crime (Brown and Altman 1981; Newman 1972). If the new development removes an area where offenders had been free to gather, then this should decrease crime, especially for residents immediately surrounding the former vacuum in social control. In past research, spillover benefits from incumbent upgrading or new housing construction have been limited to a few blocks away. Logically, replacing vacant and abandoned properties with homeowners who want to assert control over their neighborhood should benefit the area closest to the intervention, if there is any spillover at all. Thus, we will examine whether there is an initial linear decline in incivilities and crime as distance from the blighted brownfield increases, a decline that disappears when the area is replaced by the new subdivision.

Finally, few studies have examined whether incivilities continue to plague the same neighborhood over time. Some suggest that incivilities inspire clean-up campaigns so that high levels at one time can be followed by lower levels years later (Kelling and Coles 1996). Others are

more pessimistic, noting that incivilities can beget more incivilities (Skogan 1990). Alternatively, potentially ephemeral incivilities, such as litter, might change more over time than sagging roofs or other indicators of long-term decay (Ross and Mirowsky 1999). Before creating housing or crime programs to deal with incivilities, it is important to track natural levels of them over time.

In sum, our study addresses the following questions:

1. Do the new residents elevate the socioeconomic profile of the area?

2. Given the five-year lag between two assessments of incivilities, do the incidences change over time in a neighborhood that had been experiencing decline?

3. Does crime decrease for residents near a new housing revitalization site?

4. Do incivilities and place attachments predict later police-reported crime?

5. Do incivilities at Time 1 (the first assessment) and unexpected changes in incivilities from Time 1 to Time 2 (the second assessment) predict subsequent increases in crime? How do effects differ for individual- and block-level factors?

Methods

Neighborhood context

The site is undergoing gradual decline, which makes it compelling for a study of incivilities and crime. Various researchers have suggested or found that incivilities are especially important for crime-related outcomes in neighborhoods facing moderate levels of problems (Taub, Taylor, and Dunham 1984; Taylor and Shumaker 1990; Taylor, Shumaker, and Gottfredson 1985; Wilson and Kelling 1982). The target neighborhood has one of the worst reputations for, and reports of, crime in Salt Lake City. Census data from 1970 to 1990 indicate that household incomes in this area have decreased from $26,000 to $19,000 (in constant 1989 dollars), despite a city average that remained stable at about $29,000. The census block groups have an (unweighted) average of 29.43 percent poverty, compared with 16.4 percent citywide (Salt Lake City Corporation 1993); research suggests that the negative effects of concentrated poverty occur in areas with at least a 20 percent poverty level (South and Crowder 1997).

An increase in ethnic diversity in the area involves young families, because school enrollment figures show that 42 percent of the student body consists of ethnic or racial minorities (Salt Lake City Corporation 1994), compared with about 35 percent for the population at large. Although single-family detached homes comprise the majority of the housing stock, owner occupancy decreased from 68 percent in 1980 to 56.6 percent in 1990. In sum, the area resembles a classic neighborhood in transition, with more transient housing conditions and lower-income residents, reflecting the presence of long-term residents as well as the influx of younger, ethnically diverse families.

Sample selection

Given the focus on detecting spillover benefits from the new subdivision, sampling was designed to choose representative blocks at varied distances from the site, but within the same neighborhood boundaries. The sample neighborhood involves nine census block groups comprising parts of three tracts; the block groups are contiguous and largely bounded by major roads or freeways. Eligible blocks were defined as those with between 10 and 100 residential properties (thereby excluding blocks with too few residences for data analyses and excluding three blocks with large rental complexes on the arterial edge). Next, 55 sample blocks (with 1 more added to total 56 at Time 2) were randomly chosen with a probability proportionate to size procedure. In addition, to achieve a large enough sample near the brownfield, four blocks were oversampled at random from those located within two blocks of the site. These oversampled residences do not differ from surrounding ones on any of the variables chosen for this study, so all data are combined.[1] Individual properties were selected on chosen blocks by starting with the lowest address, then selecting every third residence until there were at least eight. Although 59 blocks were assessed at Time 1, police report data were missing for one of them, so 58 Time 1 blocks are included. The Time 2 follow-up study did not constitute a panel, given the change in resident populations over the years and the expansion of data collection at Time 2.

[1] Bonferonni corrected *t*-tests for differences revealed that nearby oversampled residents favored less public tax money spent on neighborhood road improvements than others (see analysis and additional methodological details in Brown and Perkins 2002). These results may reflect the fact that road building for the new subdivision had begun midway through the interviews.

Data collection procedures

Environmental inventories of properties at Time 1 (1993) preceded Time 1 resident surveys (1994 to 1995) and Time 1 police reports of crime (1995 to 1996). Then at Time 2, environmental inventories were repeated (1998), followed by Time 2 resident surveys (1998 to 1999) and Time 3 crime (1999 to 2000).

Environmental inventories. The environmental assessment measured physical signs of decay or improvement visible on a total of 488 residential properties at Time 1 and 901 at Time 2. Environmental inventories were completed by trained raters before the resident surveys, with at least 8 properties per block assessed at Time 1 and, ideally, at least 12 per block at Time 2. (Because of some limited block sizes and mergers, between 9 and 19 properties per block were actually assessed at Time 2.) Incivilities associated with homes included poor roof conditions and peeling paint, poor yard maintenance, and evidence of graffiti and litter (adapted from reliably rated inventories by Brown and Altman 1983; Perkins et al. 1993; and Perkins, Meeks, and Taylor 1992). Pairs of raters assessed a subset of the properties (365 at Time 1 and 201 at Time 2), with acceptably high inter-rater reliabilities ranging from 0.70 to 0.93 at Time 1 and 0.92 to 1.00 at Time 2.

Survey administration. At Time 1 (in 1994 and 1995), at least five residents were interviewed on most blocks (one block had 3 interviews and three blocks had 4), for a total of 357 interviews, representing a 72.71 percent response rate. At Time 2, at least 7 interviews were completed per block, yielding 617 interviews; of 930 initial contacts for interviews, 13.65 percent refused and 16.76 percent were unresolved (no one at home after eight or more attempts to contact or no English or Spanish spoken). Also, 2 interviews were unintentional repeats and were dropped. Thus, 86.35 percent of English or Spanish speakers contacted provided interviews, and 69.59 percent of all addresses contacted yielded interviews. Purchased telephone lists proved inadequate, so telephone interviews were supplemented by at-home, in-person interviews. The adult who had the most recent birthday was selected for the interview (O'Rourke and Blair 1983). Spanish and English versions of the approximately 25-minute interview addressed perceptions of neighborhood social fabric, crime problems, and physical conditions, and awareness of ongoing city revitalization plans.

Measures

Home attachment. Place attachment can be measured for many different geographic levels, from rooms in a home to cities. However,

residents' home attachments, including expressions of pride in the home and its exterior appearance, are the most relevant aspect when research concerns physical incivilities on private properties. A 3-item composite assessed how proud residents are of their house, the way their front yard looks, and the way the exterior of their house looks (adapted from Brown and Werner 1985; coefficient alpha = 0.88 for Time 1 and 0.90 for Time 2).[2]

Home incivilities. An 8-item composite included objectively observed amounts of litter; graffiti; broken windows or lights; peeling paint; roofs, lawns, and sidewalks in poor condition; and the absence of a flower or vegetable garden (coefficient alpha = 0.69 for Time 1 and 0.62 for Time 2).

Perceived incivilities/crime. In a 10-item composite, residents indicate whether the block has had any vacant homes/buildings, neighbors who do not keep up their property, a house or place where the resident suspects that drug dealing occurs, burglarized houses, street robberies or assaults, or evidence of gang activity in the past 12 months. Residents also rated, on a 10-point scale, the degree to which their block had experienced problems with graffiti, loud neighbors, traffic, and loose or stray dogs and cats in the past 12 months (adapted from LaGrange, Ferraro, and Supancic 1992; Taylor and Hale 1986) (coefficient alpha = 0.73 for Time 1 and 0.72 for Time 2).

