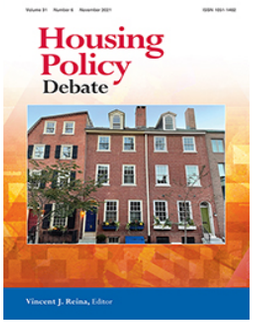

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Perceived Safety of LIHTC Residents in Ohio: Impacts of Building Design

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ABSTRACT

Ecological theories of crime have found that perceptions of neighborhood safety are influenced by a broad range of building features. Yet most research on how building design impacts perceptions of neighborhood safety for low-income renters was developed in a period of affordable housing defined by dense, segregated, and brutalist-inspired public housing. Research on low-income rental design has yet to focus on how residents in Low-Income Housing Tax Credit (LIHTC) properties perceive their levels of neighborhood safety, and how that may be influenced by building design. This study uses survey responses from 652 LIHTC residents in Ohio paired with design attributes and crime data to test how residents' perceptions of neighborhood safety are related to building design features, controlling for neighborhood violent and property crimes. We find that design features minimally impact residents' perceived neighborhood safety, and this does not vary significantly by resident characteristics. We suggest this contrast with past literature may relate to the design and maintenance standards associated with LIHTC properties. We recommend that housing finance agencies continue to encourage or incentivize affordable housing developers to design housing with features to increase natural surveillance, access control, and territoriality, and to focus on fostering community for LIHTC residents.

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The relationship between perceived safety and housing design has been a top issue for policymakers, architects, and social scientists. Scholars such as Jacob Riis, Jane Jacobs, and Oscar Newman have examined how the design of the built environment can impact both the occurrence of crime and the perception of crime. Although studies find that design may impact crime, there is also research indicating that design factors relating to natural surveillance, access control, and territoriality may relate to perceptions of safety.

Much of the research that has examined the relationship between housing design features and perceived safety has centered on low-income areas and specific types of low-income housing, specifically large-scale, dense, and isolated public housing developments. Empirical studies testing ecological models of perceived crime have found that these affordable properties had features that actually decreased residents' perceptions of safety, such as high unit density and low environmental foot traffic (Taylor-Patterson & Luberoff, 2018; Davis, 2007; Wright, 2014).

Yet the face of subsidized affordable housing has changed substantially, since the inception of the Low-Income Housing Tax Credit (LIHTC) program in 1986. The LIHTC program has become the largest producer of affordable units in the United States. In contrast to public housing, LIHTC properties are developed through public–private partnerships, which alter building design in two ways. First, developers must follow specific design requirements set forth by the local State housing

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finance agencies (HFAs) that encourage the design of housing intended for a minimum of 30 years. Second, these partner entities are often community players outside their LIHTC engagements and have a vested interest in building properties that meet local community design and foster neighborhood satisfaction. Thus, we should expect the shift from public housing to the LIHTC program to change many of the local design features that previously fostered fears of crime in past affordable housing.

However, research on perceived safety has largely remained focused on public housing and its transition to HOPE VI (Brooks, Zugazaga, Wolk, & Adams, 2005; Goetz, 2010), rather than updating ecological theories to explore how LIHTC residents' perception of safety may be mediated by newer design criteria. Further, studies of the LIHTC program have focused largely on where properties are placed and their impact on surrounding regions, rather than exploring the impact of design features on residents' perceptions.

We argue that this is a critical gap. How residents perceive their neighborhood safety is a key indicator of well-being and satisfaction (Cramm, Van Dijk, & Nieboer, 2013; Dong & Qin, 2017; Farrell, Aubry, & Coulombe, 2004; Jaramillo et al., 2020; Zhang & Zhang, 2017) and should be explored to inform how HFAs and developers change the design of low-income housing properties. This article uses a data set of 652 LIHTC residents in Ohio combined with crime data, and coded building design attributes to fill this gap. We ask three questions: (a) Do residents' perceptions of neighborhood safety correlate to neighborhood property and violent crime rates? (b) How may perceptions of neighborhood safety vary by respondent characteristics? and (c) How do building design features impact residents' perceptions of neighborhood safety?

We find that resident perceptions of neighborhood safety were negatively correlated with neighborhood property and violent crime rates. We find that LIHTC residents' feelings of safety are statistically associated with one's age and with specific design features related to visibility, access control, and territoriality. Surprisingly, many design features that have previously been associated with feelings of safety, such as entryways visible to the street, were negatively associated with perceived safety.

We argue these findings indicate HFAs can play an active role in encouraging positive feelings of safety and security through the use of specific design features. This article provides an important update to ecological theories of crime and suggests that HFAs have been incentivizing design that may encourage feelings of safety, especially when compared with past affordable housing.

Environmental Design Strategies to Improve Perceptions of Safety

Safety is a two-pronged concept: there is one's perceived safety and there is the actual incidence of crime. Fear of crime is both more widespread than actual crime and largely uncorrelated to recorded crime incidence[1] (Albertson et al., 2020; Donnelly, 1989; Fowler & Mangione, 1986; Rountree & Land, 1996; Taylor, Gottfredson, & Brower, 1984). Although less studied than crime incidence, one's perceived lack of safety can negatively affect one's quality of life and cause mental and physical health issues[2] (Blakely & Snyder, 1997; Taylor et al., 1984).

