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Value by Design: Smart Design Principles for Neighborhood Shopping Centers

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This study examines the outcome of shopping center development as reflected in their built forms. Specifically, this research explores if the design attributes of the shopping centers are related to their economic and walkability characteristics. This is a cross-sectional study focusing on 19 neighborhood shopping centers in Houston, TX, each with a supermarket chain store. It assessed design and location attributes at the architectural, site, and neighborhood scales. Data sets were obtained from the 2000 Census, parcel data, aerial photos, field audits, shopper counts, trace mapping, and photographs. Due to the small sample size, the analyses focused on bivariate analyses such as the t-test and the Kruskal-Wallis test and factor analyses. Mean property values were higher for the shopping centers located in suburban areas, and those with architectural modulations, roofline variations, and non-linear building layouts. Land value was positively associated with the presence of seating areas, and improvement values were positively associated with roofline variations in buildings. A gas station in the center and a left turn lane along the main frontage street were positively associated with total property value. Neighborhood scale variables were not significant when objectively measured but the perceptual assessment of the overall visual quality was associated positively with the land, improvement, and total property values. Design items that were associated with positive visual assessments included trees in the parking lot or along the frontage streets, seating areas near the supermarket, architectural modulations, roofline variations, and non-linear building layouts. The stores with trees in their parking lot or along the frontage street had significantly higher numbers of shoppers and higher ratings of overall visual quality, compared to those without trees. More people were present in the shopping center where there were seating areas and a dry cleaner. Pedestrian counts were positively associated with higher ratings of lighting and sidewalk conditions. The centers with bus stops had higher percentages of pedestrian shoppers than those without bus stops, while those with a fast food restaurant had lower percentage of pedestrian shoppers.

Introduction

The discussion on smart growth that use to be centered on issues of density and land use mixes has now evolved to include the holistic development of healthy, lively, and sustainable communities. Compact and convenient neighborhoods with vibrant commercial centers, pedestrian-friendly streets, and high-quality urban designs, are among the key principles (American Planning Association, 1998; Porter, 2001). The vitality of retail centers often determines the quality of the entire neighborhood. Recent studies have raised the need to re-visit the traditional urban planning theories that recommend that schools and parks should be neighborhood centers, and proposed retail-based shopping centers as a more effective center of contemporary neighborhoods (Moudon et al., 2006).

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The development of supermarket-anchored shopping centers exemplifies the patterns that are consistent with urban sprawl: fewer and larger stores located along major arterial streets and in suburban areas. The study of neighborhood shopping centers can offer insight into the geography, typology, and design patterns of urban developments in this era of sprawl. Food retailers have been through one of the most dramatic changes during the 1990s, shifting from local, fragmented markets to cross-regional, consolidated markets. The long tradition of localized markets, established by the Robinson Paterson Act of 1936 and Kefauver Act of 1950, was broken during the 1990s following the abandonment of antitrust regulations during the Reagan era. The period of consolidation resulted in the top five grocery retailers sharing about 50% of this gigantic market in 2000 (Seth and Randall, 2001), and was further complicated by the growth of Wal-Mart's super center food sales (Franklin, 2000).

Walkable, pedestrian-friendly designs are now being promoted as an essential tool to counteract urban sprawl. They can help achieve multiple public policy objectives related to smart growth, including environmental protection, economic vitality, social equity, and public health. Empirical studies show that the presence of destinations, especially routine utilitarian destinations such as grocery stores, restaurants, banks, and retail stores, are the key in promoting walking (Cao et al., 2006; Lee and Moudon, 2006). Furthermore, grocery stores are the most frequently visited stores by pedestrians (Seth and Randall, 2001; Moudon et al., 2007), contradictory to the common belief that people do not walk to grocery stores due to the need to carry heavy items. Also, people that live closer to a supermarket or have more supermarkets located nearby are likely to eat more fruits and vegetables (Cheadle et al., 1991; Morland et al., 2002). Wealthy neighborhoods have four times as many grocery stores than low-income neighborhoods (Morland et al., 2002). Furthermore, the poor pay more for their groceries (Caplovitz, 1967). Therefore, shopping centers, especially those with a grocery store, are particularly important because of their strong potential to influence public health and social equity.

Objectives

While many previous studies in retail and shopping center research address the demand, supply, and investment tools related to development (Delisle, 2005), studies on the actual outcome of the real estate development process as reflected in the built forms are limited. This research explores if and to what extent the physical setting and design attributes are related to the economic and walkability values of the development. First of all, this study reviews the literature identifying the physical design and setting attributes that may add value to shopping center developments. It then presents an empirical investigation on how the specific setting and design features of neighborhood shopping centers are associated with increased walkability and economic values.

This study focuses on multi-store neighborhood shopping centers with a chain supermarket anchor. In order to capture all of the design principles relevant to smart growth, it assesses design and location attributes at multiple spatial scales including the architectural, site, and neighborhood scales. It also covers two value concepts:

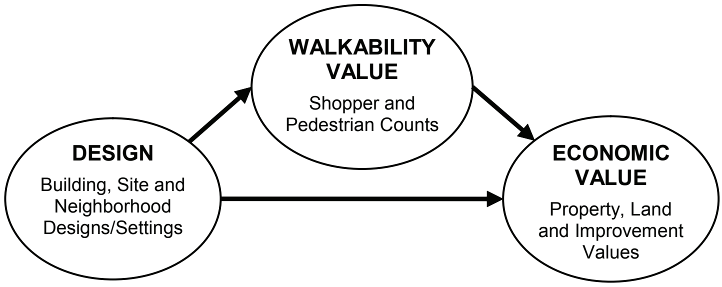

Figure 1.
Research Objectives and Conceptual Framework.

economic value and walkability value. Real estate value is considered as an estimate of a development's economic value. Walkability is considered as an important value concept to development given its significance as a key smart growth strategy, its potential to bring additional sales, and its potential social and public health value as cherished by the public and policy makers. Walkability is captured by shopper counts and pedestrian counts. Both values are conceptualized as outcomes of good design in this study (Figure 1).

Drawing from the literature, the concept of good design in this study is based on pedestrian-friendly features and aesthetic visual quality. This research focuses on objectively-measurable and easily-modifiable design features such as parking lot design, trees and landscaping, building layout, building façade, signage, sidewalks, crosswalks, and lighting. The paper provides recommendations about the potential design treatments that developers and planners may consider to improve the design quality of neighborhood shopping centers and increase walkability and economic value.