Homeownership and other variables. A number of social and demographic variables, including homeownership, gender, age, income, racial/ethnic identity, marital status, household size, religious affiliation, type of housing, and years of residence, were collected.

Police reports of crime. Following procedures used at Time 1 (Brown, Perkins, and Brown 2004), all final crime reports were tracked for each sample address after the interview was complete and until 9 months after the end of the Time 1 interviews or 12 months after the Time 2 interviews (Time 3). Crime was coded into four categories: No crime (55.5 percent for Time 1 and 55.8 percent for Time 3), 1 occurrence (20.0 percent for Time 1 and 22.7 percent for Time 3), 2 to 3 occurrences (14.3 percent for Time 1 and 13.9 percent for Time 3), and 4 or more occurrences (10.2 percent for Time 1 and 7.6 percent for Time 3). Because the time between the environmental assessment or interview and the final date for the police report data varied, the reports were divided by the number of months after the interview to compute a

[2] Cronbach's coefficient alpha is a measure of internal consistency that varies from 0 to 1, with higher scores indicating greater consistency.

crime rate measure, which ranged from 0 to 0.33 crime reports per month. The measure was log-transformed for the multivariate analyses.

To test Level 2 (block-level) variables with HLM, the above composites were simply aggregated to block means. This is appropriate for HLM because the variance predicted at each level is a separate pool.

Results

Strategy of analysis

The analyses proceed in four phases. First, we describe the new subdivision residents. Second, we examine physical incivilities and other characteristics of the neighborhood before and after the new construction and at varying distances from it. Third, we assess distance-by-time interactions to see whether the new housing was related to reductions in nearby crime and incivilities. Fourth, we test longitudinal linkages between individual- and block-level incivilities and crime, using data where incivilities are assessed for the same address at both times.

Who moved in? The major attraction of the new subdivision was its affordability. As part of a separate study (Brown, Brown, and Perkins 2004), 56 of the 84 new households were interviewed, and 96 percent said that affordability was a reason for moving in. Although the city had earmarked 20 percent of homes as affordable units, fully 55 percent of the residents reported getting some form of second loan assistance, and 41 percent said that the availability of such loans was one reason they moved in. We compared the new subdivision residents with those moving into the surrounding neighborhood at the same time to understand the type of residents the neighborhood would attract without the special brownfield conversion program. New residents to the subdivision had higher household incomes, with 61 percent reporting more than $43,000 (1997) dollars, compared with only 9 percent of other recent arrivals. Married couples comprised 77 percent of the new subdivision residents, compared with only 41 percent of newcomers to the surrounding neighborhood. Although 60 percent of both subdivision residents and other newcomers were non-Hispanic whites, Asians were the predominant minority for the subdivision (24 percent Asians and 13 percent Hispanics), while Hispanics were the predominant minority for the surrounding neighborhood (2 percent Asian and 24 percent Hispanic). Thus, the housing was all sold, and the subdivision attracted higher-income residents.

Are incivilities correlated over time? Despite the fact that incivilities can involve very changeable features, incivilities do show some stability from 1993 to 1998, as shown in table 1. The composite (8-item) measure of incivilities is correlated over time, at both the individual property ($r = 0.43$) and aggregated block levels ($r = 0.61$). All incivilities observed at the same address are correlated significantly, but modestly, over time (from $r = 0.12$ to $r = 0.30$). For data aggregated to the block level, five of the eight incivilities are correlated over time: litter, absence of a garden, peeling paint, unkempt lawns, and graffiti, with the latter three showing substantial correlations (from $r = 0.57$ to $r = 0.65$). Therefore, even though physical conditions have the potential to change greatly over time, some potentially quite dynamic variables (such as graffiti) showed substantial stability, while others (such as roof conditions) did not. Given that problems may persist for the same blocks, it is important to examine the consequences of incivilities.

Table 1. **Physical Incivilities: Means, Standard Deviations, and Correlations over Time**

		Time 1		Time 2		Simple *r*: Time 1 to Time 2	
Variables	Scoring	Mean	Standard Deviation	Mean	Standard Deviation	Property Level	Block Level
Housing incivilities	Mean of 8 items (z)	0.00	0.56	0.00	0.53	0.43***	0.61***
Roof	0 = new; 1 = average, 2 = needs repair	1.00	0.50	0.95	0.51	0.16***	0.13
Litter	Number of pieces	1.56	2.54	0.63	1.32	0.16***	0.28**
Peeling paint	1 = 10%, 10 = 100%	1.34	1.86	0.85	1.57	0.24***	0.57***
Graffiti	0 = no, 1 = yes	0.02	0.14	0.02	0.15	0.23***	0.65***
Broken windows	0 = no, 1 = yes	0.13	0.34	0.18	0.38	0.13***	0.15
Cracked brick/walk	0 = no, 1 = yes	0.71	0.46	0.71	0.46	0.12***	0.05
Poor lawn condition	0 = no, 1 = yes	0.27	0.45	0.25	0.43	0.30***	0.62***
Garden	0 = no, 1 = yes	0.59	0.49	0.55	0.50	0.29***	0.35***

*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

Time-by-distance effects

Do incivilities vary near the new subdivision? Data on physical distances from the new housing site were coded into six 1,000-foot increments (except for the last category, which involved distances from 5,001 to 7,000 feet). Qualities of the six zones surrounding the new site are summarized for both resident and housing characteristics in tables 2 and 3, respectively. These tables show both main effects for distance from the new housing (zones 1 through 6) and time (before or after the new housing was built), as well as interactions between distance and time (see the final column).

Figure 1 shows that incivilities were highest in the three zones closest to the brownfield and lowest in the three that were farthest away (based on z-score transformations). At Time 2, observed incivilities were still highest in the three zones closest to the new housing and lowest farther away, but the effect was not as strong as it was at Time 1. For example, the second row of table 2 shows that incivilities yielded a main effect for distance, tempered by a significant distance-by-time interaction, both of which are illustrated in figure 1. The pattern is

Figure 1. **Observed Incivilities by Time by Distance from New Housing**

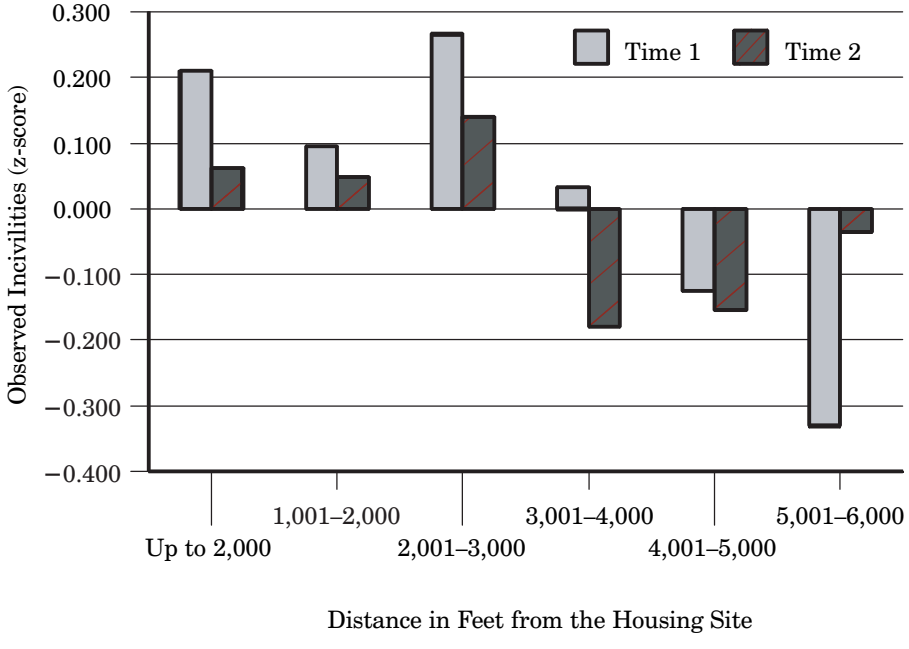


Table 2. **Area Characteristics by Distance to New Subdivision and Time: Means and Analyses of Variance**