There is a subset of sociological and design theories, frequently called ecological theories, which posit that the design of the built environment plays an active mediating role in perceptions of safety by encouraging or discouraging feelings of safety (Gieryn, 2000; Stark, 1987; Unnever, Byrne, & Sampson, 1987). Foundational theories within this tradition, such as Jacobs' *The Death and Life of Great American Cities* (1961), Newman's *Defensible Space* (1972), and Wilson and Kelling's *Broken Windows* (1982), argue that people receive cues from the built environment, which can shape whether residents and visitors feel either safe from or fearful of crime (Cozens, Saville, & Hillier, 2005). These theories include a focus on improving perceived safety in communities through the inclusion of specific design features and attributes (Cozens, Hillier, & Prescott, 2002; Cozens & Love,

2015). Although the elements that comprise these strategies may shift, there are three primary concepts associated with ecological perception: natural surveillance and visibility, access control and boundary drawing, and territorial behavior and maintenance.

Natural Surveillance and Visibility

The concept of natural surveillance and visibility is heavily influenced by Jacobs's (1961, p. 45) idea of "eyes upon the street," which asserts that the safest environments are those in which people feel they are able to be seen or watched by residents, neighbors, or passersby. Although visibility and surveillance can encompass a number of design features, we argue that the most thoroughly supported facets include building visibility, door transparency and lighting.

Building visibility stems from *The Life and Death of Great American Cities* (1961), in which Jacobs argued that the degree to which residents can see and be seen by neighbors and passersby was important for increasing one's feelings of safety. Newman (1972) similarly incorporated this idea into *Defensible Space*, arguing that when buildings provided residents with a line of sight to view doorways and other public places, this reduced fears and anxieties in its inhabitants. Thus, when people are able to observe and/or be observed in their surroundings, such as through entry doors that are not opaque and are visible to the street, they feel safer.

Resident surveillance and visibility through lighting appears to critically impact perceptions of safety. Boyce, Eklund, Hamilton, and Bruno (2000) used four field studies to gauge the impact of lighting on perceptions of safety. They found that across both urban and suburban areas, horizontal lighting on parking lots and/or sidewalks created equal levels of perceived safety between daylight and night. Lighting has been shown to be an important predictor of perceived safety in other studies (Kirk, 1988; Weiss et al., 2011), and a lack of lighting has been correlated with feelings of being unsafe in parks and open spaces (Groshong, Wilhelm Stanis, Kaczynski, & Hipp, 2018). Thus, we should expect building design features that increase residents' ability to view their surroundings, such as building visibility, ability to see their surroundings safely from the door, and entry and parking lighting, to be relevant in shaping their perception of safety.

Access Control and Boundary Drawing

Access control and boundary drawing aim to reduce fear by utilizing real or symbolic barriers. Jacobs defined this as a clear demarcation between public and private space and argued that design features such as short streets with multiple entry and exit points, sites that have multiple vehicular access points, corner lots, and areas that have grid-like layouts allow for increased traffic and create spatial boundaries between public and private space. Similarly, the National Crime Prevention Council (2009) describes natural access control as "designing streets, sidewalks, building entrances, and neighborhood gateways to clearly indicate transitions from the public environment to semi-private and private areas" (p. 1). Access controls could include built components such as gates or fences, or architectural features that help delineate or elevate a building such as an entrance elevated from nearby public areas.

Aiyer, Zimmerman, Morrel-Samuels, and Reischl (2015) found that regions with more opportunities for access—operationalized as busy streets with multiple outlets, vehicular access points, and corner lots—fostered positive feelings and increased perceptions of safety. Similar studies have found that clear means of egress increase perceived safety (Fisher & Nasar, 1992, 1995).

Empirical work suggests that clear spatial delineations imposed by fences and gates that affect access could help foster a sense of security for its residents. Studying gated and nongated communities, Kim (2006) found that residents felt safer in gated communities than in nongated communities, despite similar actual incidences of crime, arguing that this reflects the importance of

boundaries for improving residents' perceived safety. Thus, control of access through gates or fences and clearly defined boundaries may reduce opportunities for crime to occur while also producing environments where residents feel safer.

Territorial Behavior and Maintenance

Territorial behavior includes a series of design features—specifically, maintenance, outside space, and sidewalks—that help foster a sense of space and control around a development, which can lead to an increased perception of safety.

The importance of maintenance was included in Wilson and Kelling's (1982) theory of broken windows, which asserted that signs of disorder, such as a broken window or a vandalized car, suggested low levels of concern from residents, which could foster crime and further neighborhood disinvestment. Empirical work has found that well-maintained areas, both physical structures and landscapes, fostered ownership and encouraged neighborhood attachment (Johnson, Gibson, & McCabe, 2014), whereas poor maintenance (e.g., graffiti, litter) alienated residents and left them feeling disinvested in the area (Lewis & Maxfield, 1980; Reynald, 2011). For example, Kim and Seidel (2012) found that maintenance and buildings that included territorial spaces improved residents' perceived safety. Further, Groshong et al. (2018), studying perceptions of safety in a park through interviews, found that lack of maintenance led to feelings of fear.

Building height and density also appear to shape perceptions of safety. Newman (1972) studied defensible space in two areas in New York City, one of which was a high rise and the other a series of low-rise buildings; he argued that perceived safety was higher in the low-rise buildings, where lower building heights increased awareness and territorial knowledge. Holzman, Kudrick, and Voytek (1996), for example, studied how physical attributes of public housing were associated with residents' perceptions of safety and found that the smaller size of the development improved safety. Harvey, Aultman-Hall, Hurley, and Troy (2015) found that multiple buildings of lower height were linked to higher perceived safety, whereas a large single building was linked to lower safety. This suggests that larger buildings with more unit density may lead residents to feel anonymous, limiting their feeling of ownership over properties and reducing territorial spaces.