Literature Review

A literature review was performed to identify the measures and definitions of "value" and "design" to be used for this study. This covered a broad range of topics from multiple disciplines. Keyword searches were performed using the terms retail site design, retail size, retail location, tenant mix, shopping center, externalities, value definitions, valuation, location theory, shopping behaviors, shopping center designs, value-added design, and value-sensitive design. To complement the keyword search, a list of additional journals was created to conduct more extensive inquiries within each journal, because not all relevant journals were included in the standard citation databases. Twenty-seven journals were identified from the areas of real estate, retail business, and urban planning, and reviewed by researchers from relevant fields to ensure their completeness. The review process was systematic and followed the process of title review, abstract review, and full paper review. A review template was developed and used for the full review to ensure consistency in the review process and results.

Retail sales and rents were the most frequently used variables for measuring development value. In addition, property value, sale price, vacancy rate, customer loyalty, consumer satisfaction, store image, developer/development image, shopping motives, shopping mode, and consumer behaviors were often considered to be strong correlates of the value of retail developments (Sirmans and Guidry, 1993; Eppli, 1998; Mejia and Benjamin, 2002; Mejia and Eppli, 2003; Des Rosiers et al., 2005; Lee et al., 2006). Additional correlates in the literature have included increased public support, competitive edges, and faster absorption (Smith and Webb, 1997; Reimers and Clulow, 2004).

The neighborhood scale environmental variables that were most commonly found to be associated with development values were density, crime rates, traffic conditions, the locations of competing stores, the size of supporting market area, and geographic locations (urban versus suburban). For site scale design attributes, the size of the shopping center, development/store age, tenant mix, anchor store type, anchored versus non-anchored stores, tenant and retail layout/configuration (Brown, 2001; Hardin and Wolverton, 2001), accessibility, access road type, local speed limit (Laiderman, 1997), the presence of a left-turn lane (Hardin and Wolverton, 2001), regional locations, visibility, ratio/number and location of parking spaces, and aesthetics related to architecture and landscape designs were associated with the development values. Laiderman (1997) pointed out that the physical site factors were significant beyond the socio-demographic factors. The speed limit of the access road was one of the most crucial factors, and the maximum speed limit for high-performance stores was 35 mph. Smith and Sanchez (2003) found that after controlling for the demographic, store, and competitive market characteristics, spatial-locational variables explained significant amounts of variation in store performance.

The literature review also covered an additional issue relevant to this study: social equity related to access to goods and services. Disadvantaged populations with limited transportation mobility tend to rely more on local shops (Thomas, 1995) and are more likely to be stranded in food deserts (Lang and Caraher, 1998). The various levels of income are perhaps the major factor contributing to the inequitable distributions of shopping and services. Most businesses are located based on "rooftops," the total number of households in an area and the total spending power of those households. This has resulted in serious spatial and social equity problems that have left the poor with fewer grocery stores nearby (MacDonald and Nelson, 1991, Chung and Myer, 1999), paying more for their food than the others (Caplovitz, 1967). Furthermore, Helling and Sawicki (2003) found that after controlling for aggregated income, predominantly black census tracts in ten counties in metropolitan Atlanta had significantly lower accessibility to shopping and services compared to the predominantly white census tracts.

Although some empirical evidence exists on the significant roles of design or built environmental variables, the majority of the previous studies reviewed focused on the socio-demographic characteristics of the trade area. Another limitation with examinations of design and value in these studies was that the assessment methods were often based on the square footage of the built product (Commission for Architecture and the Built Environment, no date). This method does not account for the value added to the site by good design. This proposed research aims at addressing some of these gaps, by considering the "design" of the built environment at multiple spatial scales, and by expanding the traditional monetary assessment of values to include walkability, which is one of the widely valued concepts relating to the larger environmental, social equity, and public health benefits as previously discussed.

Methods

Study Sites and Selection Methods

This is a cross-sectional study focusing on 19 neighborhood shopping centers with a supermarket chain anchor store in Houston, TX. Houston is the fourth largest city in the U.S., with a rapidly growing (19.7% increase from 1990 to 2000, 3rd in the nation) and diversifying (40.7% White in 1990 to 30.8% in 2000) population. It is also known for being the only major city in the US with no formal zoning code. Along with its flat terrain, which poses no natural barriers to expansion, this city has been growing in a sprawling manner, radiating outward in all directions. Houston has had a strong automobile culture ever since the 1920s, with strip shopping malls and drive-in facilities (City of Houston, no date). About 90% of the population growth between 1990 and 2000 occurred in areas outside the Loop 610 (City of Houston, no date, 3-2). Residential and commercial flight in and out of Houston was triggered by a massive, extensive freeway construction during the 1960s (City of Houston, no date). Newer suburban retail centers have an increasing share of the city's retail sales. Houston still has about a quarter of its land area vacant or undeveloped as of 2000. However, net residential density is quite high at 8.28 units per acre, or 5.81 for single family and 21.74 for multi-family, in 2000 (City of Houston, no date).

The supermarket chain was selected based on having the largest number of stores among all comparable chain stores in Houston. Out of the initial 50 shopping centers considered, the final 19 shopping centers were selected based on: (a) spatial dispersion, stratified by areas within Loop 610, between Loop 610 and Beltway 8, and outside Beltway 8 (Figure 2); (b) a diverse income distribution in the surrounding neighborhood; (c) a diverse ethnic composition of the surrounding neighborhood; (d) no more than one center selected from the same frontage street or with almost identical site and building designs; and (e) the presence of multiple stores, excluding stand-alone supermarkets.

Data Source and Data Collection

Data was collected from multiple data sources. Socio-demographic variables were obtained from the 2000 U.S. census at the block group level. The neighborhood was defined by all census block groups within or overlapping a 1-mile radius area from the selected shopping center. Physical setting and design variables and shopper counts were collected from field audits, observations, and visual surveys with photographs.