		Distance (in 1,000-foot Increments)									
		Up to 1,000	1,001–2,000	2,001–3,000	3,001–4,000	4,001–5,000	5,001–7,000		*F* Values		
Variable	Time	(N=164)	(N=294)	(N=269)	(N=282)	(N=279)	(N=127)	Total	Distance	Time	Distance by Time
Police reports/month	1	0.07	0.05	0.06	0.05	0.04	0.02	0.05	3.42***	0.50	1.33
	2	0.06	0.05	0.07	0.04	0.05	0.05	0.05			
Incivilities (z)	1	0.21	0.10	0.27	0.03	−0.12	−0.33	0.06	17.15***	2.02	3.96***
	2	0.06	0.05	0.14	−0.18	−0.15	−0.03	−0.03			
Income (z)	1	−0.15	0.09	−0.06	0.32	−0.34	0.05	0.00	4.01***	0.21	1.08
	2	−0.02	−0.09	−0.09	0.18	−0.10	0.22	0.00			
Resident age	1	49.91	47.22	47.69	41.57	49.10	46.63	46.82	1.43	6.95***	0.75
	2	43.72	43.18	44.71	42.84	44.30	42.80	43.64			
Household size	1	3.13	3.05	3.15	4.00	2.76	3.04	3.21	3.61***	2.66	1.54
	2	3.17	3.63	3.41	3.58	3.16	3.48	3.42			
Years of residence	1	14.02	17.41	12.93	11.03	14.44	19.19	14.45	0.71	1.94	2.63**
	2	13.15	11.38	13.85	15.63	11.63	14.14	13.21			
Percent homeowner	1	64	72	68	74	66	93	71	0.79	0.19	2.25**
	2	75	77	73	76	78	66	75			
Percent non-Hispanic white	1	63	63	72	63	75	93	69	3.54***	5.41***	0.74
	2	63	53	65	64	62	74	62			
Percent Latter-Day Saints religion	1	53	43	49	29	52	70	46	2.92**	13.26**	2.15
	2	41	34	31	37	34	42	36			
Percent married	1	60	46	53	67	44	63	54	2.42**	0.57	1.69
	2	40	53	57	55	49	65	53			
Percent female	1	64	58	59	69	58	69	62	0.17	0.44	1.65
	2	65	73	66	63	69	54	66			
Percent single-family detached houses	1	91	89	87	99	76	93	89	3.73***	3.74	1.28
	2	80	89	82	90	82	83	85			

*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

Table 3. **Specific Housing Conditions by Distance to New Subdivision and Time: Means and Analyses of Variance**

Variable	Time	Distance in Feet from the Housing Site: Up to 1,000	1,001–2,000	2,001–3,000	3,001–4,000	4,001–5,000	5,001–7,000	Total	*F* tests and Significance Levels: Distance	Time	Distance by Time
Roof (new = 0, needs repair = 2)	1	1.09	1.06	1.06	0.94	0.97	0.75	1.00	4.57	0.97	1.69
	2	0.92	0.98	1.05	0.86	0.97	0.92	0.95			
Litter (number of pieces)	1	1.82	1.53	2.84	1.40	0.59	0.65	1.56	15.06**	53.88***	11.27***
	2	1.39	0.62	0.56	0.46	0.40	0.70	0.63			
Peeling paint (10 percent increments)	1	2.05	1.29	1.94	1.29	0.84	0.23	1.34	15.63***	17.60***	3.75***
	2	1.04	1.13	1.34	0.54	0.40	0.74	0.85			
Graffiti (number of pieces)	1	0.02	0.02	0.03	0.03	0.00	0.03	0.02	2.11	0.23	1.02
	2	0.04	0.04	0.05	0.01	0.00	0.01	0.02			
Broken windows/lights present	1	0.16	0.16	0.12	0.11	0.16	0.03	0.13	1.39	8.12***	1.87
	2	0.27	0.15	0.20	0.14	0.14	0.21	0.18			
Cracked brick/walk present	1	0.73	0.74	0.75	0.76	0.66	0.45	0.71	2.90**	0.88	4.96***
	2	0.57	0.70	0.81	0.68	0.68	0.80	0.71			
Poor lawn present	1	0.35	0.30	0.39	0.23	0.15	0.20	0.27	7.77***	0.34	0.65
	2	0.33	0.27	0.35	0.15	0.20	0.22	0.25			
Garden present	1	0.48	0.57	0.53	0.59	0.65	0.83	0.59	7.84***	4.09**	3.09**
	2	0.53	0.38	0.45	0.67	0.65	0.60	0.55			

*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

that incivilities are higher near the new housing site and lower farther away, but especially at Time 1, when the site was a brownfield with abandoned buildings. A similar pattern appears with homeownership. Levels varied from 64 percent to 93 percent at Time 1, with higher levels of homeownership farther from the brownfield, but later homeownership leveled out, hovering at about 75 percent across blocks at Time 2.

This pattern of interaction appears consistent across the neighborhood, including the specific physical incivilities listed in table 3. Whether years of residence, number of pieces of litter on the property, peeling paint, or the presence of gardens are examined, significant interactions generally reveal greater variability across blocks at Time 1 than at Time 2. Furthermore, worse conditions—more litter, more peeling paint, more cracked bricks or sidewalks, and fewer gardens—tend to occur in the three zones closest to the brownfield at Time 1.

HLM model specification. Bryk and Raudenbush (1992) urge researchers to use both conceptual and empirical guidance to create HLM models that are as simple as possible, without omitting important variables. For both conceptual and empirical reasons, homeownership was included as a control variable in the cross-sectional analysis from data gathered at Time 1 (Brown, Perkins, and Brown 2004) and continued to be an important predictor at Time 2. Some researchers presume that resident age indexes vulnerability and is therefore important to control for in studies of crime (Bursik and Grasmick 1993). Although not significant at Time 1, the correlations in appendix A (table A.1) and early HLM model-building results demonstrate that resident age should also be a control variable. The selection of an intact neighborhood provides a control for other sources of potential variability. Additional control variables unrelated to crime include income, race (non-Hispanic whites versus others), marital status (married or not married), religious affiliation (Church of Jesus Christ of Latter-Day Saints or not), gender, and single-family detached housing style.[3]

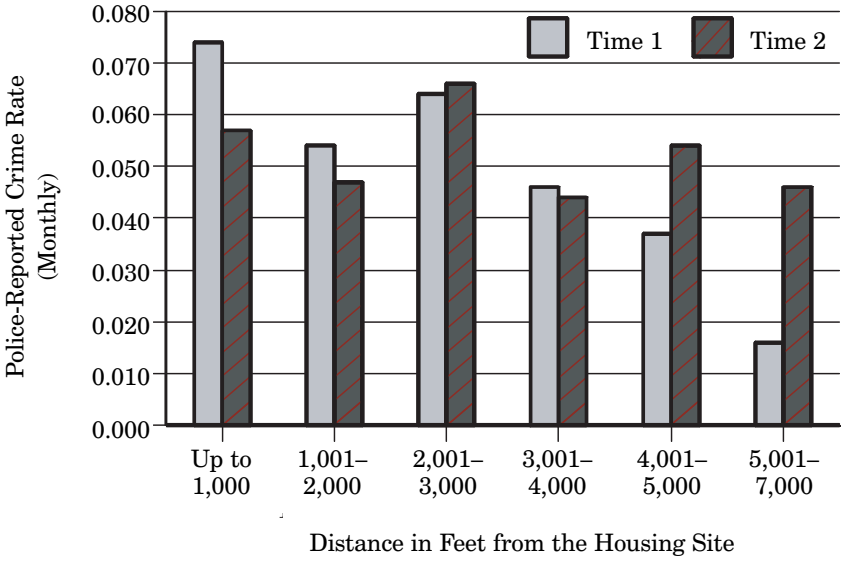
[3] When resident age and homeownership are controlled, other potential controls become insignificant. Although years of residence also had an $r = -0.15$ to crime, this effect reduced to $r = -0.03$ after controlling for homeownership. Of the two variables, homeownership was chosen as a control because of its higher correlation with crime. Household size was the only potential control variable still (positively) correlated with crime, after partialling resident age and homeownership ($r = 0.07$, $p = 0.04$). However, the subsequent HLM model was computed with and without this control variable; following Bryk and Raudenbush's (1992) criteria for dropping nonsignificant variables, household size can be dropped from the analysis. To be cautious, analyses were also run with individual- and block-level race (non-Hispanic white versus other) and income as controls, given that they are frequently used as controls in studies of diverse neighborhoods (Bursik 1988). However, block and individual race and income were insignificant

A first step in HLM is to determine whether crime varies across blocks, thereby justifying the need for HLM. This test (termed a test of the unconditional model) shows that blocks differ significantly in crime, with 14.06 percent, a significant amount, indicated as between-block variance: combined Time 1 and Time 2 data, χ^2 (57) = 275.53, $p < 0.001$.