Social Variables

Whereas design features appear to impact one's perception of safety, studies have found that there is variation in general perceptions of safety based on multiple social variables, suggesting that design changes may have differential impacts based on personal characteristics. Numerous studies have found gender to be one of the most important axes of differentiation for understanding fear; women consistently were more likely to perceive a lack of safety or to be more affected by regional signs of disorder and design than were their male counterparts (Austin, Furr, & Spine, 2002; Kim, 2006; Kim & Seidel, 2012; Kirk, 1988; LaGrange & Ferraro, 1989; Perkins & Taylor, 1996; Taylor, Gottfredson, & Brower, 1984). Women may be more likely to feel unsafe generally, which may affect how design features shape perceptions of safety.

Age and mobility have been considered a possible predictor for feeling unsafe or afraid of crime (Brisson & Roll, 2012; Brunson, Kuo, & Sullivan, 2001; Taylor & Brower, 1984), although results are inconsistent. In an early study, LaGrange and Ferraro (1989) tested the relationship between age and gender and perceptions of safety and fear of crime, finding no consistent relationship between age and perceived safety or higher fear of crime (Austin et al., 2002). Yet a number of studies have found age to be a predictor of fear. Pain (2001), in her literature review of perceived safety, highlighted the recent shift of focus on older people as having more fear, while also noting empirical data in which younger people had lower perceptions of safety. It is unclear whether age plays a role in perceptions of safety, but it should be considered in studies of perceived safety.

Linked to age, studying lower-income older adults, Clark et al. (2009) found that those with a mobility disability had increased perceptions of feeling unsafe in neighborhoods compared with those without such a disability. This suggests a mobility disability may create worse perceptions of neighborhood safety.

Tenure in place appears to affect perceptions of safety as well. In their study on the perception of safety and reported crime, Ogneva-Himmelberger, Ross, Caywood, Khananayev, and Starr (2019) found that residents who had lived in the neighborhood for less than 4 years were more likely to express feelings of being unsafe than were residents who had lived there longer.

Lastly, social networks appear to affect perceptions of neighborhood safety, such that the more people are engaged, the more secure they feel (Baum, Ziersch, Zhang, & Osborne, 2009; Lochner, Kawachi, & Kennedy, 1999; Sampson, Raudenbush, & Earls, 1997; Stewart, Baumer, Brunson, & Simons, 2009; Young, Russell, & Powers, 2004).

Crime and Safety Within the LIHTC Program

Design and ecological theories present a promising set of practices for improving perceptions of safety among rental residents. However, most of these studies are conducted on upper and middle-class areas, such as gated communities (Kim, 2006; Wilson-Doenges, 2000), universities (Day, 1999; Fisher & Nasar, 1992, 1995), and parks (Groshong et al., 2018). The bulk of the research on low-income housing focuses on public housing, specifically housing developed more than 30 years ago, which was built in a very different social and spatial landscape from the present (Newman & Schnare, 1997; Roncek & Bell, 1981; Yancey, 1971).

After World War II, urban landscapes spread out because of suburbanization, and there was rampant White flight, diversion of government funding out of cities, and the exodus of the urban tax base (Massey & Denton, 1993; Wilson, 1987). At the same time, the design of affordable housing shifted toward physical separation from other urban landscapes and adopted a Le Corbusier-style towers-in-the-park design (Corbusier, 1967), which utilized superblocks and separation from other neighborhoods (Plunz, 1990). Localities often chose poorly prepared, low-cost sites and skimped on the quality of construction, resulting in large high-rise, esthetically monotone and distinct buildings in highly segregated regions (Bristol, 1991; Von Hoffman, 1996; Yancey, 1971).

By the 1970s, some of the federally funded public housing projects, such as Cabrini Green and Pruitt Igoe,[3] had fallen into disrepair because of funding constraints and a lack of strong incentives for care by housing authorities and their inattentive management, creating problems such as crime and high vacancy (Von Hoffman, 1996). The combination of poor maintenance, isolation from communities with greater economic prosperity, and the concentration of lower income residents created a popular public image of affordable housing as a large, poorly maintained, crime-ridden warehouse in spatially concentrated pockets of poverty (Scally & Koenig, 2012).

Critics have failed to distinguish between post-WWII affordable housing and newer affordable housing developments, such as those funded by the LIHTC program (Husock, 2003; Scally, Gold, & DuBois, 2018; Scally & Koenig, 2012), which have placed a higher standard in building affordable housing to fit in with the surrounding built environment. Thus, our understanding of the relationship between design and low-income housing has not engaged with how design features may have shifted within LIHTC. This study fills that gap by engaging how perception of neighborhood safety interacts with design features and actual crime incidence with LIHTC properties.

LIHTC has overtaken public housing as the federal government's primary program to produce affordable housing for low-income renters, having produced nearly 3 million housing units (Scally, Gold, & DuBois, 2018) since its creation in 1986. LIHTC spurs the development and preservation of affordable housing through public–private partnership. Housing Tax Credits are allocated to state HFAs, which provide the credits to housing developers according to criteria defined in a qualified allocation plan (QAP; Scally et al., 2018). Once credits have been delivered and the properties are constructed, LIHTC units must remain affordable to residents earning up to 80% of the area median

income (AMI) for a period of 15 to 30 years, depending on the specific restrictive covenant. HFAs monitor compliance with affordability and other federal and local guidelines for the entirety of this period.

