

USE OF NATURAL ENVIRONMENTS BY URBAN RESIDENTS: THE EFFECTS OF NATURAL ELEMENTS ON RESIDENTS' OUTDOOR BEHAVIORS

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This study strives to determine ways to increase the use of outdoor spaces, particularly spaces that have an abundance of natural elements, in environmentally friendly housing developments. Empirical data were obtained by observing residents' behaviors (445 observations) and interviewing 61 residents in Kuemhwa Greenvill, a new housing project in Giheung Sanggal, South Korea. The outdoor natural environments were classified into four categories: reserved natural environment, built environment with a natural appearance, built environment as a green buffer, and built environment with natural elements. The survey revealed that, typically, the natural environments were utilized less than the non-natural environments. Because natural environments did not support various outdoor activities, only persons in certain limited age groups (adults and adults with children) and small groups of one or two people used them. In particular, children's play activities and social gatherings rarely occurred in the natural environments. Apart from physical, psychological, and social accessibility issues, the residents' preferences for the use of non-natural environments were related to their needs and the physical features of the environments.

INTRODUCTION

For almost a decade, the South Korean housing industry has promoted the idea that residents' quality of life can be improved by increasing the amount of natural elements in a community. Homebuyers are strongly attracted to natural elements such as streams, fields, and trees. Thus, designers and planners have begun to incorporate more ecologically appealing designs, such as solar energy street lamps, finger networks of parkways across a community, landscaped ponds, and landscaped hills, within residential blocks. Moreover, administrators and scholars have advocated for the preservation and integration of nature in human settlements. Hence, developers have responded by significantly expanding the market of environmentally friendly housing developments.

This study examines whether extended natural environments are actually used by residents in everyday living. In particular, we focused on three questions. First, does an environmentally friendly design affect residents' behaviors? Second, are natural neighborhoods actually used for daily activities as anticipated by planners, and are they used as often as other parts of the neighborhood? Third, what problems are associated with natural environments, and how can the use of natural environments be encouraged?

The development of environmentally friendly neighborhood designs has helped bring nature closer to everyday life. Although environmentally friendly designs provide only a perceptual experience, natural environments that are not suitable for the activities and needs of residents have sections that are never accessed by residents. Fences and steps created at the boundaries of natural environments hinder access and block the use of such areas by children. In this paper, we aim to understand not only the psychological and emotional advantages of access to natural environments but also their impact on the everyday behaviors of residents. Therefore, in addition to explaining which natural elements the residents consider to be essential, we also examine how natural environments are used by residents. This will help elucidate the effects of the current environmentally friendly neighborhood designs and provide suggestions for improving these designs in the future.

Previous Research

Green spaces are beneficial for people on both psychological and behavioral levels. Numerous works have discussed the benefits of natural environments. Green spaces have been linked to neighborhood satisfaction (Kaplan, 2001); restoration (Hartig and Evans, 1993; Herzog, *et al.*, 2002; Kaplan and Kaplan, 1989; Korpela, *et al.*, 2001; Ulrich, 1983); lower stress levels (Wells and Evans, 2003); reduced frustration, more patience, and greater enthusiasm (Kaplan, 1993); greater attention capacity (Kaplan, 1995; Tennessen and Cimprich, 1995); and improved aesthetic values (Kaplan, *et al.*, 1998; Woolley, 2003). In addition, natural elements promote the use of outdoor spaces, which is vital in inner-city neighborhoods (Coley, *et al.*, 1997; Sullivan, *et al.*, 2004). Natural environments also provide social opportunities (Kaplan, 1983) and improve social interactions (Kweon, *et al.*, 1998). Moreover, natural elements offer a range of opportunities for children's play (Fjortoft, 2001; Taylor, *et al.*, 1998) and support and improve the ecosystem, which controls air pollution, temperature, wind speed, noise, and water runoff (Morris, 2003).

Natural environments are important in residential areas because they provide value from both direct and indirect use. Although some benefits can be gained by merely observing nature, this study focuses on residents' direct use of nature through different activities. Previous studies have shown that direct contact with nature is highly beneficial for human beings. Yuen, *et al.* (1999) found that residents in Singapore engaged daily in recreational and sporting activities, such as jogging, relaxing, and strolling, in green areas. Moreover, they found that users of natural environments valued nature more than nonusers. Kyle, *et al.* (2004) showed that experiencing natural environments through direct use helps people make sense of a place, including developing psy-



FIGURE 1. Plan of the research site, Yongin Sanggal Kuemhwa Greenville.

chological attachments, cognitions associated with the place, and a sense of social belonging. Hence, we hypothesize that an increase in the direct use of natural environments for various activities provides people with the advantages associated with greater access to green spaces. In this study, we investigated planning natural environments for residents' direct use by emphasizing interactions with natural elements.

METHOD

Research Site

To obtain the most relevant research findings in the South Korean setting, we carefully selected the research site based on how well it represented recent housing developments in South Korea. We used three criteria to select the site. First, the design of the site had to incorporate natural elements in such a way that more green spaces could be created. Second, the selected site had to be planned by the Korean Housing Authority (KHA), a major player in environmentally friendly planning of South Korean housing developments. Third, the occupancy term had to be greater than two years to ensure that the infrastructure in the neighborhood had been adequately constructed. Based on these criteria, Yongin Sanggal Kuemhwa Greenville, a housing development project, was selected for the study (Figure 1).

KHA, the only South Korean housing agency that provides up to 50,000 houses annually, developed Kuemhwa Greenville in 2001. The neighborhood is located in a suburban area approximately

25 km (16 miles) south of the municipal border of the capital city, Seoul. Kuemhwa Greenville is comprised of 5- to 20-story apartment buildings with 2,761 middle-income families. The development has 11,000 residents, including over 550 primary-school children, and floor plans ranging from 42-115 m² (452-1,238 ft.²). The neighborhood includes two elementary schools, a middle school, a high school, community centers, retail stores, play areas, rest areas, grassy areas, and neighborhood parks (including a large natural park). Almost all of the areas are part of the master plan. In addition, the development contains many types of environmentally friendly planning elements, such as reserved hills, streams, landscaped green fields, artificial waterways, and ponds. The planner also emphasized a natural environment design to create more green blocks and green areas for children's outdoor play.