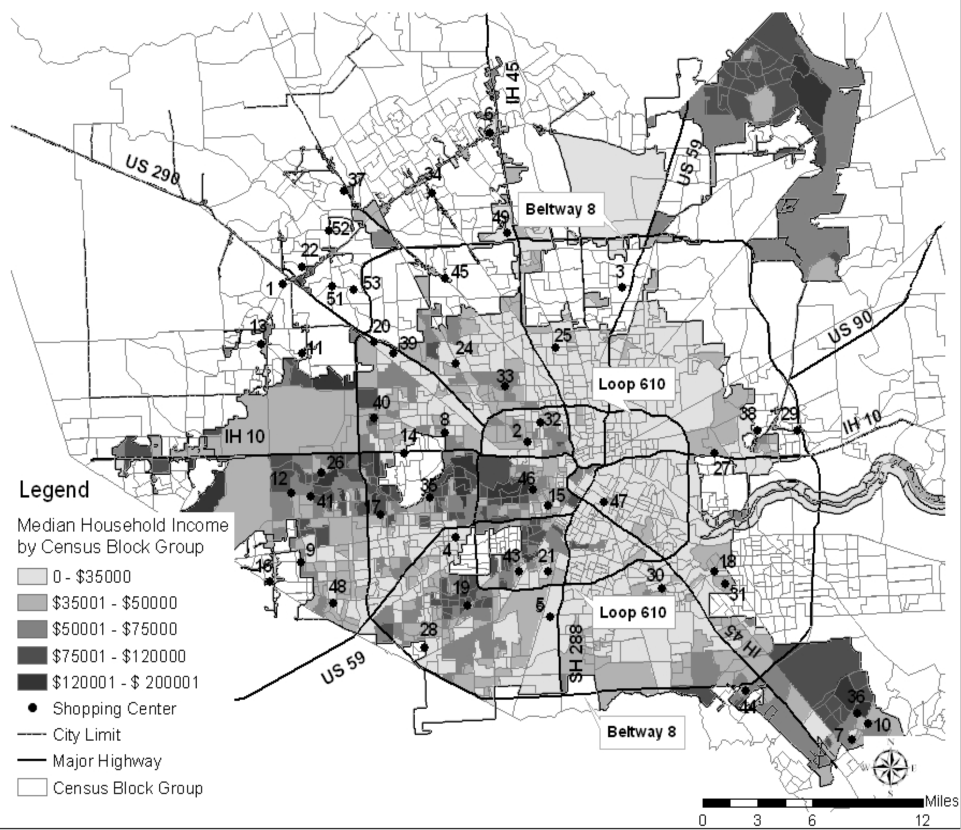

Figure 2.
Selected Shopping Center Locations in Houston, by Neighborhood Income
(n = 19, number shown are store IDs)

Secondary data were also used, including aerial photos and maps from on-line mapping websites, Digital Orthophoto Quarter-Quadrangles (DOQQs) from the US Geological Survey, and the chain supermarket's company website. The Geographic Information System (GIS) data included the parcel data with property value (from 2001) and land use information from the County appraisal district. Streets, administrative boundaries, and other GIS layers were obtained from the city's Information Technology Division under the Housing Planning and Development Department and from the Houston Geographic Information Management System website.

The environmental audit instrument, a systematic data collection tool, was developed and pilot tested on two local shopping centers. The audit instrument focused on capturing the building and the site level design variables including adjacent land uses, frontage streets, and perceptual assessments. Most of the neighborhood scale variables such as street connectivity, sidewalk availability, street trees, density, and land use mix were captured in GIS using the secondary data. The walkability value variables were collected from direct observations.

Variables

The study variables were grouped by spatial scale and dimensions (Table 1). Architecture scale variables included the number of buildings, total square footage of the buildings, number of floors, building age, visibility of the building, entrance, and signs from the frontage street. Aesthetic variables included the building's façade and entry design, roofline variations, architectural modulations, exterior materials, and color.

Physical functional variables consisted of the total land area, tenant mix, parking, visibility, accessibility, public space, seating area, year developed, drop off area, size and ratio of parking lot, lighting, and driveways to the center. Characteristics of the frontage streets were assessed, including the speed limit and the presence of a left turn lane, median island, bus stop, marked crosswalk, signaled crosswalk, bike lane, sidewalk, lighting, and street trees. Aesthetic quality variables were measured using a 10-point Likert-style scale for cleanliness, maintenance, color scheme, and overall visual quality, and by the presence of various landscaping elements or attributes in the parking lot and near the buildings.

At the neighborhood scale (census block groups within a 1-mile radius area from the shopping center), the functional variables included residential density, land use composition, regional location, distance to the closest competing store, the presence of sidewalks and bike lanes, transit service, and lighting. Subjective assessments of the neighborhood aesthetics focused on the ratings of overall visual quality, landscape visual quality, architectural visual quality, maintenance, and cleanliness. Socio-demographic characteristics of the neighborhood considered in the study were total household counts, mean population density, mean household income, education level, racial composition, mean age, marital status, and car ownership.

The shopper counts were conducted for a 20-minute off-peak period (avoiding commuting hours and lunch hours) during a weekday in June and July of 2007. Weather conditions for the audited days were partially cloudy and cloudy with a temperature ranging from the low 80s to low 90s. The snapshot counts of parked cars and pedestrians present outside at the shopping store were performed by counting them one time during the audit. Although efforts were made to keep the data collection method and protocol consistent, both the shopper count and the snapshot count data are limited due to the differences in the times that the data were collected.

Analysis

The sample size for this study is small and therefore the analyses focused on the bivariate analyses such as the t-test and the Kruskal-Wallis test to explore the correlation between the design and value variables. The non-parametric Kruskal-Wallis test was used because many variables did not meet the assumptions of normal distribution and/or equal variance. Multivariate analyses were used to estimate the property value variables after controlling for the three major confounding factors: the total parcel size, building square footage, and the number of stores in the shopping center. Factor analyses were used for the 10-point Likert-style items that measured

Table 1.
Study Variables.

DIMENSION	SCALE: Architecture	Site	Neighborhood (1 mi. area)
Functional	Number of buildings Building square footage Number of floors Building age Visibility	Total site size Tenant mix Parking & driveways Visibility, Lighting Accessibility Year developed Connectivity Drop off area Seating area Adjacent land uses *Frontage street(s):* Left hand turn lane Road classification Posted speed Crosswalk & signals Sidewalk Bike lane Transit	Distance to competing store Regional location Land use Residential density Street connectivity Sidewalk Bike lane Transit Lighting *Non-design variables:* Mean household income Education levels Racial composition Mean age Marital status Car ownership
Aesthetic	Color scheme Façade design Entry/lobby design Exterior material Roof line variations	Overall color scheme Landscaping near building Landscaping of parking lot Cleanness Maintenance	Visual quality Street trees Street cleanness Street maintenance

Note: Descriptive statistics are reported for the significant variables only in the Results section.

the perceptual assessment of the shopping centers' design quality. For this type of psychological measures, latent factors are more effective than individual observed variables.