New subdivision effects. If spillover benefits from the new subdivision occur, they are expected to be very geographically circumscribed (Ginsberg 1982). Statistically, spillover benefits would constitute a significant time-by-distance interaction effect (computed from standardized time and distance scores). That is, the residents near the new subdivision would benefit, with extra reductions in incivilities and/or crime, over and above any changes occurring farther away in the surrounding neighborhood.

The interaction between time and distance from the new subdivision, when entered alone into the equation, is significant: t (approximate df, 945) = 2.38, $p = 0.017$. Figure 2 shows that at Time 1, crime reports

Figure 2. **Police-Reported Crime by Time by Distance from New Housing**



when added to the model (all $p > 0.25$), and deviance statistics indicated that the variables did not improve model fit: χ^2 (4) = 2.37, $p > 0.5$. These variables are likely to have more explanatory power when studies sample across diverse neighborhoods instead of involving a single intact neighborhood.

were highest near the brownfield and lowest farther away. For example, crime rates less than 1,000 feet from the brownfield were 0.074 per month, but those farthest away (5,001 to 7,000 feet) were 0.016. At Time 2, crime rates were more equal across the entire neighborhood. In the zone closest to the new subdivision, crime rates had decreased to 0.057, and in the farthest zone, they had increased to 0.046 final reports per month. The linear decrease in crime with greater distance from the site was significant at Time 1 [$F(1, 343) = 11.62, p = 0.001$] and not significant at Time 2 ($F < 1$).

The next model, summarized in table 4, enters appropriate demographic controls (resident age and homeownership), as well as the observed incivilities and home attachments that were significant at Time 1. Significant individual Level 1 predictors show that younger residents ($p = 0.001$) and those who do not own their homes ($p = 0.006$) are more susceptible to subsequent crime. Properties with more observed incivilities also tended to have more subsequent crime ($p = 0.053$).[4] When these other predictors are entered into the equation, the time-by-distance interaction term maintains its statistical significance ($p = 0.026$). This combination of Level 1 predictors explained

Table 4. **Predicting Crime: Hierarchical Linear Models, Combined across Time 1 to Time 3**

Fixed Effects	Coefficient	Standard Error	*T*-ratio	*df*	*p* Value
Intercept, γ00	0.021417	0.0011	19.00	54	0.001
Level 2 (street block)					
Residents' ages, γ03	0.000305	0.0002	1.79	54	0.078
Home incivilities, γ01	0.017059	0.0049	3.47	54	0.001
Home attachment, γ02	−0.006874	0.0038	−1.81	54	0.075
Level 1 (individuals)					
Age, γ30	−0.000134	0.0001	−3.38	962	0.001
Homeowner, γ20	−0.004920	0.0018	−2.76	962	0.006
Home incivilities, γ10	0.003087	0.0016	1.93	962	0.053
Time × distance, γ40	0.001267	0.0006	2.22	962	0.026
Random Effects	**Standard Deviation**	**Variance Component**	***df***	**χ^2**	***p* value**
Intercept, U0	0.0070	0.00005	46.00	184.74	0.001
Level 1, *R*	0.0231	0.00053			

[4] Although observed incivilities were significant, resident reports of perceived incivilities were not. Perceived incivilities were not significant when added to or substituted for observed incivilities, so they were dropped from further analyses. There was some block-level correlation between the two measures ($r = 0.31$ at Time 1 and $r = 0.41$ at Time 2), indicating that observed incivilities are more likely to be present when many neighbors, not just one resident, say they are present.

a significant amount of variance over the unconditional model: χ^2 (4) = 47.43, $p < 0.0001$.

At the block level, higher average resident ages tended to go with more crime ($p = 0.078$). Residents were also more likely to experience crime if their block had more observed incivilities ($p = 0.001$) or if their neighbors had lower levels of attachment to the homes on the block ($p = 0.075$). These block-level predictors explained significantly more variance than the Level 1 predictors alone—χ^2 (3) = 26.05, $p < 0.001$. The combination of variables explains 3.64 percent of the variance between individuals within blocks and 44.44 percent of the variance between blocks.

However, these results are strongly influenced by the data collected at Time 1. If we reanalyze using only Time 2 data (deleting the time-by-distance interaction term), only individual-level resident age ($p = 0.001$) is significant, and the explained variability decreases to 3.02 percent and 11.32 percent at the individual and block levels, respectively. Thus, as the neighborhood changed over time and the distribution of both incivilities and crimes became more diffuse instead of concentrated, the ability of physical incivilities and home attachments to predict subsequent crime decreased.

Longitudinal predictions of crime from observed incivilities

Analysis strategy

To move to a more longitudinal focus on observed incivilities, the next tests incorporate a different data set structured to combine Time 1 and Time 2 data into one case for each address. Instead of testing just the incivilities composite, two promising specific, observed incivilities were also examined. Few studies of inner-ring incivilities have been conducted, so it is useful to highlight those specific incivilities that are especially significant in this context.

In addition, we conduct longitudinal tests, not just on the absolute levels of Time 3 crime, but on scores representing crime increases over earlier levels. These are residualized change scores, developed from removing the part of Time 3 crime that could be predicted from pre-existing amounts of crime at Time 1, following procedures similar to Bursik (1986), Taylor and Covington (1993), and Taylor (2001). The case that incivilities cause crime is strengthened when the ones that are assessed relate to unexpected increases in crime.

Longitudinal effects: Incivilities, lawn conditions, and litter predicting crime and increases in crime over time

For the incivilities composite, poor lawn conditions, and litter, we tested three models to answer different questions. Measures include block and individual scores on incivilities (1993) and crime (1995 to 1996) at Time 1, incivilities at Time 2 (1998), and crime at Time 3 (1999 to 2000). Results are shown in figures 3 through 5 (see also a summary of HLM specifications in appendix B and tests summarized in table B.1).

Model A: Do physical incivilities on a resident's property or block (at Time 2) predict crime risk (at Time 3)? This question is addressed in the bulk of incivilities and crime research, but does not introduce more demanding controls for changing patterns of crime.

Model B: Do physical incivilities on a resident's property or block (at Time 2) predict increasing crime risks (from Time 1 to Time 3)? This tests whether incivilities are high in areas experiencing increases in crime, but results do not indicate whether the incivilities or the crime increased first.