Procedure

Observations

We used two methods for collecting data: observation of behaviors and open-ended interviews. Observational data were collected over three months from August to October 2004 when the weather was appropriate for outdoor activities (22-30°C/72-86°F). Observations were systematically conducted on four weekdays and three weekends. The observations were made between 3:00 and 6:00 p.m. (*i.e.*, after primary school was over for the day) on weekdays and between 1:30 and 5:30 p.m. (*i.e.*, after lunch) on weekends. These times were chosen because a pilot study indicated the outdoor environments were most crowded then. Two researchers walked together along a predetermined route so they would not pass the same place twice. The exact location of each observed behavior was marked on a map (behavior mapping), and photographs were taken. Further, researchers documented information about the actors (gender, age, and group size) and the types of activities in which they were engaged. Activities were differentiated by their location, actor, and dominant and subsidiary acts. Consequently, excluding the activity of merely passing through a green space, 445 activities were observed.

Interviews

Interview data were collected on the basis of the observation results. Although the researchers observed situations when natural environments were used, the precise reasons for using the environments remained unclear. Therefore, the researchers asked residents open-ended questions about the use of natural environments within the neighborhood to clarify problems faced while using natural environments. In the interviews, "natural environments" referred to four categories related to natural elements: reserved natural environments, built environments with a natural appearance, built environments as a green buffer, and built environments with natural elements. We also referred to one category of "non-natural environments" (Figure 2).

One of the questions asked was "Do you typically use natural environments?" If the response was negative, then the researcher asked, "Why do you not use natural environments?" To obtain more specific answers, researchers repeated their questions until the interviewees finally said, "I do not know" or "No more." If interviewees did not understand what was meant by "natural environments," the researchers pointed out natural environments nearby or showed them pictures of the natural environs in their neighborhood. It was hoped that incorrect assumptions regarding natural-environment planning could be clarified from the answers to these questions. From October to December 2005 (*i.e.*, one year after the observations), researchers conducted 61 field interviews of 51 children and 10 adults. Every 10th resident observed in the outdoor space was interviewed.

Description of Environmental and Behavioral Categories

Classifying natural environments in the Kuemhwa neighborhood

Few previous studies have defined natural environments. In this paper, "natural environment" is defined as a wilderness park, forest, tree-lined green space, or anything that is the opposite of a city environment and barren space. Certain previous studies have attempted to define natural environ-






Category	Definition	Setting	Degree of naturalization	Image
(1) reserved natural environment	completely natural environments outside the development or nearby; preserved as wilderness, parks, and greens by town planning (almost reserved)	reserved hills, neighborhood parks	strong	
(2) built environment with a natural appearance	designed natural environments that intentionally make an area look like a reserved natural area (partly reserved)	areas with lots of trees, designed streams		
(3) built environment as a green buffer	attendant green areas to fill spare spaces like green buffer zones around buildings or roads (almost built)	green beside buildings, buffer areas with trees		
(4) built environment with natural elements	designed environments with a natural element (water, tree, glass) as a key design concept of artificial planning activities (almost built)	foundations, artificial waterways, designed tree areas	weak	
(5) non-natural environment	all open areas other than those listed above; area with non-natural concepts of a functional, morphological character (all built)	playgrounds, play fields, artificial landscapes, rest areas with little nature	almost none	

FIGURE 2. Definitions of five categories of outdoor environments in Kuemhwa Greenville.

ments by modeling the relationship between humans and nature in the environments. Mausner (1996) defined natural environments using four levels: (1) separation of people from nature, (2) assessment of natural elements, (3) human impact on nature, and (4) human place within natural environments. On the basis of these four levels, outdoor environments were classified into five categories: (1) totally natural environment, (2) civilized natural environment, (3) quasi-natural environment, (4) semi-natural environment, and (5) non-natural environment. A “totally natural environment” encompasses separated natural spaces such as forests, deserts, seas, and other areas rarely intruded upon by humans. A “civilized natural environment” is a space for human recreation activities such as woods with hiking trails and water bodies where people can engage in aquatic activities; one could say humans are visitors in these environments. A “quasi-natural environment” has aesthetic value, such as a landscaped park, well-maintained grass, and flower gardens. A “semi-natural environment” is influenced by humans and intended for human use; these environments, including farms, public spaces in suburban areas, neighborhood parks, and waterside restaurants, comprise both natural and non-natural spaces. A “non-natural environment” is built by humans and includes places such as roads, buildings, plazas without natural elements, and other artificial spaces. Further, Barker (1998) examined the relationship between human beings and the preservation of nature. In his study, natural environments were divided into three categories:

(1) all-naturally colonized areas; (2) residential areas with natural green spaces — that is, areas with some natural environments; and (3) open-space corridors — that is, areas with a built natural environment.

The studies by Mausner (1996) and Barker (1998) attempted to categorize natural environments, but they focused on areas, not spaces. For example, a neighborhood park was defined as one category despite the fact that it comprised spaces formed with both non-natural and natural elements. Thus, these categorizations made it difficult to define natural environments within a South Korean residential area that comprises various levels of natural environments. Therefore, we defined a new classification of natural environments to meet the research objective of this study. Natural environments have been classified as space-centered components to determine the ways in which they affect human behavior in outdoor spaces at a multifamily housing development complex.

On the basis of the characteristics of natural elements, the outdoor environments in Kuemhwa Greenville were divided into five categories: (1) reserved natural environment, (2) built environment with a natural appearance, (3) built environment as a green buffer, (4) built environment with natural elements, and (5) non-natural environment (Figure 2). The classification was made after analyzing the physical characteristics of the housing complex using a site map and photographs of each outdoor space. “Natural” was chosen to be the standard, and it was defined as a given natural resource that is intentionally planned or designed. It did not include natural elements such as seas, rivers, and forests. One researcher performed an inter-judge reliability test to verify the reliability of the classifications. After explaining the categories to three independent inspectors, they evaluated the natural categories at 40 locations within the survey site. The inter-judge reliability rating between the researchers and inspectors for the consensus evaluation of the natural environment classification system was 85.6%.

