



Original article

The cross-level impact of landscape patterns on housing premiums in micro-neighborhoods

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ABSTRACT

This paper attempts to examine the impacts of the spatial structure of landscape on housing premiums in Austin, TX through the years of 2009–2011. Dissimilar to previous studies, this paper highlighted three points. First, landscape patterns was observed—not only the composition but also the configuration in terms of shape, fragmentation, isolation, and connectivity. Second, the definition of neighborhood in this study was closely matched to the nature of a residential neighborhood, which was represented by a residential subdivision that has a name and a high level of homogeneous characteristics (i.e., development age, appraised value, lot size, and housing size). This approach specifically helps understand the impact of landscape configuration at the micro-level neighborhoods. Third, the hierarchical nature of neighborhoods and embedded parcels—nested parcels within the same neighborhood posit a certain level of identity as a whole—was given attention so that multi-level modeling could be employed. Conceptually and theoretically, multi-level modeling is a better approach to examine phenomenon that occur in multi-level units that show a clear hierarchy. The findings indicated that home buyers are willing to pay more to live in neighborhoods with the high ratio of tree cover. This is a finding consistent with previous studies. Meanwhile, the detailed spatial configuration of landscape does not play an important role at the residential neighborhood level. This result urges policy makers to be more scale-sensitive when planning landscape and indicates that micro neighborhoods are not the correct spatial level to discuss the spatial configuration of landscape, greenways, and green network.

1. Introduction

One aim of community design and planning is to encourage the construction of high quality landscapes because human beings are an vital element of landscape who are legitimate receivers of benefits that could be brought by landscape. On the contrary, sometimes poor community planning can lead to disturbances of the landscape ecology. Previous landscape theories support the idea that landscape can provide restorative, recreational, and esthetic benefits to people and also promote the place attachment and place identity that can induce behavior commitments to surrounding settings (Hunziker et al., 2007; Lewicka, 2011, p. 219). Previous empirical studies also reported positive contributions of human perception toward landscape for stress relief (Kaplan, 2001; Ulrich et al., 1991), neighborhood satisfaction (Lee et al., 2008), housing premiums (Jim and Chen, 2009; Rodriguez and Sirmans, 1994), physical, social, and educational benefits (Donovan et al., 2002; Humpel et al., 2004, 2002; Kloek et al., 2013), and promoted place attachment and behavior commitments (Hernandez et al., 2007; Lewicka, 2011; Scannell and Gifford, 2010).

Also, researchers found that landscapes, functioning as critical elements of other infrastructure, can mediate flood damage (Brody et al., 2013; Gill et al., 2007; Kim and Park, 2016) and urban heat island effects (Connors et al., 2013; Liu and Weng, 2008), as well as protect air quality and natural habitats (Benedict and McMahon, 2006; McDonald et al., 2005). It is also well known that various forms of landscape could affect neighborhood satisfaction that measures overall quality of well-being reflected in both stated and revealed preferences (Des Rosiers et al., 2002; Kweon et al., 2010; Lee et al., 2008; Stigaril and Elam, 2009; Vemuri et al., 2009).

Even though previous research is rich in finding associations between human response to landscape, there are several points that have not been fully tested. Landscape ecology theory emphasized the importance of roles of both composition and configuration of landscape on human and other ecosystems (Ndubisi, 2002). But, most empirical studies focused heavily on the types, proximity, quality, and amount of individual elements of landscape. Few empirical studies explored the spatial structure and landscape ecology indices to identify the role of landscape structure on perception and evaluation of people reflected in

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neighborhood satisfaction, which measure the overall well-being (Yang, 2008). Lee et al. (2008) tested the impact of landscape structure and neighborhood satisfaction to identify the evaluation of people, but their data were collected by survey. Although surveys can be a meaningful way to measure neighborhood satisfaction, typically their sample size should be small. Given the facts, this paper attempts to observe the impact of both of composition and configurations of landscape on neighborhood satisfaction as reflected in 9958 parcels nested in 649 subdivisions in Austin, TX from 2009 to 2011. There are relatively larger samples compared to revealed preference studies. In addition, this association was tested through multi-level linear modeling to provide conceptually and statistically more appropriate explanations of the hierarchical nature of neighborhoods and nested parcels. The results of this study are expected to serve as a foundation of landscape planning, landscape management, and land use decisions in practices that utilize more spatially and statistically sensitive approaches.