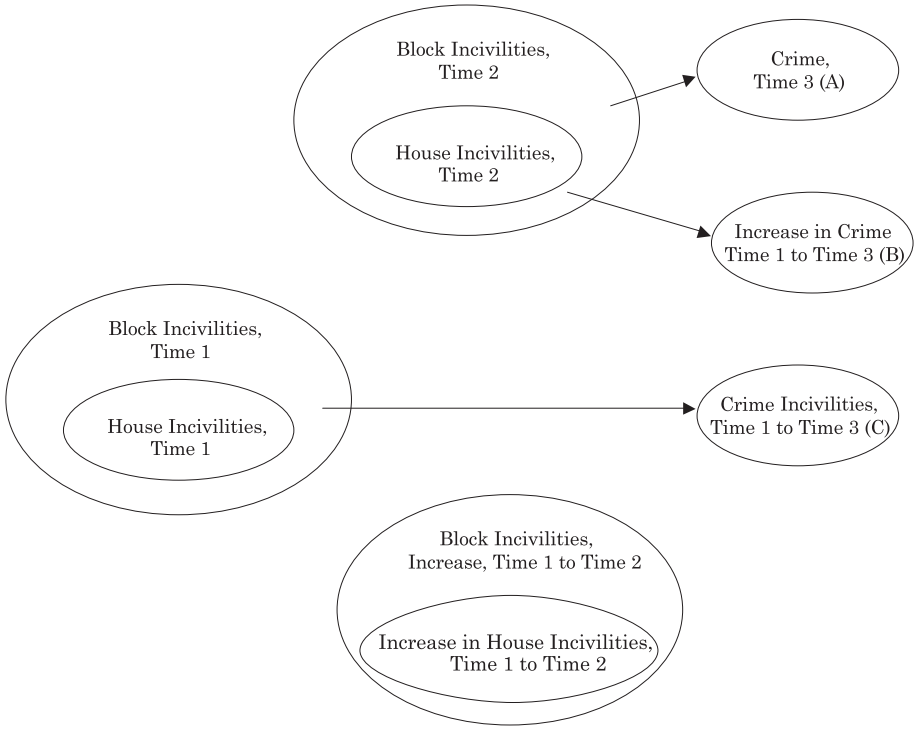
Model C: Do early (Time 1) or increasing levels (Time 1 to 2) of physical incivilities on a resident's property or block predict increasing risk of crime (from Time 1 to Time 3)? If increases in incivilities and crime go together, these related changes may reflect some pre-existing neighborhood quality. If incivilities precede crime and increases in crime, they are more likely to cause it.

Incivilities and crime. As shown in figure 3, the Time 2 block-level incivilities composite predicts subsequent Time 3 crime rates (Model A, $p = 0.001$). When controlling for earlier Time 1 crime levels, Time 2 block-level incivilities predict unexpected increases in crime at that address (Time 1 to Time 3; Model B, $p = 0.023$). Finally, more Time 1 block incivilities predict greater unexpected increases in property-level crime (Time 1 to Time 3; Model C, $p = 0.078$), demonstrating that high levels of incivilities precede the increases.[5]

Unkempt lawns and crime. As shown in figure 4, similar patterns of effects occur for the individual incivility of an unkempt lawn. Time 2 blocks with more unkempt lawns predict more Time 3 crime (Model A, $p = 0.001$). Unkempt lawns on Time 2 blocks (Model B, $p = 0.001$)

[5] All Model C tests were rerun with Time 1 crime as a control, and no changes in significance level were observed.

Figure 3. **Significant Relationships between Incivilities and Crime (Models A through C)**

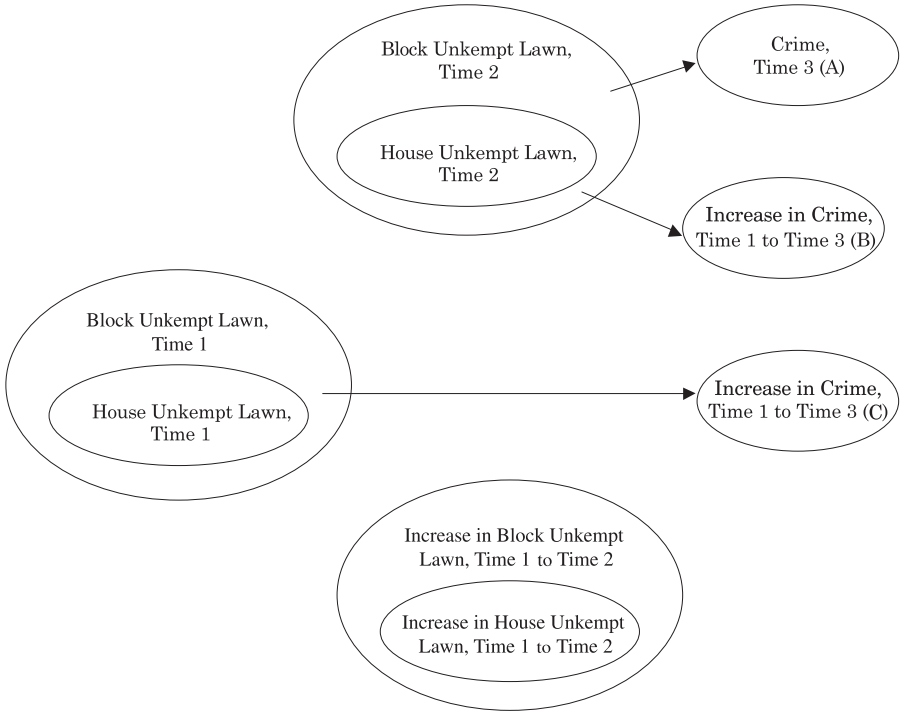


A. Arrows represent significant relationships between incivilities and crime, without controls for prior crime.
B. Arrows represent significant relationships between Time 2 (1998) incivilities and unexpected increases in crime (1999 to 2000), controlling for earlier crime (1994 to 1995).
C. Arrows represent significant relationships between Time 1 (1993) incivilities and unexpected increases in crime (1994 to 2000), controlling for earlier crime (1994 to 1995). Arrows represent significant relationships between increases in incivilities (1993 to 1998) and increases in crime (1994 to 2000).

predict unexpected increases in crime (Time 1 to Time 3). Longitudinally, Time 1 blocks with poor lawns predict unexpected increases in crime (Time 1 to Time 3; Model C, $p = 0.025$).

Litter and crime. As shown in figure 5, relationships between litter and crime were the most significant. Time 2 blocks and individual properties with more litter had more Time 3 crime (Model A, $p = 0.001$ and $p = 0.001$, respectively). Time 2 blocks with more litter also showed unexpected increases in crime (Time 1 to Time 3; Model B, $p = 0.068$);

Figure 4. **Longitudinal Relationships between Unkempt Lawns and Crime**



A. Arrows represent significant relationships between incivilities and crime, without controls for prior crime.
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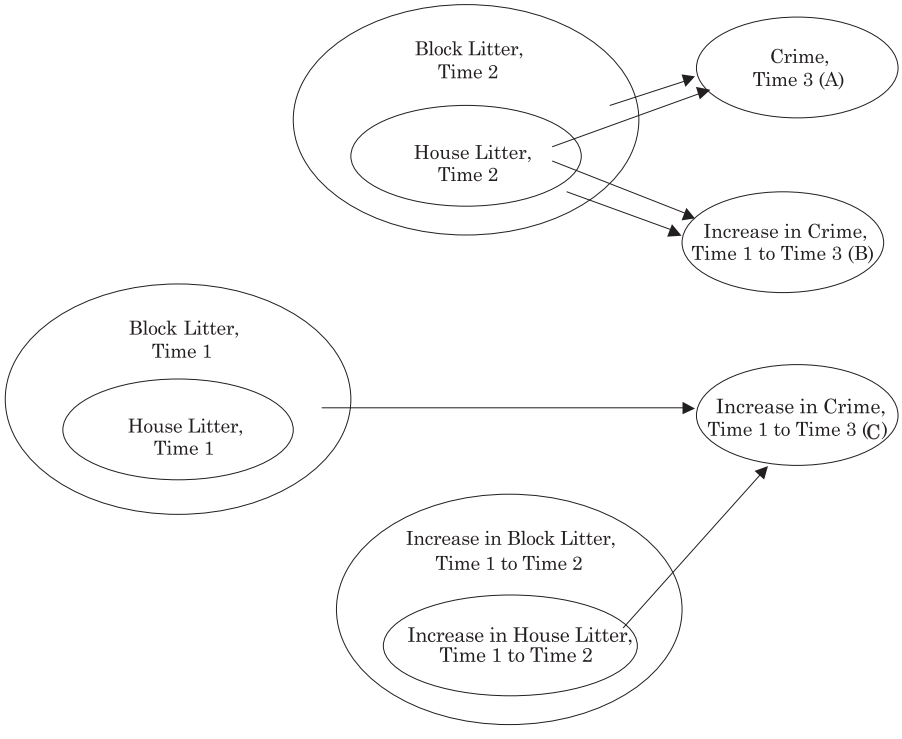
C. Arrows represent significant relationships between Time 1 (1993) incivilities and unexpected increases in crime (1994 to 2000), controlling for earlier crime (1994 to 1995). Arrows represent significant relationships between increases in incivilities (1993 to 1998) and increases in crime (1994 to 2000).