Results

Qualitative Overview

Typically located in a large piece of land, the shopping centers studied were located and designed primarily based on market considerations, including local land uses, catchment area characteristics, and automobile accessibility. They were often located along major arterials and near highways with over-sized parking lots in front of the buildings. These parking lots were usually underutilized with less than one-third of the available spaces occupied. The mean distance to major highways (State and Interstate) from the selected stores was 1.38 miles. Distance to the closest shopping center that had the same food chain anchor store was about 3.24 miles, corresponding roughly to a general catchment area criterion of around 2-3 miles used for these types of neighborhood food-retail stores.

The physical design attributes of the buildings, parking lots, overall layouts, and landscaping varied significantly. Little to no attention was typically paid to pedestrians in design. Provision of pedestrian walkways within the shopping center and accessibility from the adjacent neighborhoods were limited. Several shopping centers had vacant land, abandoned buildings, or large open spaces immediately adjacent to them, creating a hostile environment for pedestrians. The field audit also revealed physical traces of shoppers who walked or used transit to get to and from the shopping center. Frequently found physical traces of pedestrians included shopping carts left near transit stops and even along residential streets in the adjacent neighborhoods (Figure 3). Many physical barriers to walking were also present. Many stores had residential areas located immediately adjacent to them sharing property boundaries. However, pedestrian access was not possible due to tall fences. Other barriers observed included a lack of sidewalks, a lack of (signaled) crosswalks, drainage problems, poor lighting conditions, vacant lots, abandoned buildings, and a lack of tree shade. Even where sidewalks were present, they were in poor condition, with trash, overgrown weeds, cracks, holes, and standing water, especially in low-income neighborhoods (Figure 3).

Most shopping centers were of the conventional "strip" typology, consisting of a single, long building. The building was often situated far away from the streets with wide setbacks and a large parking lot occupying the space between the streets and the building. Several newer developments had an "L" shape or even more complicated layouts with multiple buildings. Parking lots in all selected shopping centers were visually prominent and covered a large proportion of the land area. However, their design, layout, and landscaping was sterile with relatively minor variations across the centers; there was the strong potential to enhance the overall visual quality and pedestrian accessibility of these shopping centers.

Some variations in architectural styles were found, especially those located in central areas. Those shopping centers in suburban areas appeared to have similar building designs. Architectural variations seemed to be focused on the entrance area including the rooflines, openings, colors, materials, and modulated surfaces. Two of the newer developments (Stores No. 46 and No. 35) incorporated design features that appeared to be included to appeal to pedestrians and to enrich the overall shopping experience, including walkways, awnings, extended seating areas near entrance, and window displays. The shopping centers with the more appealing design attributes and better accessibility from the adjacent neighborhoods tended to be located in more central areas, higher income areas, and/or areas with more White shoppers. Stores located in poorer neighborhoods or in areas with large numbers of minority shoppers had significantly poorer overall design quality and poorer maintenance conditions. They also often had trash, cracks, and peeling paint in their parking lots, and overgrown weeds and trash on nearby streets and sidewalks.

Figure 3.
Pedestrian Traces and Barriers.

Economic Value

Property Value and Neighborhood Income: The total property values of shopping centers as of 2001 ranged from $264,420 to $11,315,700, with improvement values ranging from $151,120 to $7,630,840. Newer developments were more likely to have higher improvement values (Pearson's $r = 0.671$, $p = 0.006$), higher total property values ($r = 0.634$, $p = 0.011$), and higher percentages of White populations living within 1 mile from the store ($r = 0.597$, $p = 0.019$). Those stores further away from the city center had higher neighborhood incomes and higher proportions of White households, which is evocative of the trends of population and commercial flight that the city has been experiencing over the past several decades. It appeared that these shopping centers in general were more likely to be located in wealthy neighborhoods, as well; median household income within a 1-mile radius area of the selected shopping centers was $46,527, much higher than the citywide median of $36,616.

Shopper Counts and Shopper Characteristics: From the 20-minute supermarket shopper count data, 50% of the total shoppers were White, 25% African American, 20% Hispanic, and 5% Asian. Ethnic composition of the shoppers varied significantly. The total number of shoppers ranged from 35 to 118 shoppers during the 20-minute audit (Table 2). Stores in suburban locations (outside Beltway 8) had higher mean shopper counts (81 shoppers) compared to the other stores in two more central locations (66 shoppers for the stores within Loop 610, and 63 for the stores between Loop 610 and Beltway 8). Suburban stores had a much higher proportion of White shoppers (59.5%), compared to the other locations (42.8% and 39.3%). Higher percentages of Hispanic shoppers were found for the stores within Loop 610. The snapshot counts of parked cars in the shopping centers ranged from 67 to 321 (mean 139), of which 39 to 164 were parked near the grocery store. While most stores had bike racks, only two stores had any bikes parked. One store had 63% Hispanic shoppers, which also had the highest percentage of multi-family housing parcel areas (26.7% within 1-mile and 40.2% within half-mile radius area from the center). It also had a low median household income of $29,799 based on the 1-mile area. The store with the highest proportion (74%) of African American shoppers was one of the oldest stores (developed in 1970) and had the poorest local population (median income $30,916). This store's pedestrian accessibility was very poor, as it was bounded by a river on one side and vacant land on another, and its main frontage street was poorly maintained.

Walkability Value

The snapshot count of pedestrians in the shopping center ranged from 2 to 34 (Table 2), with the highest count from one of the centrally-located stores within Loop 610 (Store ID: 46). The percentage of shoppers who engaged in some pedestrian activities during the 20-minute count (e.g., walking to other stores, waiting outside the store, or walking/biking home) ranged from 0% to 29% (mean 10%). The two stores that had more than 25% of their shoppers engaged in pedestrian activities both had distinctive characteristics. The store with the highest rate of pedestrian activities was the most ethnically diverse (57% Hispanic and 24% African American shoppers), and one of the oldest. It also had the highest percentage of single-family housing (58%) in its 1-mile neighborhood area, and had a low median neighborhood income of $30,916. The store with the second-highest pedestrian activity level was located in a predominantly White neighborhood (82% White, the highest White population percentage) with a median income of $50,497, and had a high gross residential density of 9.57 units per acre. On the other end of the spectrum, one store had no pedestrian activity at all during the 20-minute count and another 20-minute audit period; this store (Store ID: 7) was the newest (developed in 2001) and the most remotely located store in the sample.