The criteria include not only location and natural-element characteristics but also the relationship between behavior and site design elements. A “reserved natural environment” is a type of neighborhood park that is intended to be a green space for ecological conservation. These environments are maintained in their existing natural condition, and there is little or no artificial planning. Therefore, almost all of these spaces are located on the outside or edges of residential blocks. A “built environment with a natural appearance” is intended to look and feel like a typical natural environment; they are spaces that preserve natural elements rather than recreate them with artificial landscaping. Therefore, almost all of these environments contain some existing natural elements such as streams and thickets. They are located alongside reserved natural spaces or on the edges of residential blocks. “Built environment as a green buffer” refers to green spaces around buildings; these spaces are designed to improve the landscape or decrease the number of car accidents. A “built environment with natural elements” is a planned space with natural elements such as a design theme within a residential block; however, the proportion of natural space is less than 50%. A “non-natural environment” is not planned with any natural theme with respect to function, shape, or physical features. It includes play spaces, squares, rest areas planned within play areas, and spaces displaying formative arts.

Classifying behavioral activities

As shown in Table 1, the activities in the research site were classified into 16 categories to determine the types of activities that occurred in outdoor spaces. This categorization is based on Min, *et al.* (2006), who classified children’s outdoor activities into 10 categories: ball games/ball play, cognitive/nature play, using playground equipment, toy play, social gathering, rest/relaxation, wheel play, structured games, romping/simple mobile hangout, and playing around. However, some activities were difficult to define using these 10 categories; therefore, we included six additional categories based on the specific use of the environment.

TABLE 1. Outdoor activities at the study site.

Type of activity	Source (Min, <i>et al.</i> , 2006)	Definition	Examples of activity
Resting/relaxing	Rest/relaxation	Having time to rest	Sitting, lying, reading, eating, drinking, talking, watching others, sleeping
Gathering/resting		Gathering to relax together while doing minor actions	Sitting, standing, leaning, lying, reading, eating, drinking, talking, watching others
Social gathering	Social gathering	Meeting together for a particular purpose (<i>e.g.</i> , childcare, education, hobbies)	Sitting, standing, talking, eating, drinking, watching others, laughing
Social exchange		Meeting others for a short time to exchange information	Sitting, standing, talking, walking
Gathering/playing	Playing around	Gathering and playing multiple things, moving around in crowds to play together	Sitting, standing, talking, shouting, romping, wheel play, playing on play equipment
Play using play equipment	Using playground equipment	Using slides or swings and other activities on various designed play equipment	Riding on equipment, running, jumping, talking
Constructive/imaginative play	Cognitive/nature play	Playing with something (helpful for children's creativity)	Playing with dirt, flowers, and plants; collecting bugs; drawing; sitting; standing
Toy play	Toy play/wheel play	Play that depends on manufactured toys, including bike riding	Riding, sitting, standing, talking, jumping, throwing
Structured games with toys		Playing games with specific rules using toys	Playing slap match, video games, or with natural elements; watching others; jumping rope
Structured games without toys	Structured games	Playing games with specific rules without using toys	Playing tag or rock-paper-scissors, treasure hunting, running, sitting, talking
Simple ball play	Ball games/ball play	Playing games without specific rules with a ball	Playing with a ball, running around, talking, standing, sitting
Structured games with a ball		Playing games with specific rules with a ball (<i>e.g.</i> , soccer)	Playing a game, watching others, running, talking, standing
Simple romping/body challenging	Romping/simple mobile hangout	Capering and frolicking in the field, climbing on something	Running around, body play, body challenging, standing, leaning, pushing each other
Walking/hovering/hanging out		Moving using environmental characteristics	Walking, moving, looking around, standing, drinking
Exercising		Moving body energetically for health	Strolling, jogging, riding sports equipment, running, talking
Other		Activities not listed above, that occur rarely, or are too complicated or complex	Working, doing chores, gardening, special events (<i>e.g.</i> , flea markets, markets, concerts)

Relaxation, such as resting by sitting on a bench, reading a book, or drinking, is the primary purpose of resting/relaxing. Gathering/resting is a sort of group resting but with social implications. Among the group activities, social gathering has more social meaning than resting/relaxing and gathering/resting, and it differs from gathering/playing and gathering/resting because it does

TABLE 2. Activity frequency in each outdoor environment (n = 445).

Category of outdoor space	Frequency (%)		Area % of neighborhood
		Totals	
Reserved natural environment	50 (11.2)*, **	*All natural environments: 151 (33.9)	39.5%
Built environment with a natural appearance	6 (1.3)*, **		4.5%
Built environment as a green buffer	18 (4.0)*, **	**More natural environments: 74 (16.6)	20.2%
Built environment with natural elements	77 (17.3)*		11.5%
Non-natural environment	294 (66.1)		24.3%

not aim at simple resting or playing. Formal and informal social contact routinely enhances community growth. Thus, social exchange is a sort of temporary social activity, such as a short wait to discuss or exchange information. Gathering/playing has multiple purposes but also indicates a social relationship rather than just playing; it includes children playing in an organized, congenial group. Play using play equipment means that children play with physical objects in a space, such as swings and slides. Constructive/imaginative play implies behaviors such as constructing a structure, collecting bugs, and playing games that enhance children’s creativity (e.g., playing house, playing in the dirt, drawing a picture, observing flowers). Toy play is a type of play without rules, but it uses toys and includes riding a bicycle or skateboard. Structured games with toys is a type of play that has rules and uses toys, such as playing with picture cards or a game of slap-match. Structured games without toys is a type of play that uses rules pertaining to the physical attributes of the environment, such as playing hide-and-seek or rock-paper-scissors. Simple ball play involves playing with a ball, but it does not have any specific rules (e.g., kicking a ball randomly). Structured games with a ball means a ball game with specific rules, such as baseball, football, basketball, and badminton. Simple romping/body challenging does not use specific play equipment or tools but does use an environmental factor or body movement such as simple frolicking or hanging from a wall. Walking/hovering/hanging out includes sightseeing and pacing. Exercising includes health-related behaviors such as strolling, jogging, and exercising with sports equipment. “Other” includes activities not described in the above 15 categories, such as activities involving an event like organizing a community market and performing outdoor chores.