2. Literature review

2.1. Landscape and human relationship

Human beings are an essential part of landscape ecology (Naveh, 2000); therefore, landscape ecology research has highlighted the importance of understanding the interactions between human and environment relationships (Turner et al., 2001). According to Hunziker et al. (2007), the human-landscape relationship could be categorized into two ways; as physical “space” and cultural and social “place” (Hunziker et al., 2007; Kienast et al., 2012; Ode and Miller, 2011). The first highlighted the role of landscape on restoration from stress and attentional fatigue (Kaplan, 2001; Kaplan, 1995; Ulrich et al., 1991), promotion of esthetical pleasure (Ulrich, 1983), and some other direct benefits such as emotional (e.g., escape from urban settings, feeling of freedom, and identifying with nature), intellectual (e.g., learning nature and local history), social (e.g., social gathering and team building), and physical aspects (e.g., outdoor recreation and feeling being in fresh air; Mostyn, 1979). Numerous empirical studies found the positive impacts of landscape on the promotion of physical activities, social activities, and relief from urban settings (Hayward and Weitzer, 1984; Jim and Chen, 2006; Özgüner and Kendle, 2006; Parsons et al., 1994). The latter regarded landscape as a critical element of increasing place attachment, place identity, and place dependence, each of which imply a positive bond between people and their environments, conscious and unconscious preference, feelings, values, and behavior tendencies, the strength of connections between occupants and specific places respectively (Jorgensen and Stedman, 2001). Empirical studies also found that people develop attachment, identification, and behavior commitment to their surrounding landscapes (Hartig et al., 1997; Hernandez et al., 2007; Rishbeth and Powell, 2013) and a promoted sense of place often becomes strong motivation for community actions including landscape conservation practices in turns (Erickson et al., 2002; Theodori, 2004).

2.2. Landscape patterns on housing premium

Even though it is clear that the association between landscapes and humans should be observed into two modes—sense of space and sense of place—, neighborhood satisfaction studies often combine these two concepts since neighborhood satisfaction arises from the subjective and objective evaluations of occupants experience in neighborhoods (Amérigo and Aragones, 1997). Theoretically, direct and objective benefits from landscape such as economic, recreational, aesthetic, and restorative benefits is likely to increase neighborhood satisfaction (Lee et al., 2008) and therefore promoted place attachment, identity, and dependence (French et al., 2013). Because of the limited data availability of sense of place that required detailed survey data, numerous studies used housing price as a useful proxy to quantitatively measure

neighborhood satisfaction that encompasses the concept of sense of place by focusing on the characteristics of “space.”

In academic research, neighborhood satisfaction is typically measured by two types of preferences: state and revealed. The stated preference approach primarily relies on surveys that evaluate the satisfaction or quality of a neighborhood as a whole or based on specific conditions. Alternatively, the revealed preference approach focuses on market prices that were paid for properties and assumes that people are willing to pay for the neighborhood characteristics they prefer. Both have pros and cons, but it is clear that the observation of housing prices serves as a powerful means to evaluate the quality of neighborhood settings. Previous studies have examined the associations between different types of landscape features and levels of neighborhood satisfaction as revealed by housing premiums. Particularly, the existence, amount, view, or distance toward landscape elements including urban parks, trees, water features, or several types of open space has been identified to have a positive association with housing (or apartment) transaction prices (Baranzini et al., 2010; Baranzini and Schaerer, 2011; Jim and Chen, 2010; Luttik, 2000; Mansfield et al., 2005; Sander et al., 2010; Schlöpfer et al., 2015; Wen et al., 2014, 2015; Yoo and Wagner, 2016).

As shown above, the impacts of composition of landscape on human perception and activities on neighborhood satisfaction have been widely studied, while the configuration has been relatively less tested, though landscape ecologists argue that both configuration and composition are critical factors defining the human-landscape relationship (Ndubisi, 2002). If the composition and configuration of landscape are critical circumstances in human dimension, how can we define the better or worse condition? There is no absolute number and standard, yet some principles were commonly adopted in empirical studies. One of the most popular spatial guidelines, proposed by Forman (1995) and Shafer (1994), assume that heterogeneous sizes of patches, wide corridors, less fragmented and isolated, and more connected landscape could serve better for the ecosystem because these conditions could facilitate flow and movement of species and prevent habitat loss (Lee et al., 2008). Based on these assumption and landscape ecology metrics, landscape planning and management tools utilized the concept to analyze the best area for creating greenways and habitat. Academic literature tested how the configuration affects the citizens' scenic beauty estimation (Antrop and Van Eetvelde, 2000), water quality (Jones et al., 2001), and biodiversity (Uuemaa et al., 2009). Lee et al. (2008) conducted a similar study in which we are interested, which found that less fragmented, less isolated, and well connected landscape would increase neighborhood satisfaction as measured by revealed preference. Given the fact, hypothetically, the different landscape mosaic would influence the level of neighborhood satisfaction and be reflected in housing prices.

2.3. Definition of neighborhoods and operationalization concerns

Even though researchers have adopted the term “neighborhood” as their unit of analysis, the units of data collection used to represent a neighborhood are by no means uniform. The most frequent neighborhood operation was to draw buffers by Euclidean or network distances, typically a quarter-mile, a half-mile, or one mile. A quarter to a half-mile corresponded to a 5-min walking distance, and one mile corresponded to the maximum acceptable walking distance (Lawhon, 2009). Buffer-drawn neighborhoods underscore the importance of personal familiarity and accessibility to one's immediate surroundings (Park and Rogers, 2015). Buffer-drawn neighborhoods prove to be efficient for data collection but not for fulfilling the general definition of neighborhoods, since each parcel contains its own neighborhood. Parcels within a neighborhood are typically bound by a soft boundary (e.g., subdivisions, gated communities, apartment complexes, fee-based communities, homeowners' associations, zip codes, or assessor's codes) or a hard boundary (e.g., administrative districts, geographic barriers:

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