Availability of transit service is often the key to walkability and many previous studies have reported it to be among the strongest correlates of walking (Lee and Moudon, 2006). Transit service was clearly associated with the store's geographic location. All stores within Loop 610 had bus transit services in at least one of their frontage streets. Five out of seven stores (71.4%) from the area between Loop 610 and Beltway 8 and only one out of the seven stores (12.5%) outside Beltway 8 had transit services.

Table 2.
Shopper Counts and Characteristics.

Class	Measure	Mean	SD
Total	Total number of shoppers	72.75	22.60
	Number of parked cars in the shopping center	138.89	64.15
	Number of parked cars near the grocery store	84.17	30.88
	Number of people outside of shopping center	13.44	7.62
	Number of people outside of grocery store	10.69	7.80
Gender	Percentage of male shoppers	43%	6%
	Percentage of female shoppers	57%	6%
Race	Percentage of White shoppers (citywide: 30.8%, 2000 Census)	50%	25%
	Percentage of Hispanic shoppers (citywide: 37.4%, 2000 Census)	20%	18%
	Percentage of African shoppers (citywide: 25.0%, 2000 Census)	25%	19%
	Percentage of Asian shoppers (citywide: 5.5%, 2000 Census)	5%	5%
Age	Percentage of child shoppers	10%	5%
	Percentage of young shoppers	39%	7%
	Percentage of middle-aged shoppers	43%	9%
	Percentage of older shoppers	7%	5%
Company	Percentage of shoppers who shop alone	56%	10%
	Percentage of shoppers who shop with family or friends	44%	8%
Egress	Percentage of shoppers who walk toward parking lots	90%	9%
	Percentage of shoppers who walk to other stores, wait, and walk/bike home	10%	9%

Design

Overall Aesthetic Quality: The factor analysis consisted of a principal component analysis with varimax rotation. It revealed four latent factors related to the overall visual aesthetic quality and the perceptual assessment of the shopping centers. These four factors captured about 77.2% of the total variation from 27 observed variables. Two variables that created their own individual factors were excluded, as well as one variable that was not loaded significantly to any factor (based on the minimum factor loading of 0.5). Many visual quality items related to the architecture, including building color, façade design, signage design, etc., were loaded onto the first factor. The second factor captured the visual quality items related to the surrounding neighborhood, including the street conditions. The third factor captured lighting and sidewalk conditions. The last factor captured two variables with opposite directions of associations: landscape visual quality of the shopping center and parking circulation (Table 3). This was likely due to the fact that shopping centers with some landscaping treatments had slightly more complicated parking lot designs as a result of planted medians and other landscape treatments incorporated into the parking lot, making driveway circulation less clear or less efficient. Figure 4 shows examples of high-rated and low-rated visual quality of the shopping center and the surrounding neighborhoods.

Table 3.
Factor Analysis Results of Perceptual Assessment Variables.

Factor Name	Measure	1	2	3	4
Factor 1: Visual and Design Quality	How is the visual quality of the supermarket building?	**0.906**	0.274	-0.006	0.046
	How is the color scheme of the supermarket building?	**0.914**	0.248	0.004	-0.147
	How is the sign design of the supermarket building?	**0.916**	0.210	-0.123	-0.205
	How is the facade design of the supermarket building?	**0.917**	0.231	-0.022	-0.098
	How is the entrance design of the supermarket building?	**0.928**	0.243	-0.012	-0.094
	How clean is the shopping center?	**0.740**	0.251	0.206	0.075
	How is the color scheme of the shopping center buildings?	**0.896**	0.256	0.080	0.283
	How is the sign design of shopping center?	**0.895**	0.175	0.067	0.349
	How is the facade design of the shopping center buildings?	**0.917**	0.171	0.052	0.327
	How is the visual quality of shopping center?	**0.827**	0.162	0.304	0.312
	How is the architecture visual quality of shopping center?	**0.886**	0.111	0.266	0.286
Factor 2: Neighborhood Aesthetics and Maintenance	How is the overall visual quality of the neighborhoods?	0.222	**0.937**	0.005	0.001
	How is the architecture visual quality of the neighborhood?	0.385	**0.901**	0.020	0.068
	How is the landscape visual quality of the neighborhood?	0.240	**0.935**	-0.006	-0.013
	How is the level of enclosure in the neighborhood?	0.403	**0.741**	0.212	0.096
	How is the level of tree shading in the neighborhood?	-0.087	**0.859**	-0.023	0.150
	How is the level of transparency in the neighborhood?	0.361	**0.589**	**0.579**	0.008
	How clean are the streets in the neighborhood?	0.358	**0.759**	-0.204	-0.082
	How is frontage streets' road condition?	0.096	**0.532**	0.312	0.247
	How clean are the buildings in the neighborhood?	0.434	**0.693**	0.104	-0.099
Factor 3: Lighting & Sidewalk Condition	How is the shopping center's lighting condition?	0.094	0.112	**0.718**	-0.288
	How is the frontage streets' lighting condition?	0.069	0.067	**0.886**	0.055
	How is the frontage streets' sidewalk condition?	0.461	-0.127	**0.503**	0.069
Factor 4: Parking Circulation & Landscape	How is the landscape visual quality of the shopping center?	0.568	0.292	0.047	**0.652**
	How efficient is parking lot's vehicular circulation in the shopping center?	-0.063	0.048	0.162	**-0.787**

Small Shopping Center, Parking Lot
with No Trees

Large Shopping Center, Parking Lot
with Trees

Adjacent Neighborhood, Single Family
with Landscaping

Adjacent Neighborhood, Multi-Family
with Fences and Wires

Figure 4.
Visual Quality of the Shopping Center and the Surrounding Neighborhoods.

Architectural Scale: The shopping centers in the sample had up to 25 individual stores, with a mean of 11 stores. All but one were single-story buildings. The shopping center buildings were built between 1959 and 2001 (6 to 49 years old at the time of the survey). Most buildings (14 out of 19) had some roofline variations and all but two buildings had openings with windows or glass walls and used diverse exterior materials including concrete, bricks, and glass (Figure 5). Most buildings had architectural modulations, especially on their facades, and many had benches and seating areas incorporated into the building's entrance area. In general, two color tones were used for the buildings, typically white to yellow white and red-brown to maroon tones. Several buildings had covered walkways or awnings. All buildings had clearly defined entrance designs with pitched roofs, extended entry lobby areas, articulated exterior modulations, and additional details in the architectural treatments (Figure 5). Signs for the stores were somewhat coordinated across different stores within the same shopping center but with little variation across the shopping centers.