Time 2 individual properties with more litter had unexpected increases in crime as well (Time 1 to Time 3; $p = 0.001$). Time 1 blocks with more litter predict unexpected increases in property-level crime (Time 1 to Time 3; Model C, $p = 0.016$). In addition, individual properties that saw unexpected increases in litter also showed unexpected increases in crime ($p = 0.001$). Once again, high levels of litter relate to crime, even with the more demanding test demonstrating that high levels of litter precede increases in crime.

In sum, observed incivilities are significant predictors of crime in four of six cases when earlier levels of crime were not controlled (Model A).

Figure 5. **Longitudinal Relationships between Litter and Crime**



A. Arrows represent significant relationships between incivilities and crime, without controls for prior crime.
B. Arrows represent significant relationships between Time 2 (1998) incivilities and unexpected increases in crime (1999 to 2000), controlling for earlier crime (1994 to 1995).
C. Arrows represent significant relationships between Time 1 (1993) incivilities and unexpected increases in crime (1994 to 2000), controlling for earlier crime (1994 to 1995). Arrows represent significant relationships between increases in incivilities (1993 to 1998) and increases in crime (1994 to 2000).

When we introduce controls for earlier levels of crime (Model B), high levels of 1998 incivilities predict more unexpected increases in crime (from Time 1, 1995 to 1996, to Time 3, 1999 to 2000) for four of six cases. There is little evidence that incivilities and crime undergo similar dynamic changes—only increases in house levels of litter go with unexpected increases in crime (the only one of six dynamic relationships that is significant in Model C). But pre-existing levels of incivilities do predict later unexpected increases in crime. Block levels of all three measures of incivilities in 1993 (Time 1) predict later unexpected increases in crime from Time 2 (1995 to 1996) to Time 3 (1999 to 2000); individual property levels of incivilities in 1993 do not.

Discussion

Both lower levels of incivilities and the presence of a new housing subdivision nearby were related to lower risk of crime for residents. The new housing was also related to fewer incivilities on nearby blocks. The value of attending to housing conditions on existing inner-suburban blocks threatened by decline and the value of investing in new housing are underscored in these analyses. Both these small- and large-scale strategies deserve attention from policy makers as ways to foster better conditions and lower crime in neighborhoods.

The new subdivision also provided an array of benefits aside from any spillover effects to the rest of the neighborhood. First, no residents were displaced to build these houses. Second, because existing houses are small and not of historic interest, gentrifying pressures have not taken hold here as they have in other parts of the city with Victorian housing stock. Third, the new subdivision provided more housing than anticipated to residents eligible for special loans, but at the same time lifted the average income levels of in-movers. Because of rising prices, fully 55 percent of new households qualified for second loans, surpassing the goal of 20 percent initially set by the city. Without special programs to provide new housing, it is likely that area incomes would continue to decline.

Residents of the new subdivision also reported place attachments as strong as those of the long-term residents of the surrounding area and stronger than those of newcomers to the surrounding area (Brown, Brown, and Perkins 2004). Consequently, although initially attracted primarily by affordability, the new residents help diversify neighborhood incomes and appear to be satisfied with their homes. Although these are worthy benefits, this research has focused on whether the housing could also create spillover benefits of reducing crime and incivilities for the surrounding neighbors, many of whom doubted that any reduction in crime would occur.

Incivilities and crime

Results support hypothesized relationships between incivilities and crime. Incivilities observed at one address, and particularly those on block neighbors' properties, increase the likelihood of unexpected increases in police-reported crime at that address. Even mundane incivilities, such as a poorly kept lawn or litter, predict greater vulnerability to crime. If a dwelling has these qualities, the resident is more vulnerable to crime. If neighbors' homes, collectively on the block,

have more of these qualities than other blocks, the resident is also vulnerable to future crime.

About one-fourth of the lawns were rated as being in poor condition at both Time 1 and Time 2. However, despite this kind of stability, a resident who lived on a block where lawns got unexpectedly worse over time was more vulnerable to crime. These effects are in addition to the general vulnerability to subsequent crime found for residents whose lawn or whose neighbors' lawns are in poor condition.

The number of pieces of litter observed in front of respondent homes decreased by more than half from Time 1 to Time 2 (from 1.56 to 0.63 pieces). Both individual and block levels of litter at Time 2, block levels of litter at Time 1, and unexpected increases in individual property litter from Time 1 to Time 2 predict later vulnerability to crime. In this geographic area, lawns do not thrive and require frequent attention. Similarly, litter is easy to deposit and may require vigilance to remove. Both litter and lawns can be sensitive barometers of residents' (or landlords') investment in preserving neighborhood appearance.

These results show that our ideas about incivilities can be broadened to include more suburban indicators that might be less meaningful in urban settings, where lawns are infrequent and small. There, poor lawns may be less noticeable; in suburban neighborhoods, where lawns are numerous and large, they take on more symbolic freight. These results are in keeping with research on territorial personalization that reveals how suburban residents use the physical environment in a variety of ways that convey positive messages about their identities as individuals and as members of the block (Brown 1987; Werner, Peterson-Lewis, and Brown 1989).

In past research, in a much higher-income neighborhood in Salt Lake City, even personalized name plates and address markers, which police caution against using, were associated with less risk of burglary (Brown and Altman 1983). In riskier neighborhoods, more or different visual demarcation of a property may be needed to create symbolic messages strong enough to deter prospective offenders (Brower, Dockett, and Taylor 1983). Efforts to combat incivilities and create more civil places can draw on the long, rich history of territorial personalization research. Residential pride of ownership and maintenance of territories are widespread and can provide a neighborhood resource for mobilizing efforts to clean up incivilities. Although there are cultural differences in territorial personalization, general concerns for property maintenance may provide enough common ground to enable residents of diversifying neighborhoods to work together toward shared goals.

Yard care and clean-up are actions that residents often undertake spontaneously and direct solely to their own properties. Yet programs could be developed to extend these benefits of pride of place to the block or neighborhood. Some research has identified indigenous "place managers," small shopkeepers or apartment managers who assume control over places and their informal policing. These individuals provide a valuable service, and their efforts have been reinforced by police in ways that decrease physical incivilities and increase civil behavior (Mazerolle, Kadleck, and Roehl 1998); perhaps place managers can be cultivated in more suburban areas as well. Alternatively, policies aimed at property improvements (code enforcement, evictions) have been linked to safer and better-maintained residential areas (Meier 1983). Such policies may enable residents concerned about block appearances to be more involved with improvements. If they are provided with the proper improvement tools and policies, these residents might inspire broader neighborhood revitalization efforts.

Because maintenance activities are ongoing, they may provide an enduring and positive basis for programs to encourage neighborhood social organization, place attachment, or collective efficacy (Sampson, Raudenbush, and Earls 1997). Such programs may be especially important because formal crime prevention programs such as Neighborhood Watch have limited effectiveness (Sherman et al. 1997). Neighborhood clean-ups, home or garden tours, community gardens, and home repair classes may be an effective way to encourage both a reduction in incivilities and an increase in common bonds between neighbors. The resulting social cohesion or collective efficacy may itself protect against fear (Ross and Jang 2000), crime (Sampson, Raudenbush, and Earls 1997), and decline (Taub, Taylor, and Dunham 1984).

New housing, incivilities, and crime

If the absence of incivilities on one's block signals protection from crime, does the addition of a new subdivision reduce nearby incivilities and crime? Although it is impossible to rule out other reasons for the pattern observed, the results are consistent with the theory that the new housing lowered both crime and observed incivilities in nearby blocks.

