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A STUDY OF THE PERCEPTION OF ELEMENTARY SCHOOL FENCES IN URBAN AREAS

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Rising crime rates have become a social problem in urban areas worldwide. However, the use of solid fencing for safety at urban elementary schools is facing a challenge in Taiwan. The purpose of this study is to examine students' and staff's perceptions of four fence types in terms of their protective, social, visual, and imagery functions, as well as students' and staff's preferences for and choices of fences. In addition, the effects of fence functions on participants' preferences for and choices of fences were investigated. The results suggest that, in terms of the protective function, students and staff considered walls the best fence type and mounds the worst. However, they believed mounds were the best in terms of social, visual, and imagery functions, while walls were perceived as the worst with regard to these functions. In addition, both groups liked mounds the most and walls the least, but they were more likely to choose railings and less likely to choose mounds. The findings also revealed that protective, visual, and imagery functions had an impact on both the students' and staff's fence preferences. As for fence choice, the four fence functions affected both groups differently. The findings suggest that no single fence type can solve all functional problems, and trade-offs must be made in fence design for urban elementary schools.

INTRODUCTION

Due to Taiwan's historical and political background, in the past, the primary consideration in the planning and design of all levels of schools, both public and private, was making the staff's execution of tasks and control of students convenient. In the name of safety, tall, solid walls were erected and enclosed campus policies were tightly enforced to remove threats to school and student safety so that students, teachers, and administrators could study and work in protected, isolated environments. Enclosed fences, which provided a sense of control, clearly demarcated the domain of schools. Their endless, rigid appearance prevented outside interference, but they often created an imposing or negative impression. They also hampered the aesthetic cultivation for which educational institutions should strive. Moreover, this type of fence, with a strong protective function, isolated schools from the communities in which they were located. These school campuses lost opportunities to interact with the neighboring communities.

The movement for educational reform was not seen in Taiwan until the 1990s, when both parents and school officials began striving for a more diverse educational environment. In addition, a severe earthquake struck central Taiwan on September 21, 1999 (the 921 earthquake). Nationwide, more than 1,500 schools were damaged, with 293 collapsing completely. Of these, 220 (75.1%) were elementary schools (Nanfang, 2008). Encouraged by educational reform groups and architectural professionals, the Ministry of Education (MOE) took advantage of post-disaster reconstruction and promoted the New Campus Campaign (Li, 2001). In 2002, the Sustainable Campus Project (SCP) was instituted. At present, 512 schools are participating in the SCP and reconstructing their campuses; elementary schools account for 393 (76.8%) of these.

The SCP consists of 18 reform items, including changing school fencing. The construction of "inviting fences" allows for better interaction between schools and communities and transforms campuses into the backyards of communities (Tang, 2003). The design approach for inviting fences is achieved through utilizing terrain variation and plants and enhancing the visibility of school campuses (MOE, 2010). Although in recent years, the Taiwanese government and educational reform groups have tended toward removing rigid school fences and replacing them with inviting fences, many parents (Li, 2002; Tang, 2001), teachers, and school administrators have raised a cry of protest over safety concerns, especially in urban schools (Chen, 1997; Chuang, 2008; Hsu, 2005; Yu, 2009). Therefore, such a proposition has not actually been widely adopted. For example, in Taipei, the capital of Taiwan, 18 schools participated in the SCP, and only five of them chose to change their fences (MOE, 2010).

Educational environments not only consist of the soft environment built from the educational relationship between students and teachers but also encompass the hard environment, or the material conditions and facilities needed for sustaining the soft environment — that is, the campus (Lin, 1986). Therefore, the construction of a suitable physical campus can effectively support education and learning. In fact, the establishment of a school campus is not simply the building of a physical and social environment; it is also the creation of an ideological and cultural environment (Lin, 1995). Buffington and Baxter (2001) believed that changing a building's function, appearance, and image could infuse new life into the structure. As school buildings and campuses are the largest tools of educational environments (Huang, 1993), they should be changed in tandem with educational reform. The transformation of a fence not only directly changes a school's physical form, it also indirectly reflects a school's beliefs regarding education and management. In addition, it affects the perceptions of teachers, students, and outsiders toward schools and becomes an important component in formulating a school's cultural landscape.

1A

1B

1C

1D

FIGURES 1A-D. Images of school fences in different periods in Taiwan.

LITERATURE REVIEW

The Development of School Fences in Taiwan

In Taiwan, the development of elementary school fences can be divided into four periods: the Japanese occupation period, the martial law period, the liberation period, and the New Campus Campaign period (Chang, 2006). During the Japanese occupation period (1896-1945), Taiwan was a Japanese colony, and the spread of knowledge was considered a school's most important function. The construction of educational facilities such as classrooms and libraries was prioritized, and having a school gate was unimportant. Some schools only used pillars to define their boundaries.