Site Scale: The shopping center sites were typically large in size (mean 6 acres, ranging from 1 acre to over 12 acres), taking up multiple parcels and sometimes the entire street block. Most (14 out of 19) shopping centers had a single "I" shape building, typical of the strip-type shopping centers, and two had an "L" shape layout. Three centers incorporated a more complicated building layout with multiple freestanding buildings, which tended to be located in higher-income neighborhoods (median $43,917 to $71,568) than the others.

The shopping center buildings were separated from the streets often by an oversized parking lot. The aerial photo analysis showed that parking area occupied

Figure 5.
Variations in Architectural Designs.

about 40% to 70% of the entire land area (mean 52%). The mean number of parking stalls was 449 with the range from 200 to 996 stalls. While occupying the majority of the land area, the actual counts of parked cars (67 to 321, mean 139) showed parking lots were underutilized with only about 31% of the parking spaces occupied on average. The shopping centers had three to ten driveways into the center from two to four frontage streets. Five centers had no sidewalks along their frontage streets. Even for those frontage streets lined with sidewalks, the widths were usually narrow (typically three feet) and only two centers had five-foot sidewalks. Two suburban centers had no crosswalks (Store IDs = 6 and 38); these centers were located right at the edge of the city's boundary. Only two centers had bike lanes along their frontage streets. The frontage streets had posted speed limits of 35 to 45 miles per hour. All but one center's frontage streets had multiple power lines and other utility lines, which significantly damaged the visual quality of the street landscape.

The types of other retail or service stores located in the shopping center along with the supermarket appeared to have some similarities. Up to 25 different stores were located in a shopping center; the most frequently found type of store was the beauty/hair salon (14 out of 19 stores). Most anchor supermarkets had a drug store (100%) and a bank (79.0%) located within the store. Other commonly found stores in the shopping centers were restaurants (63.2%), dry cleaners or laundromats (57.9%), fast food restaurants (52.6%), banks (47.4%), video stores (41.2%), drug stores (36.8%), post offices (36.8%), gas stations (31.6%), and clothing stores (31.6%). Coffee shops, discount stores, insurance offices, eye care shops, gift shops, pawnshops, hardware stores, clinics, bike shops, liquor stores, ice cream shops, shoe shops, jewelry shops, and fitness centers were also found but only in a few centers.

Neighborhood Scale: Commonly found land uses immediately adjacent to the shopping centers included single-family and multi-family residential areas (adjacent to 11 shopping centers each), offices (8), restaurants (8), fast food restaurants (9), retail stores (13), service facilities (14), vacant land (6), and big box retail stores (3).

In relation to the larger neighborhoods within a one to one-and-a-half mile radius from the shopping center, these shopping centers tended to be situated in areas with significantly higher proportions of residential areas, commercial uses, offices, and public/institutional uses than the citywide average (Table 4). The land use compositions and street network patterns presented a wide range of variations within the shopping centers studied. Figure 5 shows examples of mixed-use versus predominantly residential neighborhoods located in urban and suburban settings. Street patterns around most urban shopping centers featured grid-like patterns with varying sizes of street blocks. Suburban stores had super blocks with loops and cul-de-sacs. Gross residential density of the 1-mile neighborhood ranged from 2.86 to 13.57 units per acre. The densest neighborhood was for Store ID = 4, where the proportion of multi-family housing was the highest (Figure 6). The store with the lowest residential density was located the furthest away from a highway; it was primarily White (78%, compared to the mean of 66%), with high proportions of vacant land and office/institutional uses in the surrounding neighborhoods.

Linkage between Design and Value

Mean property values (as of 2001) were $2,311,660 for the stores within Loop 610, $4,599,414 for those between Loop 610 and Beltway 8, and $6,332,274 for those outside Beltway 8. This difference was significant at the 0.05 level. Total user counts were significantly higher for the outer Beltway stores with 81 shoppers, compared to 66 and 63 for the other two locations. These suburban stores outside Beltway 8 also had higher percentage of White shoppers (50.5%) compared to those within Loop 610 (26.7%) and within Beltway 8 (28.3%). As expected, property values for those shopping centers located in middle-income ($40,000 to $50,000 of median yearly household income) or high-income (>$50,000) neighborhoods were much higher (mean $5,001,814 and $5,984,713, respectively) than those located in low income areas ($2,287,638). A much higher number of White shoppers were found in high-income neighborhood centers (62.2%), as compared to the middle-income (30.0%) and low-income neighborhood stores (12.3%). Number of parked cars near the grocery store was much higher for the high-income neighborhood stores (102 cars) than the other stores (55 to 83 cars).

Design and Economic Value: Total property values were higher for stores with architectural modulations (mean $5,408,196 vs. $2,051,387), roofline variations (mean $5,706,469 vs. $2,066,550), and non-linear (other than "I" shape) building layouts (mean $7,525,272 vs. $3,583,568) (Table 5). Higher land values were associated with seating areas and a lack of landscaping near the building. Improvement values of the shopping center buildings with roofline variations were more than twice of those

Table 4.
Land Uses in Surrounding Neighborhoods Compared to the Citywide Means.

	% of land uses within		Citywide Mean*
(*n* = 16)	0.5 mile area	1 mile area	
Single family	40.4%	38.3%	21.0%
Undeveloped/Vacant	13.8%	16.2%	24.0%
Multi-family	10.6%	9.2%	3.8%
Commercial use	10.5%	9.2%	4.0%
Public/Institutional use	6.3%	7.0%	4.9%
Park/open space	5.9%	8.1%	8.8%
Industrial use	5.0%	5.1%	6.8%
Office use	3.6%	2.8%	1.3%
Agriculture	0.9%	1.3%	2.6%
Others	2.9%	2.8%	22.8%

without roofline variations (mean \$2,844,891 vs. \$1,246,914). In the multivariate analyses which controlled for the total property size, square footage of the buildings, and the number of stores in the shopping center, the presence of a gas station in the center, and a left turn lane along the main frontage street were positively associated with the total property value ($p < 0.01$). The presence of seating areas near the entrance to the grocery store and a coffee shop in the shopping center were positively associated with increased land value in the multivariate analyses. However, many significant design variables from the bivariate analyses did not hold their significance in the multivariate analyses (Table 5).