RESULTS OF BEHAVIOR OBSERVATIONS

Frequency of Activities in Outdoor Environments

The categories of outdoor activities presented in Table 2 and Figure 3 were further divided into two categories: non-natural and natural environments. Most activities occurred more often in non-natural environments. Among the categories of natural environments, built environments with natural elements were most commonly used (17.3%). Non-natural environments had a higher frequency of use (66.1%) than natural environments (33.9%). These observations indicate that non-natural environments provide more opportunities for behavioral experiences than natural environments. The activity frequencies in built environments with a natural appearance (1.3%) and built environments as a green buffer (4.0%) were much lower than in other settings. The use of a non-natural environment with clear planning intentions was compared to the use of a natural environment without a clear purpose. Thus, the planning of natural elements in the neighborhood does not support residents’ daily activities.

Numerous activities were concentrated in spaces with obvious functions, such as plazas, playgrounds, and sports fields in residential blocks. Moreover, the spaces were linked to one another (Figure 3). Hence, our findings strongly suggest that the frequency of an activity is related to the space’s main function, accessibility, and connectivity with other spaces. In a natural park (i.e., a

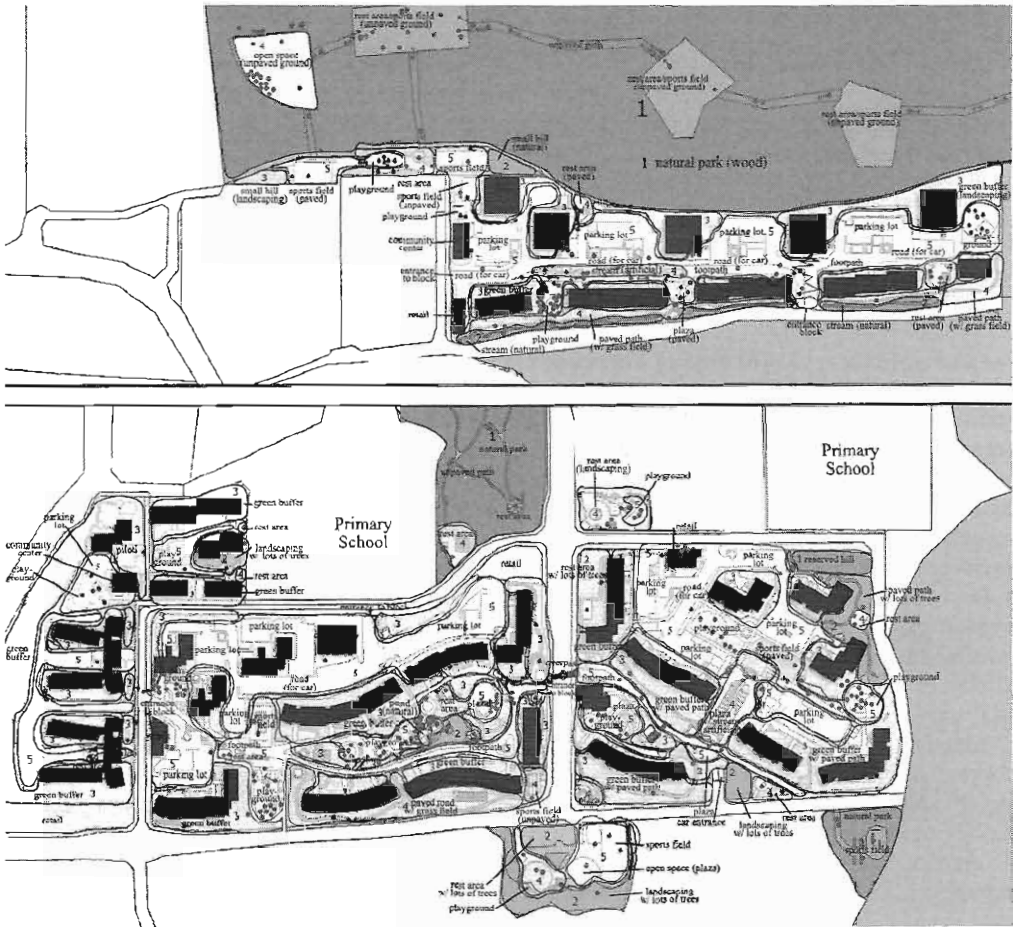


FIGURE 3. Dot analysis of behavior frequency for outdoor environments: (1) reserved natural environment, (2) built environment with a natural appearance, (3) built environment as a green buffer, (4) built environment with natural elements, and (5) non-natural environment. A dot indicates a group behavior setting.

reserved natural environment), more activities occurred when the natural spaces were connected. However, Figure 3 also shows that almost all activities occurred in limited spaces based on the functions of the spaces. Activities in a space with an obvious function did not spread to surrounding areas. For example, almost all non-natural environments were planned with built environments as a green buffer, but the range of activities in non-natural environments did not expand into the built environments as a green buffer.

Relationships Between the Types of Activities and the Environment

Of all the activities, resting/relaxing was most frequently observed (21.1%), and children's activities such as play using play equipment, structured games with toys, and constructive/imaginative play were observed rather often (14.4%, 9.2%, and 8.3% respectively). The most common activity in natural environments overall was exercising (94.3%); this included strolling, mountaineering, and exercising with equipment. Children's activities (*i.e.*, play using play equipment or toys, simple romping/body challenging, simple ball play, and structured games with toys) and social activities (*i.e.*, social gathering, gathering/playing, gathering/resting, and social exchange) were rarely observed in natural environments (10.9%, 18.8%, 23.8%, 20.0%, 26.8%, 22.9%, 44.4%, 44.4%, and 0%

TABLE 3. Relationship between type of activity and physical environment.