LIHTC developments are distinct from public housing in many ways that are likely to impact their design features. For example, each state's LIHTC allocations are generally not large enough to meet the demand for all LIHTC credits available, so the application process is very competitive. HFAs are thus able to require specific building design features that encourage high-quality construction. Second, LIHTC is an ongoing credit allocation that provides financial benefits to nongovernmental developers. Given that these developers have a financial stake in the construction and continued receipt of LIHTC credits, they are incentivized to design and build properties in ways that foster and encourage ongoing maintenance and esthetically pleasing design. This combination may compel these developers to design housing properties that are more responsive to the community and reflect the neighborhood character. Thus, the design features in LIHTC properties are likely to differ substantially from those in public housing.

Few studies have looked at perceptions of neighborhood safety for LIHTC residents. Rather, much research directed at safety and the LIHTC program has been on the placement of LIHTC properties, finding that these properties tend to be placed in areas with higher levels of crime (Ellen, Lens, & O'Regan, 2012; Tillyer & Walter, 2019; Woo & Joh, 2015), even when compared with other subsidized and low-income renters (Lens, Ellen, & O'Regan, 2011). This suggests that although LIHTC residents may be at a greater risk of fearing for their safety from living in neighborhoods with higher crime, few studies have focused on their perceptions of neighborhood safety.

Drawing on ecological design theory, we should expect that building design features may help improve perceptions of neighborhood safety for LIHTC residents (Alkimim, Clarke, & Oliveira, 2013; Lewis & Maxfield, 1980). In one of the few studies focusing on LIHTC residents and their perceptions of opportunity, Reid (2019) determined that the neighborhood crime rate was not significantly associated with residents' perceptions of their local safety, but was considered secondary to a broad set of economic, place, and social factors, such as social support or access to amenities. However, beyond Reid's (2019) analysis, few studies focus on how LIHTC residents' feelings of safety may be mediated by other housing design characteristics. We argue that it is particularly important to understand how building design may influence feelings of safety for LIHTC residents, as it both updates ecological theories in light of more modern affordable housing and provides critical information for state HFAs and other local housing providers who have some ability to shape the design features of affordable units, which are being sited in higher crime neighborhoods.

In this study, we focus on LIHTC residents' perceptions of neighborhood safety and how they may be influenced by building design. We test the hypothesis that perceived neighborhood safety will be moderated by building design features—specifically related to natural surveillance and visibility, access control and boundary drawing, and territorial behavior and maintenance—rather than actual neighborhood crime rates.

Data and Methods

Study Location

We use Ohio LIHTC properties as a case for analysis, as the demographics of Ohio and its LIHTC program provide a useful landscape to understand the perceived neighborhood safety of renters living in LIHTC properties. The demographic and financial profile of Ohio's LIHTC population closely mirrors that of LIHTC populations in other states (see Table 1). Ohio's LIHTC has a slightly lower income and a slightly lower rate of rental assistance than the national average, but this is likely due to skew from coastal states with overall higher incomes, such as New York, California, New Jersey, etc. This suggests Ohio provides us with a reasonable stand-in for LIHTC residents generally.

Table 1. Ohio 2017 LIHTC population and all LIHTC properties 2017.

Variable name	Ohio	All states
Median household income	$16,136	$17,540[a]
Race (%)		
White	31.0	28. 8
Black	42.3	30.8
Not reported	22.9	41.4
Disability status of at least one member (%)	7.1	12.1
Rental assistance (%)	31.4	39.9

Note. LIHTC = Low-Income Housing Tax Credit.
Source: Ohio Housing Finance Agency (2018) and Novogradac (2020).
[a]Data from Scally et al. (2018).

Additionally important for our focus on Ohio, OHFA—the state's housing finance agency—has worked to include innovative set-asides and competitive criteria in the QAP that encourage high-quality building design features such as universal design, durable features, security amenities, and community integration. This focus on community integration encourages properties to "coordinat[e] and/or complement the local architecture, promot[e] resident integration with the broader neighborhood and encourage[e] community safety to the greatest extent practicable" (Ohio Housing Finance Agency, 2018, p. 7), and provides a unique opportunity to examine how design features may impact perceptions of neighborhood safety.

Sample Construction

To construct a sample of LIHTC residents, we focus on 9% LIHTC properties in Ohio, as these are all funded through a similar competitive process and are required to conform to the criteria set forth in the QAP each year.[4] There were 741 LIHTC active properties in Ohio in 2018. We selected 100 properties using a random stratified sample to ensure representation from axes of stratification that may affect design and perceived safety: geographies, building ages, and populations served. First, properties were divided into urban and nonurban properties, as density, land availability, and need may shape design in unique ways. Second, properties were divided based on population served: general occupancy or senior properties specifically designed for adults older than 55, which may have unique design features to meet the safety and mobility needs of residents. Finally, we divided properties based on placed-in-service date, such that those constructed more than 15 years ago were coded separately from those constructed less than 15 years ago, as this may affect both design and construction features. We stratified all properties along these axes, and then randomly selected properties within those stratifications to survey within these groups.

Surveys were distributed in paper and electronic form in 2018. Questions focused on prior home location, reasons for moving, current housing and neighborhood preferences and satisfaction, perception of safety, and demographic information. Our survey was sent to 4,891 households (11% of all Ohio LIHTC households). In total, 676 of sampled households returned the survey; 24 of the returned surveys were unusable because they were incomplete, reducing the sample size to 652. Table 2 shows the demographic profile of the responses compared with the entire Ohio LIHTC renter profile in 2018. The respondents in our sample are older, less racially and ethnically diverse, and more female than the LIHTC resident population overall in the same year.