The total number of shoppers can be considered a proxy for a store's sales. Stores with trees in their parking lots had significantly higher numbers of shoppers than those without trees (80.8 versus 56.8 shoppers per 20 minutes, $p < 0.1$). Similar associations were found for stores with street trees along their frontage roads (89.3 versus 45.0 shoppers per 20 minutes, $p < 0.1$). Total property values were strongly correlated with the number of parked cars in the shopping center (Pearson's $r = 0.709$, $p < 0.01$). About half of the centers' parking lots had trees, which was significantly associated with increased overall landscape visual quality assessment ratings (mean ratings of 5.10 with trees vs. 3.43 without trees out of 10, $p < 0.05$). Kruskal-Wallis tests using a three-category property value variable (low < \$2,500,000, \$2,500,000 <= medium < \$5,000,000, high >= \$500,000) showed that property value was positively associated with (a) higher overall visual quality, architectural visual quality and landscape visual quality of the shopping center; (b) more parked cars in the shopping center; and (c) more office uses and fewer institutional uses within the 1-mile neighborhood area ($p < 0.1$ for all variables).

None of the objectively measured neighborhood-scale land use and design characteristics were significantly associated with the shopping center's property value. However, the perceptual assessment of the neighborhood's overall visual quality (factor variable) was associated positively with the land value ($p < 0.05$), improvement value

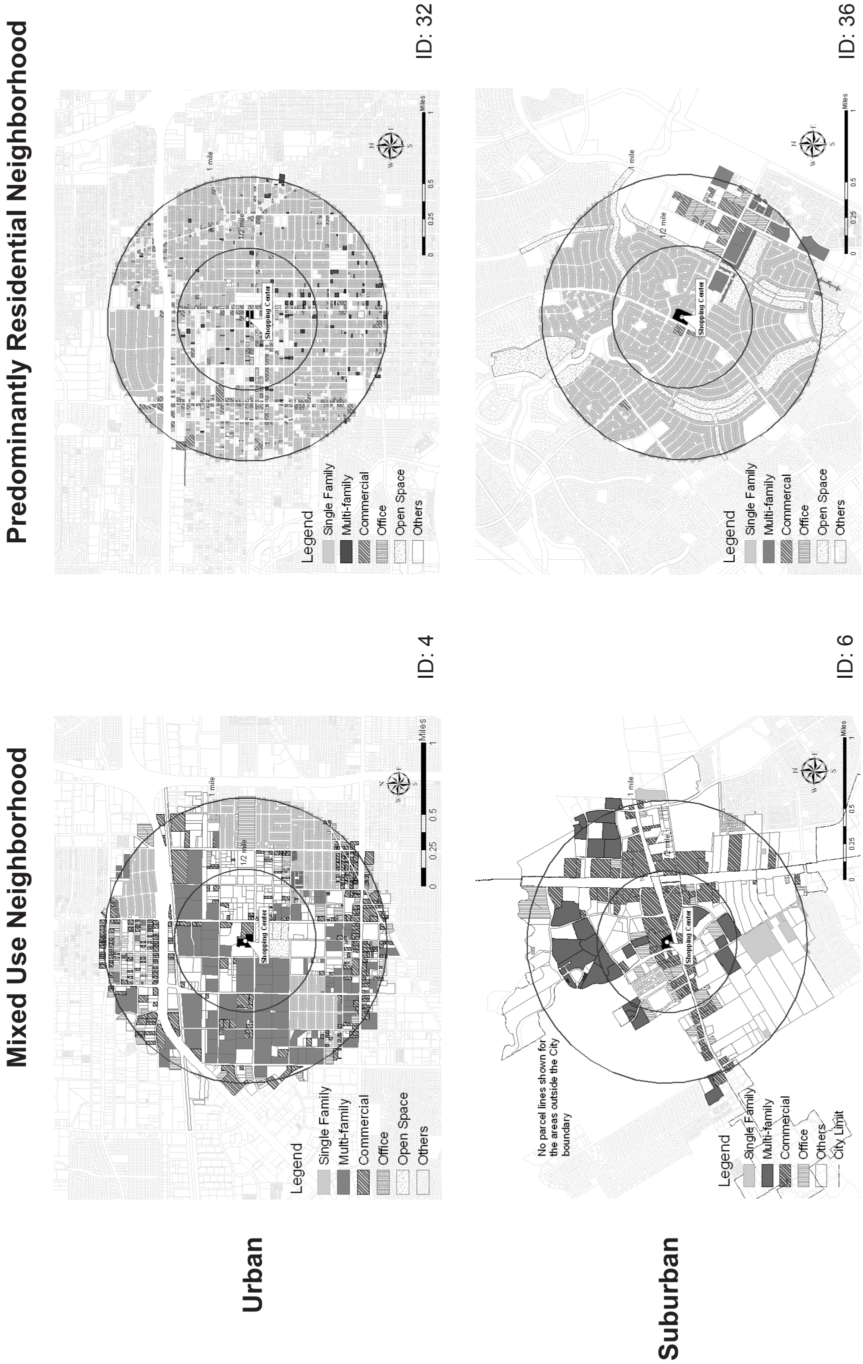

Figure 6.
Neighborhood Land Uses and Street Patterns: One Mile Radius Area from the Shopping Center