Type of activity	Frequency of activity in environment (%)						
	Reserved NE	BE with a natural appearance	BE as a green buffer	BE with natural elements	All NEs	Non-NE	Total
Resting/relaxing	11 (11.7)	---	4 (4.3)	22 (23.4) ^d	37 (39.4) ^c	57 (60.6) ^b	94 (21.1) ^d
Play using play equipment	1 (1.6)	---	---	6 (9.4)	7 (10.9)	57 (89.1) ^a	64 (14.4)
Structured games with toys	---	1 (2.4)	---	10 (24.4) ^d	11 (26.8) ^c	30 (73.2) ^b	41 (9.2)
Constructive/imaginative play	1 (2.7)	1 (2.7)	7 (18.9) ^d	5 (13.5)	14 (37.8) ^c	23 (62.2) ^b	37 (8.3)
Exercising	30 (85.7) ^a	---	---	3 (8.6)	33 (94.3) ^a	2 (5.7)	35 (7.9)
Social gathering	1 (2.9)	---	---	7 (20.0) ^d	8 (22.9) ^d	27 (77.1) ^a	35 (7.9)
Toy play (including bike riding)	---	---	2 (6.3)	4 (12.5)	6 (18.8) ^d	26 (81.3) ^a	32 (7.2)
Simple romping/body challenging	1 (4.8)	1 (4.8)	1 (4.8)	2 (9.5)	5 (23.8) ^d	16 (76.2) ^a	21 (4.7)
Walking/hovering/hanging out	1 (5.6)	1 (5.6)	---	5 (27.8) ^c	7 (38.9) ^c	11 (61.1) ^b	18 (4.0)
Gathering/playing	---	1 (5.6)	---	7 (38.9) ^c	8 (44.4) ^c	10 (55.6) ^b	18 (4.0)
Simple ball play	---	---	1 (10.0)	1 (10.0)	2 (20.0) ^d	8 (80.0) ^a	10 (2.2)
Gathering/resting	1 (11.1)	---	1 (11.1)	2 (22.2) ^d	4 (44.4) ^c	5 (55.6) ^b	9 (2.0)
Structured games without toys	---	---	1 (12.5)	2 (25.0) ^c	3 (37.5) ^c	5 (62.5) ^b	8 (1.8)
Social exchange	---	---	---	---	---	6 (100.0) ^a	6 (1.3)
Structured games with a ball	2 (40.0) ^c	---	---	---	2 (40.0) ^c	3 (60.0) ^b	5 (1.1)
Other	1 (8.3)	1 (8.3)	1 (8.3)	1 (8.3)	4 (33.3) ^c	8 (66.7) ^b	12 (2.7)
Total	50 (11.2)	6 (1.3)	18 (4.0)	77 (17.3) ^d	151 (33.9) ^c	294 (66.1) ^b	445 (100) ^a

Note. NE = natural environment, BE = built environment, ^a 75-100%, ^b 50-74.9%, ^c 25-49.9%, ^d 15-24.9%. Percentages may not add up to 100 due to rounding.

respectively); however, these were commonly observed in non-natural environments. It appears that built environments with a natural appearance and built environments as a green buffer, in particular, are not appropriate settings to support outdoor activities (Table 3).

Characteristics of Activities in the Outdoor Spaces of the Research Site

Residual analysis was performed in SPSS to correlate the types of activities, main user age groups, main user group sizes, characteristics of natural elements, main natural elements, and functions of the areas. In the Pearson's chi-square test, significance is verified with adjusted residual values. With a 5% level of significance, if the adjusted residual value is higher than 1.96 in SPSS analysis, the observed frequencies are higher than expected. On the contrary, when the adjusted residual

TABLE 4. Characteristics of users and outdoor activities at the study site.

Type of activity	Main user age group	Main user group size	Characteristics of natural elements	Main natural elements	Function of area
Resting/relaxing	Adults w/out children, seniors	1, 2	Ambient	Trees, shade, grass	Rest area
Play using play equipment	Children, adults w/ children	3-5	Not specific	Not specific	Playground
Structured games with toys	Children	6-8, 9+	Not specific	Not specific	Rest area, around retail shops/ entrances to buildings
Constructive/ imaginative play	Children	2	Object of manipulation	Sand, dust, plants, fruit, bugs	Playground
Exercising	Adults w/ and w/out children, seniors	1	Physical feature	Hills, trees, shade	Natural park
Social gathering	Children	3-5, 9+	Ambient	Trees, grass	Rest area
Toy play (including bike riding)	Children	1	Not specific	Not specific	Plaza, pedestrian way
Simple romping/ body challenging	Children	3-5	Physical feature, object of manipulation	Hills, trees, stones	Rest area
Walking/hovering/ hanging out	Children, adults w/ children	2	Ambient	Trees, shade	Not specific
Gathering/playing	Children	3-5	Ambient	Sand, trees, bushes, stones, fruit	Water space
Simple ball play	Children	3-5, 6-8	Ambient	Suitable ground, stones, trees	Plaza/sports field, green buffer
Gathering/resting	Adults w/ children, seniors	3-5, 6-8	Ambient	Trees, shade	Rest area
Structured games without toys	Children	6-8, 9+	Object of manipulation	Trees, water, flowers, grass	Sports field
Social exchange	Adults w/ children	3-5	Not specific	Not specific	Pedestrian way, around retail shops/ entrances to buildings
Structured games with a ball	Adults w/ and w/out children	2, 9+	Ambient	Suitable ground, trees, shade	Natural park, parking lot
Other	Mixed	1, 9+	Ambient	Trees, grass	Plaza, pedestrian way

value is less than -1.96, the observed frequencies are less than expected. In Table 4, significant factors have been selected for defining the characteristics of outdoor space activities.

Most outdoor activities were closely related to children's play (10 of the 16 categories in Table 4). Hence, the observations indicate that outdoor spaces are mostly used for children's play and collective activities. In order to analyze the role of the natural environment for activities, the natural

TABLE 5. Relationship between users' age group, users' group size, the day of the week, and the physical environment.