Spillover benefits of brownfield conversion to housing may be even greater in other settings. In Boston, for example, commercial garbage disposal crews had dumped literally mountains of garbage on abandoned brownfields targeted for housing development (Medoff and Sklar 1994). The abandoned Salt Lake City site had scattered litter, broken

glass, and weeds in the parking lots, but was not as devastated as the Boston site. New construction programs that provide even more housing may have stronger effects, especially when they replace larger and more deteriorated sites (see Ellen et al. 2001 for the effects of larger projects on property values).

However, the results are not completely positive, given that both crime and incivilities rose in the blocks farthest away from the new subdivision (about 4,000 to 7,000 feet away). It is not clear whether this pattern should be treated as displacement of crime or newly generated crime. If data collection had stopped at 3,000 feet from the subdivision, the conclusion would have been more positive—a reduction in problems within 1,000 feet of the subdivision and no increases between 1,000 and 3,000 feet away. But it is not clear how to interpret the increases in the outer rings away from the intervention site. The rings that experienced increases in crime did not have large abandoned sites that could easily substitute for the abandoned brownfield. Further, an examination of the distant blocks that recorded increases in crime shows that they are located in a variety of directions from the new housing. It is not clear how crime displacement can be conceived as radiating from one particular site to a variety of distant sites. In addition, the most distant ring experienced a reduction in homeownership, which generally protects from crime. Therefore, although the data cannot disprove the possibility of displacement, it seems less plausible than alternative explanations (less homeownership, higher incivilities) and the geographic dispersion of the increase.

Another possibility is that those who moved into the new subdivision left the more distant rings, destabilizing the edge. We find this unlikely for several reasons. First, it is difficult to imagine why residents would move from only those locations to the new housing and not move from closer areas as well. Second, a study of 56 of the 84 new households (see Brown, Brown, and Perkins 2004) shows that 73 percent had been renters, whereas most of our sample were homeowners. In addition, only 30 percent moved to the new subdivision to be close to family or friends, and 39 percent moved from somewhere beyond Salt Lake City. Therefore, it is unlikely that many new residents relocated from the more distant ring. Decreased homeownership and other changes in the distant ring appear to reflect causes other than the new subdivision.

Another question is why the physical incivilities and attachments of residents were more powerful in predicting crime at Time 1 than at Time 2. Because physical incivilities showed less geographic variability at Time 2, the ability to predict crime may have decreased as the neighborhood became more homogeneous with respect to incivilities.

Another possibility, always present in field studies, is that incivilities and attachment represent some third unmeasured variable, but to explain their diminishing importance, that third variable would need to change its relationships with incivilities over time. Alternatively, perhaps the decline of incivilities over time might account for their diminished importance. Given a higher level of incivilities at Time 1 than at Time 2, perhaps they were above some threshold that enhanced their ability to predict crime.

Similarly, place attachment, as a residential strength, may be more important under worse physical conditions in protecting against crime. Wilson and Kelling (1982) suggested that incivilities would best predict crime in declining neighborhoods. Studies indeed demonstrate a stronger impact of incivilities on fear in moderately stable neighborhoods (Taylor, Shumaker, and Gottfredson 1985) and lower impacts in neighborhoods with high levels of incivilities (Taylor and Shumaker 1990). Thus, researchers may want to determine whether a certain level of incivilities has an effect on the link between incivilities and crime or the operation of protective factors (such as place attachment or collective efficacy).

Our results constitute useful extensions of past research on incivilities because they involve a different setting. Salt Lake City is not a large, old city in the East or Midwest; much of the housing in the target neighborhood was constructed after World War II. Thus, our research establishes that first-ring suburbs may have unique problems and possibilities for links among incivilities, housing, and crime or crime prevention. The area is also different from a social standpoint: Many other studies involve neighborhoods with a large percentage of black residents. Here, they constitute less than 2 percent of the state and the sample—therefore, a small percentage of the population. Black neighborhoods may have a unique heritage arising from decades of extreme structural inequality, segregation, and discrimination (Massey and Denton 1993). (Hispanics and Asian Americans are the prevalent ethnic minorities in the neighborhood.)

Finally, compared with studies in Chicago that found less of a role for incivilities (Sampson and Raudenbush 1999), our study measured incivilities on private property, where environmental psychology suggests that their symbolic effects are especially potent. Finally, most studies of incivilities examine neighborhood- or block-level vulnerability to crime. Environmental criminology and our results link incivilities to crime at the individual property level and to vulnerability as well. Additional studies of a variety of declining suburbs are needed to establish the generality of links we observed between incivilities and crime in this neighborhood.

To the extent that incivilities in suburban neighborhoods are a problem, it will likely worsen over time. According to a recent poll, most urban and design professionals believe that the decline of the first-ring, post–World War II suburbs will become a major problem in urban areas in the 21st century (Fishman 2000). Post–World War II houses were often very small, too small to attract today's home buyers. They were also constructed of materials that will require much upgrading at this point in their usable life span. Similarly, problems such as crime, which used to be seen as an exclusively central-city phenomenon, are being exported to the suburbs (Baldassare 1992). Consequently, both the places and the people of aging suburban areas deserve greater research attention.

Another feature that distinguishes our study from many others is the targeting of one neighborhood. Perhaps the easiest way for a researcher to demonstrate the effects of incivilities is to sample widely and to include both wealthier and poorer neighborhoods. Results will generally show more decay, incivilities, and crime in the poorer parts of town. However, the policy implications of such findings are not politically feasible—calls to redistribute wealth or compel wealthier neighborhoods to accept their fair share of affordable housing will likely have a limited impact. However, when it can be demonstrated that incivilities make a difference block-by-block in demographically similar neighborhoods, then intervention possibilities may be more manageable. These results confirm Taylor's (1997b) arguments that blocks are important intervention units for revitalization because improvement or decline can happen block-by-block. Indeed, block effects were consistently more powerful than individual effects. Interventions may need to address macro-level neighborhood threats, such as deindustrialization or disinvestment, and more micro-level block and property threats, such as incivilities, to be effective.

Simple recognition of variability within neighborhoods may enable housing officials, police, and others to capitalize on opportunities to target interventions at blocks. Although some cities have designated "municipal beat officers" (Kennedy 1996) or "beat health officers" (Mazerolle, Kadleck, and Roehl 1998) to deal with abandoned houses or other incivilities, we believe that other organizations beyond the police may be effective as well. For example, community development corporations have had lengthy experience with improving neighborhood physical conditions and may have good relationships with local residents. The challenge may lie in finding any organization that can cross old service and professional boundaries to provide comprehensive neighborhood improvements with respect to crime, housing conditions, and other problems (Schorr 1997).

Our study of suburban incivilities shows that the actual features in the physical environment, not just residents' perceptions of those features, are important predictors of crime. Although no field study can rule out all threats to validity, our study found that physical incivilities, observed by trained raters and controlling for earlier levels of crime, predict later police-reported crime rates. These results were obtained despite a seven-year lag between the first assessments of incivilities and the later assessments of crime. Similarly, after a new subdivision was built, surrounding blocks experienced a decline in nearby crime and incivilities. Thus, incivilities and improvements are real in both physical form and consequences and suggest that future housing policies should examine consequences for crime.