The response rate of 13.3% represents a clear limitation; this is considered low by standard survey practices, which aim for 20% or higher (Kaplowitz, Hadlock, & Levine, 2004). Yet this is not uncommon among studies of LIHTC residents, who represent a hard-to-reach, vulnerable population. Similar studies that have focused on LIHTC or similar populations and programs have seen lower

Table 2. Study sample demographics and social features compared with Ohio LIHTC (Low-Income Housing Tax Credit) adult population, 2018.[a]

Variable name	Study sample (n = 652)	Ohio's LIHTC population
Age		
Mean	64.00	48.22
Median	65.00	46.00
Gender (%)		
Male	18.42	30.02
Female	79.37	69.97
Race (%)		
White	67.33	58.48
Non-White	32.67	41.52
Ethnicity (%)		
Hispanic	02.42	01.73
Non-Hispanic	91.43	98.21
Household income		
Mean	$14,475	$16,136
Median	$12,499	
Tenant rent portion		
Mean	$459.20	$334.93
Median	$450.00	$283.00
Tenure		
Mean	5.54	–
Median	4.00	
Perceived network		
Mean	8.00	–
Median	8.00	

Note. [a]Based on total reporting population. Source: Annual Owner Certification data for OHFA financed LIHTC properties 2018 and respondent data from LIHTC survey.

response rates, of less than 10% (Reid, 2019; Texas Department of Housing and Community Affairs, 2018).[5] To address this limitation, we ensure that we do not extrapolate to all LIHTC residents in Ohio but try to use these findings as good initial indicators for future research.

Data and Variables

Guided by ecological theories of crime, our analysis relies on data from three sources—resident survey responses, coded design variables, and the Ohio Incident-Based Reporting System (OIBRS)—to test how perceptions of neighborhood safety may be influenced by building design features. We detail the construction of these variables below, and their descriptive statistics are highlighted in Tables 3 and 4.

Dependent Variable

Perceptions of Neighborhood Safety. The dependent variable is based on a response from our LIHTC resident survey, which asked respondents *How safe do you feel in your neighborhood?* from very unsafe (1) to very safe (5) (see Table 3). One limitation of this measure is that the survey did not specifically ask residents if they have been a victim of a violent or property crime, which could influence their perception of neighborhood safety (Goldman-Mellor, Margerison-Zilko, Allen, & Cerda, 2016).

Independent Variables

Design Features

Using ecological theories as a guideline, we created a deductive codebook to rate properties based on specific attributes related to the design and esthetic appearance of each sampled building. Multiple photographs were obtained of the buildings and their properties, using a combination of administrative photos collected by OHFA during routine monitoring, photos obtained from Google Street View, and pictures of properties listed on rental websites.

Table 3. Definitions and distributions of independent and dependent variables.

Variable name	Definition	Study sample $n = 652$
Perception of neighborhood safety	Mean	3.86
	Min	1.00
	Max	5.00
Design elements: Natural surveillance and visibility		
Entry lighting	1—Presence of a light for the main entrance of the unit/building	88.54
	0—Not present	11.45
Parking lighting	1—Presence of a standalone light for the parking lot	77.44
	0—Not present	22.56
Door transparency	1—Door has glass either within it or directly adjacent	78.78
	0—Opaque doors and surrounding	21.22
Visibility to building	1—Building entrances are visible to neighbors	91.72
	0—Not visible	8.28
Entry visibility	1—Main entrance is visible to the street	55.21
	0—Not visible	44.79
Design elements: Access control and boundary drawing		
Vehicular access	0—Only one vehicular access point for the building from the street	44.02
	1—Two or more vehicular access points	55.98
Corner	1—Property has at least one building located on a corner lot	55.52
	0—Not on a corner	44.48
Fence	1—Presence of fencing delineating units from the broader area	77.50
	0—No fence present	22.53
Entry security	1—Building has shared entrance or a mix of shared and private entrances	47.54
	0—Building only has individual private entrances	52.45
Design elements: Territorial behavior and maintenance		
Maintenance landscaping	1—Landscaping is well maintained (cut lawn, etc.)	22.29
	0—Not well maintained	77.71
Maintenance building	1—Exterior well maintained (paint, structure, repairs)	94.24
	0—Not well maintained	5.76
Outdoor space	1—Presence of common space for residents (playground, outdoor seating, patio areas)	52.96
	0—No common space	47.04
Sidewalks	1—Presence of sidewalks leading to/from units	92.79
	0—No sidewalks present	7.21
Building material	1—Dominant building material is brick, stone, or other high-status material	43.15
	0—Dominant material is cement, stucco, vinyl, or other low-status material	56.85
Total stories	0—Tall buildings (4–8 stories)	7.32
	1—Short buildings (1–3 stories)	92.67
Unit density	Measure of units per building	
	Mean	369
	Min	36
	Max	610
Building count	Measure of buildings on site	
	Mean	5.24
	Min	1
	Max	46

Source: Coded photographs of LIHTC (Low-Income Housing Tax Credit) properties.

The buildings were deductively coded (descriptions in Table 3) on natural surveillance and visibility, access control and boundary drawing, and territorial behavior and maintenance. Two people coded buildings using a codebook that defined the absence or presence of features. Intercoder reliability was tested at the outset of this process to ensure coding was consistent between the two coders. The distribution of coded items is given in Table 3.

Respondent Characteristics

Respondent demographic characteristics were collected from our LIHTC resident survey. We include measures of age, gender, mobility disability, length of stay in neighborhood (tenure), and strength of social networks (a combination of responses based on how strongly they disagreed (1) to strongly agreed (5) that they had family, friends, and/or a strong community network near them; see Table 2).