Factors	Classification	Frequency of activity in environment (%)					Total
		Reserved NE	BE with a natural appearance	BE as a green buffer	BE with natural elements	Non-NE	
Users' age group (age range) ($\chi^2 = 78.1$, df = 12, $p < .001$)	Children (0-18)	2 (.9)	5 (2.2)	12 (5.3)	39 (17.3) ^d	167 (74.2) ^b	225 (50.6) ^b
	Adults w/ children (19-59)	23 (17.4) ^d	1 (.8)	2 (1.5)	22 (16.7) ^d	84 (63.6) ^b	132 (29.7) ^c
	Adults w/out children (19-59)	22 (36.7) ^c	---	3 (5.0)	12 (20.0) ^d	23 (38.3) ^c	60 (13.5)
	Seniors (60+)	3 (12.5)	---	1 (4.2)	4 (16.7) ^d	16 (66.7) ^b	24 (5.4)
	Mixed (all ages)	---	---	---	---	4 (100.0) ^a	4 (.9)
Users' group size ($\chi^2 = 21.9$, df = 16, $p < .05$)	1	13 (18.6) ^d	1 (1.4)	6 (8.6)	16 (22.9) ^d	34 (48.6) ^c	70 (15.7) ^d
	2	17 (12.2)	1 (.7)	7 (5.0)	22 (15.8) ^d	92 (66.2) ^b	139 (31.2) ^c
	3-5	17 (9.8)	3 (1.7)	4 (2.3)	26 (15.0) ^d	123 (71.1) ^b	173 (38.9) ^c
	6-8	3 (6.8)	1 (2.3)	---	8 (18.2) ^d	32 (72.7) ^b	44 (9.9)
	9+	---	---	1 (5.3)	5 (26.3) ^c	13 (68.4) ^b	19 (4.3)
Day of the week ($\chi^2 = 29.8$, df = 4, $p < .001$)	weekday	12 (4.6)	3 (1.1)	10 (3.8)	48 (18.3) ^d	190 (72.2) ^b	263 (59.1) ^b
	weekend	38 (20.9) ^d	3 (1.6)	8 (4.4)	29 (15.9) ^d	104 (57.1) ^b	182 (40.9) ^c
Total		50 (11.2)	6 (1.3)	18 (4.0)	77 (17.3) ^d	294 (66.1) ^b	445 (100) ^a

Note. NE = natural environment, BE = built environment, ^a 75-100%, ^b 50-74.9%, ^c 25-49.9%, ^d 15-24.9%. Percentages may not add up to 100 due to rounding.

elements in the environments were categorized into three types: ambient, object of manipulation, and physical features. Activities such as resting/relaxing and gathering/resting do not use the natural environment directly. However, the natural environment provides trees for shade and grass to sit on; thus, the natural elements are ambient resources. Activities such as constructive/imaginative play, simple romping/body challenging, and structured games without toys use natural elements (e.g., bugs, flowers, water, sand) as objects of manipulation. Natural elements are used as physical features in activities such as constructive/imaginative play and exercises employing the physical features of natural elements, such as slopes and large open spaces. Some activities, such as play using play equipment and structured games with toys are not related to the natural environment and occur in non-natural physical settings (Table 4).

Each activity has specific natural characteristics, functions, and user characteristics, and the environment has to be suitable for the specific features of the activity. Although most activities occurred in areas according to their design intentions (e.g., playgrounds, sports fields, plazas, natural parks), the residents also used parking lots, pedestrian ways, and building entrances for such activities.

User Characteristics

In order to understand who actually uses outdoor spaces, we examined the correlations between the environment and users' age group,¹ users' group size, and the day of the week (Table 5). Children definitely used outdoor spaces more often than adults without children (50.6% versus 13.5%), indicating that outdoor spaces are an important part of children's daily activities. However, natural environments were not well used by children (25.7%). Adults without children were more likely to be in a natural environment (61.7%), particularly in a reserved natural environment (36.7%). On the other hand, non-natural environments were used by all age groups, including children (Table 5).

Analysis of the age group differences according to the day of the week (weekday versus weekend) showed an insignificant correlation ($p > .05$), but it did indicate that more families (adults with children) used natural environments on weekends than weekdays. However, for other types of user groups, there was no obvious difference between weekday and weekend use. Natural environments other than built environments with natural elements were used more on weekends. This could be because residents use more non-natural environments for various activities during the week, whereas reserved natural environments are used more for specific activities such as exercising on weekends.

With regard to user group sizes, midsize group activities were more common; two-person and three- to five-person groups recorded 31.2% and 38.9% activity, respectively, across all environments. In reserved natural environments, individual activities (18.6%) were preferred over group activities. Most activities by three- to five-person and six- to eight-person groups were observed in non-natural environments (71.1% and 72.7% respectively). The analysis of correlation between environment and gender did not show any significant differences ($p > .05$).

INTERVIEW RESULTS

Reasons for Not Using Natural Environments

The behavior observations imply that natural environments are not well used, and the types of activities occurring within such environments are limited. Therefore, residents were interviewed to ascertain problems associated with the use of natural environments. During the interviews, we focused on reserved natural environments and built environments with a natural appearance because planners hoped the use of these natural areas would be encouraged by introducing environmentally friendly planning and providing suggestions for future designs.

The survey targeted outdoor users. Most of the 61 interviewees were children — 51 elementary-school students (84%) and 10 adults (16%) — and most (95%) said they did not use natural environments for everyday activities (see the 16 categories in Table 3). Interviewees provided 192 reasons why they did not use natural environments; the average number of reasons per person was 3.15. These reasons could be classified into five categories: needs, physical features, physical accessibility, psychological accessibility, and social accessibility (Table 6).