Table 5.
Design Variables Significantly Correlated with Development Values

		Descriptive Statistics		t-test		Multiple Regression*	
		Yes	No	t	Sig. (2-tail)	t	Sig. (2-tail)
Total property value in 2001							
Architecture	Does the supermarket building have architectural modulations? (Yes=12, No=4)	$5,408,196	$2,051,387	-3.016	0.010	ns	ns
	Do the shopping center's buildings have varied rooflines? (Yes=11, No=5)	$5,706,469	$2,066,550	-3.187	0.008	ns	ns
	Does the supermarket offer seating areas? (Yes=13, No=3)	$5,146,412	$2,066,850	-2.792	0.014	ns	ns
	Does the supermarket building have bike racks? (Yes=12, No=3)	$5,301,773	$2,451,813	0.025	0.025	ns	ns
Site	Does the shopping center have "I" shape building layout? (Yes=12, No=4)	$3,583,568	$7,525,272	-2.194	0.046	ns	ns
	Does the shopping center have a gas station? (Yes=6, No=13)	$9,831,357	$3,354,603	-4.232	0.001	2.656	.024
	Does the main frontage street have a median island? (Yes=10, No=5)	$6,012,463	$2,224,856	-3.112	0.011	ns	ns
	Does the main frontage street have a left turn lane? (Yes=12, No=3)	$5,354,773	$2,330,547	-2.521	0.026	2.091	.066
Parcel land value in 2001							
Architecture	Does the supermarket building offer seating areas? (Yes=14, No=5)	$1,853,562	$218,335	-3.813	0.002	1.945	.080
	Does the supermarket building have bike racks? (Yes=13, No=5)	$1,879,249	$349,334	0.025	0.025	ns	ns
Site	Does the shopping center have a coffee shop? (Yes = 2, No=17)	$4,021,230	$1,117,594	-3.149	0.006	2.924	.015
	Does the main frontage street have a median island? (Yes=12, No=6)	$1,936,572	$349,803	-3.158	0.007	ns	ns
	Does the main frontage street have a left turn lane? (Yes=14, No=4)	$1,677,999	$461,422	-2.402	0.029	ns	ns
Property improvement value in 2001							
Architecture	Do the shopping center buildings have roofline variations? (Yes=14, No=5)	$2,844,891	$1,246,914	-2.140	0.047	ns	ns
	Does the shopping center's supermarket building have grasses nearby? (Yes = 2, No=17)	$5,415,420	$2,072,483	-2.128	0.048	ns	ns

($p < 0.1$), and total property value ($p < 0.1$). From the other subjective assessment variables, visual quality of the grocery building was positively associated with parcel's land and total values ($p < 0.1$). The frontage streets' road conditions were positively associated with the improvement value only ($p < 0.1$).

An additional finding that is worth noting is the significant correlation between the racial composition of the 1-mile neighborhood and the shopping center's design characteristics. Shopping centers located in White-dominant neighborhoods were more likely to have street trees and left turning lanes along the frontage streets; restaurants, gas stations, and banks within the shopping center; and modulations in the grocery store building (all significant at the 0.05 level). For example, those centers with street trees along the frontage streets had about 70% White neighborhood residents, compared to only 38% for those without street trees. This association was reversed for Hispanic residents, where more Hispanic residents in the neighborhood were associated with reduced likelihood of having street trees along the store's frontage street (23% versus 52% Hispanic residents for the streets with versus without trees). In addition, the proportions of White residents were higher for those stores with architectural modulations than those without them (69% versus 53%). Hispanic-dominant neighborhoods were more likely to have transit stops at the local shopping center. Further, the stores in Hispanic-dominant neighborhoods had much fewer design features in their buildings, including roofline variation, architectural modulations, and diverse exterior materials ($p < 0.05$).

Design, Aesthetics, and Walkability: The number of people present in the shopping center and near the grocery store were positively associated with the factor variables capturing the shopping center's lighting conditions and sidewalks, as well as those capturing the neighborhood's lighting conditions as well. More people were present in the shopping centers and near the grocery stores where there were seating areas, as compared to those without seating (13-16 people versus 5-7 people, $p < 0.1$). Shopping centers with a dry cleaner also had many more pedestrians present outside the shopping center (17.1 versus 8.7, $p < 0.05$). Based on the number of shoppers who walked to other stores or to homes, those centers with bus stops had a significantly higher percentage of walkers than those without bus stops (16.1% versus 5.0%, $p < 0.1$). A reverse pattern was found for fast food restaurants, where shopping centers with a fast food restaurant had much lower percentage of pedestrian shoppers (5.1% versus 16.0%, $p < 0.1$). Design items that were associated with positive visual assessments included trees in the parking lot and along the frontage streets, seating areas near the grocery store, architectural modulations, roofline variations, and non-linear building layouts (all $p < 0.1$).

Discussion and Conclusion

Findings suggested that certain design attributes or elements at the architecture and site scales were associated with the property value of shopping centers, while the neighborhood scale design attributes showed no significant associations with the development value. Architecture features associated with development value included modulations, roofline variations, and seating areas near the building entrance. Site scale elements that contributed to increased property value included the non-linear buildings layout, the presence of a gas station in the center, and the presence of a left turning lane and median island along the main frontage street. From the multivariate analyses, the presence of a gas station and a left turning lane were positively associated with total property value, while the presence of a coffee shop and seating areas were positively associated only with the value of the land.

Walking and pedestrian activities within the shopping centers were limited due to many barriers discouraging or prohibiting these activities. Barriers observed during the field audit included standing water and drainage problems along the streets; fences blocking direct access to the stores, even from the immediately adjacent areas; stray dogs in the neighborhood; narrow and poorly-maintained sidewalks with cracks, holes, overgrown weeds, and trash; a lack of (signaled) crosswalks; a lack of bus services; and poor lighting conditions in the neighborhood (Figure 2). During field visits, people were walking to and from the adjacent neighborhoods where there were no fences, and people were also walking to other stores in the shopping centers, especially when there were retail stores immediately adjacent to the supermarket and (covered) walkways connecting the stores. Physical traces of walking were also observed, such as shopping carts left in neighborhood streets and near transit stops. These findings indicate that people do walk when provided with supportive conditions. Furthermore, aesthetic quality was an important factor for encouraging walking, as was demonstrated from many previous studies investigating the connection between neighborhood environments and walking. This study also showed that the perceived assessment of the aesthetic quality of the shopping center was significantly correlated with the number of people present in the shopping center. Several design elements appeared to contribute to improved visual quality including trees in the parking lot or along the frontage streets, architectural modulation, roofline variation, and non-linear building layouts.

Limitations to this study included a small sample size and inconsistency in the times that the environmental audits and shopper counts were performed. Therefore, this study is limited primarily to identifying exploratory and bivariate associations between the development values and design attributes. The roles of confounding and mediating factors have not been considered, except for the three variables controlled in the multivariate analyses. However, it examined a large number of design variables at multiple spatial scales and identified the potentially significant subset of variables that could be further studied in future research. This study offered some insights into the potentially significant roles of the neighborhood shopping center, in terms of its economic and walkability values. Many architecture and site scale design features found important in this study could be easily implemented in practice if they are considered during the planning and design processes of the shopping center development.

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