Controls

Given the important role that actual crime incidences may play in perceptions of neighborhood safety, we developed two crime incidence exposure variables from the OIBRS for the state of Ohio in 2017. OIBRS is Ohio's version of the Federal Bureau of Investigation (FBI) National Incident-Based Reporting System (NIBRS), which allows law enforcement agencies to submit crime statistics. Using data from the 2017 OIBRS, we created a property crime exposure rate and a violent crime exposure rate for each tract (see Table 4). Property crime included events categorized as burglary, larceny, or motor vehicle theft. Violent crime included events coded as murder, rape, robbery, or aggravated assault. The total counts of each event per census were tallied, then divided by the 2017 census tract population (determined using American Community Survey 5-year estimates), and then multiplied by 1,000 to obtain the rate of each type of crime per 1,000 individuals.

Crime data are only a reflection of reported and documented crime, not an indicator of all crime that occurs. Crime rates are influenced by the willingness to call and report crime incidence to police, as well as factors such as police presence, distrust of police, etc. As LIHTC buildings tend to cluster in lower income areas (Dawkins, 2011; Freedman & McGavock, 2015), the areas of focus for this study may have slightly skewed crime numbers. Thus, we do not argue that these crime rates are reflective of all crime, but they provide an effective way to understand general violent and property crime levels within a census tract/neighborhood.

We also added in neighborhood controls. We include measures of percentage ownership, vacancy rate, median home value, percentage non-Hispanic White, and percentage neighborhood poverty, all from the 2013–2017 American Community Survey 5-year estimates. Given the diverse geographic nature of Ohio, we also included a measure to control for regional density (urban, suburban, rural), as defined by the Kirwan Institute for the Study of Race and Ethnicity at the Ohio State University.

Analysis

To answer our first question—Does neighborhood crime rates influence perceptions of neighborhood safety?—we conducted a basic Pearson correlation between perceived neighborhood Safety and both the property crime and violent crime rates. To answer our second and third research questions, we employed a series of ordinary least squares (OLS) regressions. Our standard OLS regression tests how respondent characteristics and design attributes relate to one's perception of neighborhood safety, when controlling for neighborhood features. The general model is given below:

Table 4. Ohio crime data by tract, 2017.

	Violent crime, Ohio	Violent crime, sample (n = 652)	Property crime, sample (n = 652)
Incidence count	n = 24,628	n = 6,124	N = 46,595
Tract, mean	11	9.39	71.46
Tract, median	6	3.00	29.00
Tract, max	124	89.00	508.00
Tract, standard deviation	12.67	16.36	96.57

Source: Ohio Incident-Based Reporting System (OIBRS, 2017).

$$Y = \alpha + \beta_{1*} visbility + \beta_2 * control + \beta_3 * territoriality + \beta_3 * Controls + \varepsilon$$

where

Y = perception of neighborhood safety;

Visibility = Visibility design features for the building;

Control = Control access design features for the building;

Territoriality = Territoriality design features for the building;

Controls = Controls for property and violent crime rate for the tract and neighborhood features.

Our first OLS regression tested how demographic features relate to LIHTC residents' perception of safety with neighborhood controls. The second regression tests the relationship of design features with neighborhood safety and neighborhood controls. The final regression tests the relationship between perceived neighborhood safety, individual attributes, and design features, while controlling for neighborhood attributes.

Findings

Research Question 1: Do residents' perceptions of neighborhood safety correlate with neighborhood crime rates?

Residents' perceptions of safety were negatively correlated with both neighborhood violent crime rates and neighborhood property crime rates, such that as crime rates increase, residents' perceptions of neighborhood safety decrease (see Table 5). Whereas the correlation between perceived safety and violent crime is slightly stronger (–0.240) than that between perceived safety and property crime (– 0.115), both relationships are very weak (i.e., < 0.3). This finding supports past evidence that the relationship between neighborhood crime rates and perceived neighborhood safety is weak. Further, it indicates that despite the likelihood of LIHTC units being placed in high-crime areas, neighborhood crime rates do not appear to have a large influence on one's perception of neighborhood safety, suggesting that other neighborhood or individual factors may greatly affect one's perception of neighborhood safety.

Research Question 2: How do perceptions of neighborhood safety vary by respondent characteristics?

Table 6, regression 1 examines how perceptions of neighborhood safety are impacted by respondent characteristics. We find that perceptions of neighborhood safety vary by respondent characteristics. Respondent age (0.007) and strength of social network (0.073) are positively and significantly associated with one's perceived neighborhood safety. The effect sizes of these attributes are small.

Research Question 3: How do building design features impact residents' perceptions of neighborhood safety?

Table 5. Pearson correlation between crime and perceived neighborhood safety.

	N = 652
Violent crime	– 0.240***
Property crime	– 0.115 **

Source: Ohio Incident-Based Reporting System (OIBRS, 2017) and LIHTC (Low-Income Housing Tax Credit) survey respondent data.

Table 6. Impact of design elements on perceived safety.

	(1)	(2)	(3)
Intercept	2.767 (3.79)***	2.551 (.920)**	2.559** (.917)
Gender	− 0.019 (.062)		− 0.040 (.072)
Age	0.007 (.003)*		0.007 (.004)*
Tenure	− 0.002 (.008)		0.004 (.010)
Disability	− 0.000 (.001)		− 0.004 (.002)
Network	0.073 (.014)***		0.047 (.017)**
Entry lighting		0.626 (.192)***	0.177 (.188)
Parking lighting		0.132 (.163)	− 0.030 (.163)
Door transparency		− 0.488 (.169)**	− 0.398 (.154)*
Visibility to building		− 0.643 (.230)	0.051 (.239)
Entry visibility		− 0.078 (.127)	− 0.011 (.134)
Vehicular access		− 0.051 (.132)	0.066 (.130)
Corner		− 0.024 (.121)	− 0.015 (.124)
Fence		− 0.046 (.177)	− 0.170 (.195)
Entry security		− 0.285 (.160)	0.074 (.157)
Maintenance landscaping		− 0.113 (.170)	0.133 (.156)
Maintenance building		− 0.052 (.315)	− 0.037 (.327)
Outdoor space		0.270 (.124)*	0.136 (.117)
Sidewalks		0.307 (.217)	0.006 (.211)
Building material		0.122 (.103)	− 0.102 (.106)
Total stories		− 0.101 (.297)	0.136 (.303)
Unit density		− 0.182 (.004)	− 0.001 (.004)
Building count		− 0.004 (.105)	− 0.008 (.013)

Note. Standard errors are given in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$. Source: Cody R. Price and Katherine F. Fallon, 2020, Ohio.