Appendix A

Table A.1. **Simple and Partial Correlations: Level 1 Combined (Time 1 and Time 2) Data Set**

Variable	N	1	2	3	4	5	6	7	1
1. Crime	967	1.00							
2. Observed incivilities	941	0.19***	1.00	0.05	−0.28***	0.03			0.14***
3. Distance by time	967	0.07**	0.06**	1.00	0.02	−0.01			0.07**
4. Attachment	966	−0.12***	−0.33***	0.01	1.00	−0.16***			−0.07**
5. Perceived incivilities	967	0.02	0.05	−0.01	−0.18***	1.00			0.00
6. Homeowner	957	−0.18***	−0.20***	−0.05	0.27***	−0.06	1.00		
7. Age	955	−0.15***	−0.22***	0.02	0.19***	−0.09***	0.28***	1.00	
8. Income (z)	846	0.00	−0.13***	0.03	0.06	0.06	0.19***	−0.15***	0.01
9. Household size	962	0.12***	0.13***	−0.01	−0.01	−0.09***	−0.09***	−0.45***	0.07**
10. Years of residence	958	−0.15***	−0.23***	0.02	0.21***	−0.03	0.34***	0.69***	−0.03
11. Non-Hispanic white	940	−0.08**	−0.11***	−0.03	−0.10***	0.19***	0.10***	0.35***	−0.03
12. Latter-Day Saints religion	937	−0.10***	−0.07**	−0.02	0.05	0.09***	0.18***	0.32***	−0.04
13. Married	937	−0.07**	−0.07**	0.03	0.11***	−0.03	0.09***	0.07	−0.06
14. Female	940	0.00	−0.01	−0.05	0.05	0.03	−0.00	0.07	0.00
15. Single-family detached house	963	−0.04	−0.11***	0.02	0.13***	−0.07**	0.40***	0.12**	0.03

Note: Simple *r*s are below the diagonal; partial *r*s (resident age and homeowner controlled) are above the diagonal and in the final column.
*$p < 0.10$. **$p < 0.05$. ***$p < 0.01$.

Appendix B

HLM is chosen primarily for its ability to analyze nested data correctly and to partition variance into individual versus block levels; see Perkins and Taylor (1996) for a detailed review. The recommended steps include testing to ensure that HLM analyses are needed and that all important variables are retained but that superfluous ones are deleted (Bryk and Raudenbush 1992). Level 1 model building occurs first; a separate equation is computed for Level 2 predictors of crime reports.

Given the power limitations inherent in 58 blocks, as well as past practices (Perkins and Taylor 1996) and recommendations to increase probability levels for more reliable group data (Kenny and la Voie 1985), Level 2 will be adjusted to 0.10. Because of the low levels of missing data, equations use full maximum likelihood estimation procedures and pairwise elimination of missing variables. Level 1 data are centered for the block, and Level 2 data are centered for the entire sample. All analyses were conducted using HLM 5.01 (Raudenbush et al. 2000).

Because the longitudinal analyses focus on observed incivilities but exclude psychological variables obtained from resident interviews, the data for analyses summarized in table B.1 include crimes occurring after incivilities were assessed. Thus crimes occurring after the collection of incivilities data but before the interviews are included to provide the most sensitive possible measures of later crimes.

In table B.1, unexpected changes are assessed by saving the standardized residuals from using Time 1 variables to predict the same variable in Time 2 (following a line of incivilities research reviewed by Taylor 1999a, 2001). All equations in table B.1 control for Time 2 individual homeownership, age, interview mode (telephone versus face-to-face interviews), and interval between Time 1 and Time 2 assessments of incivilities. Models A and B also control for Time 2, block-level homeownership, and age; Model C controls for Time 1 block-level homeownership, resident age, and the change in ownership from Time 1 to Time 2.

In addition, we tested alternative treatments of the crime outcome variable. As recommended by Snidjers and Bosker (1999), a square root transformation of crime counts collapsed into five categories of crimes (0 to 5 or more) yielded very similar results. A nonlinear Poisson analysis of the Time 2 crime counts (ranging from 0 to 11 crimes and controlling for Time 1 crime) showed some differences (three variables

Table B.1. **Predicting Police Reports with Time 1, Time 2, and Unexpected Change (Δ) in Selected Incivilities from Time 1 to Time 2 (HLM Results)**

Predictors	Crime Outcome	Model	Level (L) and Time of Incivility Predictors	Final Police Reports	
				Coefficient	*p* Value
Incivilities (8 items)	Time 3	1A	L1 (house), Time 2	0.003098	0.080
			L2 (block), Time 2	0.010789	0.001***
	Time 1–3 change	1B	L1 (house), Time 2	0.036093	0.453
			L2 (block), Time 2	0.369162	0.023**
	Time 1–3 change	1C	L1 (house) incivilities, Time 1	0.019896	0.796
			L1 (house) incivilities Δ, Time 1–2	0.011194	0.686
			L2 (block) incivilities, Time 1	0.215450	0.078*
			L2 (block) incivilities Δ, Time 1–2	0.041298	0.589
Bad lawn condition	Time 3	3A	L1 (house), Time 2	0.002910	0.116
			L2 (block), Time 2	0.018094	0.001***
	Time 1–3 change	3B	L1 (house), Time 2	0.100742	0.083
			L2 (block), Time 2	0.768016	0.001***
	Time 1–3 change	3C	L1 (house) lawn, Time 1	0.052752	0.438
			L1 (house) lawn Δ, Time 1–2	0.041866	0.152
			L2 (block) lawn, Time 1	0.590328	0.025**
			L2 (block) lawn Δ, Time 1–2	0.118897	0.211
Litter	Time 3	2A	L1 (house), Time 2	0.003642	0.000***
			L2 (block), Time 2	0.006250	0.000***
	Time 1–3	2B	L1 (house), Time 2	0.072634	0.001***
			L2 (block), Time 2	0.169258	0.068*
	Time 1–3 change	2C	L1 (house) litter, Time 1	−0.013342	0.413
			L1 (house) litter Δ, Time 1–2	0.094210	0.001***
			L2 (block) litter, Time 1	0.072277	0.016**
			L2 (block) litter Δ, Time 1–2	0.114818	0.112

Note: All models control for Time 2 individual homeownership, age, interview mode (phone or in person), and time interval between Time 1 and Time 2 assessments of incivilities. Models A and B also control for Time 2, block-level homeownership, and age; C model also controls for Time 1 block-level homeownership and resident age and the change in ownership from Time 1 to Time 2. Final reports were collected after house conditions were rated.
*$p < 0.10$ for block-level predictors. **$p < 0.05$. ***$p < 0.01$.

became less significant and three became more significant; a summary table is available from the first author on request).

We conducted additional tests to determine whether place attachments on the block at Time 1 could reduce the impact of incivilities on later changes in crime (in Model C), but it was not a robust factor. Results for lawn and litter were unchanged, although the significance of the incivilities composite did decline (from $p = 0.078$ to $p = 0.175$). Similarly, a composite measure of social ties on the block did not account for the change. We also tested changing income and years of residence, but they did not really reduce the effects of incivilities on later changes in crime (although again the significance of the incivilities composite did

decline from $p = 0.078$ to $p = 0.204$). Results are consistent with the idea that particular incivilities in this context may have a direct effect on offender decisions to commit crimes, although an unmeasured social variable may account for the effects as well.

Explained variance. Model A, with an outcome of the log-transformed police report rate in the months after the assessment of incivilities (N = 875), showed that 3.12 percent of the variance was between blocks. The equations testing the incivilities composite and the single incivilities of poor lawn and litter accounted for all of the between-block variance and modest amounts of within-block variability (1.56 percent, 1.56 percent, and 3.17 percent for within-block variability predicted by the incivilities composite, lawns, and litter, respectively). For Models B and C, residualized change scores indicate unexpected changes in crime from Time 1 to Time 3 (N = 463); 17.12 percent of the variability in change scores was due to differences between blocks. Model B, using Time 2 data to predict unexpected changes in crime (Time 1 to Time 3), reveals that modest within-block variability was explained (0.86 percent, 1.16 percent, and 2.53 percent, respectively, for composite, lawns, and litter). Also, greater proportions of between-block variance were explained (1.48 percent, 10.85 percent, and 21.78 percent, respectively, for composite, lawns, and litter).

In Model C, which tested Time 1 incivilities and changes in Time 1 to Time 2 incivilities to predict unexpected changes in crime, 17.12 percent of the variability again occurred between blocks. Modest amounts of within-block variability are explained (1.11 percent, 1.44 percent, and 2.99 percent, respectively, for composite, lawns, and litter), while more substantial amounts of between-block variability are explained (39.47 percent, 51.22 percent, and 47.40 percent, respectively, for composite, lawns, and litter). For all three models, the remaining residual variance is still significant, suggesting that other variables are needed.

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