Non-natural environments such as playgrounds, open spaces, and sports fields were sufficient for residents' daily activities. Therefore, people did not see a need for natural environments (16.1%). Moreover, the physical features of the natural environments did not support residents' desired activities (31.3%). This suggests that physical features should be creative and must meet the needs of residents. Because natural environments were separated from frequently used roads and facilities, they were not easily accessible (16.1%). In addition, psychological accessibility was an issue, as people were unaware that the natural environments existed (28.1%). Because natural environments were located in peripheral areas, people often did not recognize these areas (16.7%) and felt unsafe in them (11.5%). In this study, social accessibility was related to children who were not allowed to use such areas (8.3%).

Both adults and children said they did not need natural environments because they were satisfied with numerous alternative spaces (20.5% of adults and 14.9% of children), they felt the natural environments were unsafe (15.9% of adults and 10.1% of children), and the natural environments lacked facilities (11.4% of adults and 16.9% of children). Children were more concerned than adults with the physical distance to the environments (14.2% versus 9.1%) and environmental cognition (*i.e.*, not knowing the environments existed) (18.9% versus 9.1%) (Table 6).

TABLE 6. Reasons for not using natural environments.

Problems	Issues	Number of responses (%)			Typical responses
		Adults (n = 10)	Children (n = 51)	Total (n = 61)	
Needs	Satisfied with alternative spaces	9 (20.5)	22 (14.9)	31 (16.1)	<ul style="list-style-type: none"> • I do not need to go to natural spaces because there is a children's park in front of my home. I can do everything, such as playing and exercising, there. • I do not need it. There are more interesting things in my apartment.
Physical features	Space	4 (9.1)	7 (4.7)	11 (5.7)	<ul style="list-style-type: none"> • There is not enough space for resting. • The sand is too hard to play with. • I often do inline-skating. The ground in natural places isn't appropriate for skating. • There isn't play equipment. It's not fun. • There is nothing to play with. • I cannot sit anywhere. Seating is limited. • Necessary facilities like restrooms are missing. • The environment around the natural areas isn't good. It's dirty and has an unattractive view. • There are a lot of barriers on the ground. • Pebbles are an obstacle. I can't use natural areas.
	Material	1 (2.3)	7 (4.7)	8 (4.2)	
	Facilities	5 (11.4)	25 (16.9)	30 (15.6)	
	View	2 (4.5)	1 (.7)	3 (1.6)	
	Surface	2 (4.5)	6 (4.1)	8 (4.2)	
Physical accessibility	Physical distance	4 (9.1)	21 (14.2)	25 (13.0)	<ul style="list-style-type: none"> • It's too far. I like to play near my home. • The playground is closer than the parks, and nearby spaces are good for me to play in. • It is dangerous to go to natural areas. It is hard to cross the roadway with a child.
	Approach barriers	4 (9.1)	2 (1.4)	6 (3.1)	
Psychological accessibility	Sense of safety	7 (15.9)	15 (10.1)	22 (11.5)	<ul style="list-style-type: none"> • I am scared of animals and bugs. I hate them. • Mother said to me, "Don't go to the park; it is dangerous." • I am fearful. I am a little person. • I do not know about natural areas. I have not been going there. • I am unfamiliar with this space, although it is nearby.
	Environmental cognition	4 (9.1)	28 (18.9)	32 (16.7)	
Social accessibility	Disruption of social (age) segregation	2 (4.5)	14 (9.5)	16 (8.3)	<ul style="list-style-type: none"> • Natural areas are for adults. There are no children.
Total		44 (100)	148 (100)	192 (100)	

Note. Percentages may not add up to 100 due to rounding.

CONCLUSIONS AND IMPLICATIONS

Use of Natural Environments in the Survey Site

This study examined the potential use, various benefits, and effects of natural environments (Kaplan, 1993, 1995; Tennesen and Cimprich, 1995), with an emphasis on residents' behavioral experiences of natural environments at the neighborhood level. An analysis of the activities in the survey site revealed the following aspects:

- Although the survey area includes a large number of natural elements, they are rarely used, and when they are, it is merely as an ambient background.

- Most activities occur in non-natural environments because such environments are suitable for many different types of activities.
- Natural environments are not as effective for various outdoor activities, particularly for children's play and social activities.
- Natural environments tend to be used for private activities for adults and adults with children (and not for children only), whereas non-natural environments are used for various activities by different age groups and group sizes.

Three reasons could be responsible for the above observations: (1) the weak physical and psychological effect of natural environments on the minds of residents, (2) the presence of physical and social barriers, and (3) the lack of support for residents' activities provided by the natural environments. We will discuss these reasons in the next section.

Reasons Why Natural Environments Are Not Used

Residents use non-natural environments more frequently than natural environments because of their needs; the environments' physical features; and issues concerning physical, psychological, and social accessibility. Outdoor behavior observations in a residential housing development complex designed using environmentally friendly planning techniques showed that natural environments are not effectively used in residents' daily activities, despite the presence of many natural elements. In contrast, non-natural environments with artificial elements are used as intended by the designers.

Many aspects of the natural environment do not fulfill the physical and psychological aspects related to choice, design intention, cognition, and maintenance. The outdoor area in the survey site has sufficient alternative non-natural spaces within the residential block; thus, residents do not feel the need to go to natural spaces outside or on the edges of the residential blocks. In particular, reserved natural environments and built environments with a natural appearance are located independent of designated spaces such as playgrounds, sports fields, and main pedestrian roads. Because the layout of these natural environments is not arranged for the smooth extension of activities, residents do not use these spaces in everyday life.

We expected that outdoor activities would occur in various functional spaces but that each specific activity would be found in just one or two types of spaces. The results revealed that most outdoor activities did occur in the designated spaces. It seems that outdoor activities are affected by design intentions because the residents tended to act within the given range and followed the designated purpose. Because the design intention of non-natural environments is clear, residents easily comprehend the characteristics of these spaces and act in accordance with their design intention. However, the possibility for various activities is limited if a space has stereotypical planning and a rigid design intention with simple aims. Almost all of the natural spaces were planned with similar features such as trees, grass, and water; thus, natural spaces have simple purposes such as exercising and resting. Built environments with a natural appearance and built environments as a green buffer were used less than other environments; both had similar planning with trees and grass but did not have obvious design intentions or activity purposes. Although it is anticipated that these spaces provide ecological benefits (Woolley, 2003), residents tend to think of these two environments as spaces that are not for use and unrelated to daily life.