Regression 2 tests the relationship between respondents' perception of neighborhood safety and building design variables while controlling for neighborhood crime rates. Findings suggest residents' perceptions of neighborhood safety are impacted slightly by building design features, albeit not necessarily in ways that we expected given the literature. Regression 2 shows the presence of a visible outdoor entry light (0.626) and outdoor space (0.270) positively and significantly impacts perceptions of safety. Door transparency (− 0.488), however, is negatively and significantly associated with one's perceived safety, meaning buildings that had solid front doors with no glass for visibility increased one's perceived safety. This is consistent with premises in the literature, which suggest that an opaque door may increase perceptions of safety. None of the design features associated with boundaries had a significant relationship with perceived safety.

Lastly, regression 3 includes demographic characteristics, design features, and controls. Age (0.007) and strength of networks (0.047) remain significantly and positively associated with perceptions of safety. Adding in demographic characteristics reduces some of the impact of the design features, which suggests that design characteristics may not affect all demographics equally. Rather, age and network strength are important differentiators in perceived safety. This should not be surprising given the literature, which consistently finds that neighborhood networks bolster positive neighborhood feeling and reduce perceived insecurities (Baum et al., 2009; Lochner et al., 1999; Sampson et al., 1997; Stewart et al., 2009; Young et al., 2004). This also adds some support to literature claiming that older age may negatively affect perceptions of safety (Pain 2001). Only one design feature is related to perceived safety. Door transparency (− 0.409) remained negatively and significantly associated with one's perceived neighborhood safety.

Discussion and Conclusion

This article examines how LIHTC building design features relate to residents' perceptions of neighborhood safety, updating previous studies focused primarily on public housing. We find that neighborhood crime rates are significantly and negatively associated with one's perceived neighborhood safety. Whereas studies have found LIHTC properties tend to be located in higher crime areas

(Freedman & Owens, 2011; Woo & Joh, 2015), the actual incidence of crime may not necessarily affect residents' perceptions of neighborhood safety; rather, other neighborhood, building, or personal attributes could play a larger role in explaining their perception of safety. This suggests that the emphasis on LIHTC properties should include not only crime incidence, but also resident perception and well-being, to better understand how local LIHTC environment actually impacts residents.

By testing the relationship between perceived neighborhood safety and building design features, our analysis suggests that when controlling for neighborhood crime rates and neighborhood attributes, perceived neighborhood safety is only slightly impacted by building design. This finding conflicts with past research, which has argued that design features are key for mediating perceived safety. We propose two potential explanations for the divergence from past studies. First, as discussed earlier, the nature of the LIHTC program has substantially altered the way in which affordable housing is constructed. Although LIHTC properties do tend to be placed in neighborhoods with slightly higher crime rates than do nonaffordable rentals (Freedman & Owens, 2011), LIHTC programs also have more stringent design requirements than past affordable housing programs. These design and maintenance requirements also allow for substantially less variation than the design and maintenance criteria of past affordable housing. On the one hand, this may mean all LIHTC properties have high-quality design features that positively impact perceived safety —particularly given their likelihood to be in higher crime regions—but as a result, they do not provide sufficient variation for empirical outcomes. On the other hand, we do not know whether LIHTC properties with worse design and less quality construction would influence residents' perceptions of safety. This suggests that future research should focus on areas where variation in design may be clearer, such as design differences between states, or at junctures where design criteria changed substantially over time within a single state.

Although the findings conflict with ecological models, they lend support to recent critiques of ecological models. Also, some recent studies have also found no direct significant relationship between design features and feelings of safety; they argue for a broader look at social and structural factors (Marzbali, Abdullah, Razak, & Maghsoodi Tilaki, 2012; Minnery & Lim, 2005). As affordable housing moves away from the highly segregated, poorly maintained high-rise design of earlier affordable housing, design features are less influential on general perceptions of neighborhood safety. Our finding, for example, that perceived community network remained statistically significant in all models highlights the key role of nondesign factors, such as community, in perceptions of neighborhood safety. Future studies should engage more deeply with the social and structural factors surrounding affordable properties and how variation in building design and maintenance influences one's perception of safety.

Second, it is possible that neighborhood connections are key to perceived safety, and LIHTC may be one effective means of maintaining neighborhood ties. Although there is little information available on mobility into public or subsidized housing, preliminary data suggest that the majority of LIHTC residents are moving very short distances into their property (Price, 2019), meaning LIHTC residents are either intentionally or unintentionally remaining in close proximity to past neighbors and community ties from past homes. This could mean that they have the opportunity to maintain social ties within the community while moving into new housing given the short distance in moves. By contrast, public housing of the 1960s to 1980s was located far from existing communities, requiring a disruption of community for those who moved into public housing and resulting in lower levels of perceived community. Some studies have shown that there was indeed strong community among some of the public housing residents (Clampet-Lundquist, 2004), yet other studies focused on design have argued that specific features reduced the likelihood of community development given the large anonymous buildings with wide hallways (Yancey, 1971).