During the martial law period (1945-1987), Chiang Kaichek liberated Taiwan from colonial status, and it came under the authoritarian rule of the Kuomintang. Most schools renovated or extended the buildings that had been abandoned during the colonial period due to postwar economic hardship. The design principle for school architecture was simplified, standardized, and plain, producing a dull atmosphere (Figure 1A). Fence design emphasized rectangular models and eschewed decoration. Tall, nondescript, solid walls were used, functioning as rigid separators. During the latter part of the period, Taiwan's economy greatly improved, but fences changed little.

During the liberation period (1987-1999), Taiwan's change to a democratic system had an influence on education, which manifested in the appearance of school fences. Plain, solid walls were beautified with colorful paintings or decorations (Figure 1B). Sometimes students were invited to paint drab walls. During this period, the primary function of fences was to block schools off from noise and intruders. Fences were still high and protruding, resembling great bulwarks. In the late 1990s, several educational reform groups began to promote the improvement of school architecture, hoping to enliven the teaching and learning atmosphere of schools. They promoted the concept that a fence should not only have a protective function but should also convey a school's messages. This was manifested through fences emphasizing visual penetrability and aesthetic considerations. Railing fences appeared (Figure 1C).

In 1999, during the New Campus Campaign period, the traumatic 921 earthquake severely damaged many schools. Taking advantage of the reconstruction opportunity, the MOE promoted the transformation of school campuses and, unprecedentedly, invited students, teachers, and community residents to participate in the reconstruction of schools. The SCP was subsequently implemented. During this period, fence design emphasized the integration of fences with the surrounding environment. The appearance of fences began to change in different ways, the most significant of which was the replacement of hard walls and railings with soft hedges, creating a park-like landscape at the edges of schools (Figure 1D). The concept of a so-called "wall-free campus" has invited a more liberal atmosphere into schools.

The Meanings and Functions of Fences

Historically, fences have been tools for defense or occupation. The installation of a fence clearly announces an occupant's existence, and thus, the fence becomes a device related to law (Kotchemidova, 2002). When people want to clearly divide public spaces from private spaces, defensive spaces appear (Altman, 1975; Watson, 1970). The concept of defensive space is related to security and control, risk reduction, the preservation of privacy, and the maintenance of status and power (Gold and Revill, 1999). Ideologically, fences separate different social units in spaces. When people enter and exit spaces enclosed by fences, they constantly gather and regather. A myth supporting the use of fences is that humans need orderly separation (Kotchemidova, 2002).

Faced with a rapidly rising crime rate in modern society, both Jacobs (1961) and Newman (1973) proposed the use of defensive space for crime reduction. They believed that constructed environments could be transformed into defensive spaces by controlling the architectural elements. Although they did not specifically mention the use of gated neighborhoods in their work, perimeter walls and security guards have become the most commonly used methods of defense (Tijerino, 1998). Fences are viewed as a means of resolving social conflicts, and their continued use has led people to focus on the issue of control (Kotchemidova, 2002). This has already become an important and widespread social reality.

Undoubtedly, the original purpose of installing school fences was to define the property boundaries and prevent interference from outside so that school affairs could be run smoothly while the safety of students, staff, faculty, and property was ensured. Interference could come from improper human conduct or noise and pollution from the surroundings. However, the protective function of school fences has become the primary argument for their existence. In industrialized countries, the rising crime rate in urban areas has become a pressing social issue. Research has revealed that urban residents generally have higher levels of risk perception and fear of victimization (LaGrange, *et al.*, 1992; Miethe and Lee, 1984; Skogan and Maxfield, 1981). In addition, females and children (the most prevalent social groups in schools) are subject to a higher risk of victimization (*e.g.*, Finkelhor and Dziuba-Leatherman,

1994; Grisso, *et al.*, 1999; Moracco, *et al.*, 2007). These findings unquestionably support the need for defensive fences for crime prevention.

However, high, enclosed fencing can severely hinder the relationship between schools and communities (Tang, 2003). By using such fencing, community residents, events, and environments are completely removed from the content of school education and are even regarded as the main sources of interference. Schools using such barriers forget that communities are the foundation for their existence and development (Chang, 1999). In other words, the installation of fences based solely on protective concerns directly jeopardizes the social function of fences because of their physically repellent and visually impenetrable characteristics.

In actuality, fences are not merely physical barriers. As Postman and Weingartner (1969) pointed out, when objects become "notifications," they trigger meaning-making. They are no longer merely insurmountable barriers. The instrumental purpose of fences becomes symbolic and reflects human consciousness. Gates and fences are an outsider's initial contact with a school's physical environment. Although fences are not the central element of school entrances, their widely stretched physical forms obviously declare the existence of schools in vast space. Seemingly endless fences unavoidably become an important element in determining first impressions of schools.