These two views are problems regarding space choice and design intention and are related to the cognition of space (Figure 4). Natural environments are separated from the usual routes for daily activities, and this separation disturbs residents' cognition of the environments, which in turn, causes residents to view them as unsafe spaces. People do not want to approach these natural spaces because many have rough, wild areas that might be a safety hazard. Among the natural environments, built environments with natural elements are better managed; thus, these spaces are used more often and for a greater variety of activities than are other natural environments. In contrast, non-natural environments are located near the circuit for daily activities and are easy to access. In addition, they




		
<p>Physical accessibility/ approach barriers: The block and natural park are separated by a road, and the park entrance is close to the road.</p>	<p>Psychological accessibility/ environmental cognition: The stream is separated from the main pedestrian road and is located in the backyards of residential buildings.</p>	<p>Physical accessibility/ approach barriers: The natural landscaping area was planned with steps, which makes it difficult to access and prohibits children from entering the green space.</p>

FIGURE 4. Problems with natural environments.

are connected to the main pedestrian road, which plays a major role in the flow of daily activities. Therefore, non-natural environments are easy for residents to cognize as spaces for everyday life.

Generally, natural environments have tremendous potential for behavioral and psychological benefits (Hartig and Evans, 1993; Kaplan and Kaplan, 1989; Sullivan, *et al.*, 2004). However, residents' behaviors are not solely dependent on this potential. For residents who use them, the potential of natural environments has changed to "actualized affordance" (Kytta, 2002, 2004). Barriers, including limited accessibility and obstacles, have prevented most residents from recognizing the affordances offered by natural environments (Figure 4). People decide whether to use a space by evaluating it through direct experience (*i.e.*, by being in the space) and indirect experience (*i.e.*, by hearing about it from others). The usability of natural environments is only recognized through direct experience; however, residents feel that natural environments are difficult to access because almost every natural environment on the survey site is located at a distance from residential blocks and adjacent to roads meant for vehicles. In particular, children worry about these barriers when they approach natural environments. Moreover, children believe that natural spaces are for adults. Natural environments are planned for simple design intentions such as exercising and social segregation. Thus, children feel uncomfortable in natural spaces because of disturbances from other social groups such as adults.

As stated above, actualized affordance is an important factor for using a space. Many interviewees said that the physical features do not fit the activities they expect to conduct in natural environments, thereby indicating that the planned natural environments on the survey site do not support various activities. In other words, affordances in natural environments are not sufficient to support human activities. Because a series of affordances is necessary to accomplish an activity, if one of them is missing, the space is not used. Therefore, on the basis of the interview results, we hypothesize that the missing affordances of the natural environment in the survey site are related to physical features such as space, material, facilities, view, and surface.

Implications for Increasing Use of Natural Environments

Kaplan's (1985) study on outdoor green space use showed the arrangement of green spaces is important, but the scale and number of green spaces is not. Similarly, this research demonstrates that the most important aspect of planning a natural environment is not quantity (*i.e.*, ratio of green spaces to non-natural spaces) but quality (that is, the flow and extent of activities, the proximity to daily activity routes, the activity-environment fit, and accessibility).

According to Moore and Young (1978), outdoor green spaces are important for increasing physical activity among children, which in turn, provides emotional restoration. However, our study indicates that natural environments are not used well by children at the survey site; this is probably related to the territory and approach to green space planning. Natural environments must be planned in accordance with children's behavior and the usability of areas. To increase the use of natural environments by children, natural outdoor spaces must be placed within or adjacent to areas that children use frequently. Children need a natural environment that cultivates their creativity, and its character must not be restricted by function only. Kaplan (1973, 1983) showed that natural spaces such as gardens provide the perfect opportunity to share information and increase the use of natural spaces. Hence, spaces with programs that encourage creative and active use of the environment by the residents are needed in natural environments. As opposed to merely providing ambience, natural elements are important for the direct experience and use of nature. To promote various activities in outdoor spaces, natural elements should be planned so they meet the needs of residents and support the intended activity. If residential areas are planned by considering behavioral resources using natural elements, more activities will be promoted.

Min and Lee (2006) confirmed that a setting in which multiple activities can be pursued becomes a place with psychological value. That is, the psychological domain of outdoor spaces is the same as the activity domain. In this context, "domain" implies a favored physical setting. Therefore, the psychological domain is a setting in one's mind, whereas the behavioral domain is a setting that a person actually uses. In a natural environment, the effects of the psychological domain are significant because natural elements in residential areas are the objects of preference (Kaplan, 1985; Kuo, *et al.*, 1998; Talbot and Kaplan, 1986; Talbot, *et al.*, 1987). However, despite the importance of nature in a residential space, we found that natural environments were not used well in the survey site. Hence, to create a more usable natural environment, natural places should be developed by uniting two domains: the psychological and the behavioral. For this, affordances for various activities should be made part of the planning process.

According to a previous study (Talbot, *et al.*, 1987), people use and care for a natural environment when it is within their cognitive range. Most of the natural environments in the survey site seem to be beyond the residents' cognitive range. The planned natural environments are not only physically distant but also functionally distant from the residents because the natural environments are separated from routes used in everyday life. Hence, natural environments are not related to important daily activities such as collective activities, playing with play equipment, shopping, and meeting others. In fact, planned natural environments are difficult to access because there are sharp boundaries between them and residential areas. Therefore, to resolve the aforementioned issues, natural environments must be planned so they are in close proximity to areas where residents' daily activities are conducted. This can be done by (1) placing suitable physical natural elements close to housing complexes, (2) eliminating physical and psychological barriers, and (3) improving cognitive and social accessibility.

NOTE

1. We divided users into five categories based on their age and whether they had children: (1) children (ages 0-18), (2) adults (ages 19-59) with children, (3) adults (ages 19-59) without children, (4) seniors (over 60 years), and (5) mixed (all ages).

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