Although we cannot determine how the levels of community ties in public housing compared with community ties in LIHTC properties, it is clear that HFAs have tried to encourage community development in multiple ways. OHFA, for example, has focused on community integration to

"coordinat[e] and/or complement the local architecture, promot[e] resident integration with the broader neighborhood and encourage[e] community safety to the greatest extent practicable" (Ohio Housing Finance Agency, 2018, p. 7). The emphasis on community integration in design and social engagement may have strengthened perceived social networks, thereby influencing perceptions of neighborhood safety. This potential maintenance of networks and community appears to be more important than design features. Future analysis should focus on how perceived safety varies for those who have moved different distances.

Our results have important implications for policy and practice. First, as HFAs create incentives for LIHTC housing in their QAP, they should continue to be attentive to and proactive with building design features of LIHTC buildings and continue to maintain high-quality design and maintenance standards through the 30-year affordability compliance period. Although our results suggest that building design minimally impacts one's perception of safety, we still do not know how this would have varied if building design and maintenance standards were worse off.

Second, HFAs should continue to incentivize design elements at the building level to help residents feel safe. HFAs can use the QAP to award points for projects that incorporate design principles that foster community building. Some state HFAs such as New Jersey and Rhode Island already incorporate design principles in their QAPs and should be used as a model for other HFAs. For example, New Jersey's 2018 LIHTC application states that the HFA will award points to applicants that include community policing or public safety enhancements in the development, including the incorporation of design characteristics that help foster community and ownership of the space (New Jersey Housing and Mortgage Finance Agency, 2018, p. 35). Without these key incentives intended to enhance design and community integration, it is unclear whether these features would continue to reach the standards they currently are built to. Although some developers may continue to collaborate with community partners, we hypothesize that the quality of LIHTC construction and its connectedness to the community could fall, resulting in worse perceptions of safety from residents. This may be particularly true given the thin margins that LIHTC operates on; developers are held to tight construction budgets and may be willing to sacrifice certain design features to have more flexibility with budget.

Lastly, this article provides an important update to ecological theories of crime, by shifting the focus from public housing to LIHTC. As the LIHTC program continues to be the dominant funding mechanism for building new affordable housing in the United States, researchers and policymakers must invest time in understanding not only the lived experiences of those residing in LIHTC properties but also how building design quality and standards of LIHTC properties can influence resident perceptions, rather than relying on data from older housing programs. For example, we find LIHTC residents generally feel safe in their neighborhoods and that many of the building design elements recommended in the literature to increase one's perceived safety have been incorporated into LIHTC developments. As a result, this highlights the important role that some design features play and suggests that LIHTC properties may be more responsive and attentive to resident needs and safety concerns than public housing is.

Notes

1. Breetzke and Pearson (2014), studying the relationship between reported crime and fear of crime, studied three geographical scales, from the local neighborhood to the broader region, in New Zealand and found that the incidence of crime had little or no effect on feelings of safety. Similar studies have found that incidence of crime and local victimization rates may not be the correct calibrator of safety, because there is substantial individual variation in perceived exposure to crime (Balkin, 1979; Donnelly, 1989). It is not whether fear of safety is accurate; perceptions have the power to affect individual actions and motivations (Ferraro, 1995).
2. Research on the link between crime and well-being indicate that increases in crime—for both direct victims and nonvictims—can have a detrimental impact on one's mental health and well-being (Cornaglia, Feldman, & Leigh, 2014; Diener & Tov, 2007). Crime is also related to physical health; multiple studies have found that perceived safety was one of the most important qualities for physical mobility (Bauman et al., 1996; Chandola, 2001;Hawthorne, 1989; Loukaitou-Sideris, 2006; Ross, 1993; Weinstein et al., 1999).

3. Pruitt Igoe was 11 stories high with double-loaded corridors, designed in the modernist style influenced by Le Corbusier and the Congrès International d'Architecture Moderne.
4. We focus on 9% projects rather than a combination of 9% and 4% projects, because of the differences within the program and the types of programs they tend to fund. The 9% credit is generally reserved for new construction and projects submitted through a competitive process defined by the QAP, whereas 4% credits are typically used for rehabilitation projects or new construction that is financed with tax-exempt bonds and not as tied to the QAP. Similarly, the credit rates fluctuate according to the market, such that the 4% has fluctuated between about 3.15% and 3.97% compared with the 9% which has ranged between 7.35% and 9.27%—but has had an established floor of 9% since 2008. Given this, the credits are distinct both in what they tend to fund and in how equity is assigned to the credits. We argue that this difference in policy requirements and incentives may change design in ways that would not allow us to compare effectively, and would limit our ability to make substantial policy recommendations.
5. To help increase our response rate for this hard-to-reach, vulnerable population, we employed a number of methods. We emailed on-site property managers of sampled properties to notify them of our resident survey. We encouraged them to partner with us and to have them encourage their residents to complete the survey and inform us if any resident had questions regarding the survey. We also included a lottery to win a $50 gift card incentive for survey completion, which is a relatively standard lottery amount and has been shown to be an amount and type of incentive that helps increase survey response (James & Bolstein, 1990, 1992; Mack, Huggins, Keathley, & Sundukchi, 1998; Singer, 2002). Similarly, studies have found that monetary incentives might be especially effective in recruiting low-income and minority respondents, who ordinarily would be underrepresented (Goyder & Warriner, 1999; Groves & Couper, 1998; Singer, 2002).

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No potential conflict of interest was reported by the authors.

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