From the perspective of architectural aesthetics, first perceptions of the beauty of school environments can be manipulated straightforwardly through the use of certain materials, colors, and forms for fences. Moreover, each school can create its own unique identity through fence design that reflects local history and culture (Tang, 2006). Just as the physical features of a school are important components in fashioning its image (Chen, 2003; Chien, 2006; Xu, 2002; Zhang, 1999), a school fence is a part of the visual identity that reflects the school's corporate identity (Huang, 1996). A positive school image can enhance the cohesiveness and attractiveness of a school's internal organizations (Xu, 2002) and benefits a school with regard to establishing a good relationship with the surrounding community (Zhang, 1999).

Therefore, school fences are multifunctional. They are not just substantial barriers for delimiting the boundaries of campuses and protecting school staff and students from outside threats. The aesthetic sensibility and uniqueness of a campus can also be presented through the manipulation of the physical form, color, and material of fencing. Furthermore, visually inviting and environmentally beneficial fences foster social relationships between schools and their surrounding communities. Subsequently, a positive school image can be constructed through the favorable characteristics of widely stretching fences.

PURPOSE OF RESEARCH

Educators, environmental professionals, and researchers have devoted much attention to the planning and design of schools, and publications on this topic are copious (*e.g.*, Chiu and Huang, 2004; Nair and Fielding, 2005; Perkins, 2001; Sanoff, 1994; Schneider, *et al.*, 2000). Research on school environments has mainly focused on the functional issues of classrooms (*e.g.*, Huang, 1993; Lopez, 2003; Mader and Willi, 2002; Maxwell, 2000) and playgrounds (*e.g.*, Gibbs, 2000; Keller and Hudson, 1991; Schab, 2005; Zrein, 2007). The study of other types of school architecture, such as fences, is very limited. Nowadays, urban areas worldwide are subject to higher crime rates. For a long time, defensive fences have been used as an important means of crime prevention, and the convention has been commonly accepted in the planning and design of elementary schools in Taiwan. In recent years, however, the use of defensive fences for elementary schools has been challenged by environmental designers and educa-

tional reform groups. Nevertheless, the implications of "friendly fences" or even "fenceless" campuses, as promoted by the MOE, are still controversial and rarely adopted by elementary schools in Taiwan, especially in urban areas.

The purpose of this study is to understand the perceptions of elementary school students and staff with regard to four fence types (walls, railings, hedges, and mounds) in terms of their protective, social, visual, and imagery functions and to determine the students' and staff's preferences for and choices of the four fence types. In addition, the effect of fence functions on students' and staff's preferences for and choices of fences was investigated. Three research questions were addressed:

(1) Do differences exist between elementary school students' and staff's perceptions of four fence types in terms of their protective, social, visual, and imagery functions?
(2) Do differences exist between elementary school students' and staff's fence preferences and choices? and
(3) Do the four fence functions affect students' and staff's fence preferences and choices?

RESEARCH METHOD

Setting

Taipei, the largest city in Taiwan, is also the nation's capital. In general, the residents of Taipei are more open to new concepts and phenomena than residents of other parts of the country (Huang, 2007). However, only a few of the 159 public elementary schools in Taipei have opted to change their fences as a means of campus reform. In this study, public elementary schools in Taipei were chosen as the settings for investigation. Taipei has 12 administrative districts; one school from each district was invited to participate in the survey so that each district was represented by staff and students.

Participants

The participants consisted of the students and staff (teachers and administrators) of the selected elementary schools. To ensure the participants were able to fully understand the questionnaire, student participants were limited to fifth and sixth graders. A total of 550 valid questionnaires were obtained, 308 from students and 242 from staff.

Visual Representations

This study utilized computer technology to simulate four fence prototypes: walls, railings, hedges, and mounds. Each fence type was presented from front and side views and in two design approaches, simplified and elaborate. Two sets of visual representations were produced, one for each design approach. Each set contained eight images, which were developed as 4" x 6" photos (Figures 2-3). Of the four fence types, walls have been used the longest in Taiwan, followed by railings, which are considered an improved fence type. These two fence types are currently the most widely adopted by Taiwanese schools. In recent years, hedges have been vigorously promoted by the government and educational reform groups. This study proposes mounds as an alternative fence type; they have never been used as school boundaries in Taiwan. The design concept of mounds utilizes changes in terrain to create a boundary so fences can be integrated with the surrounding environment and not be visually obtrusive.

In this study, two levels of design complexity, simplified and elaborate, were presented for each fence type to reflect the development of school architecture under different economic

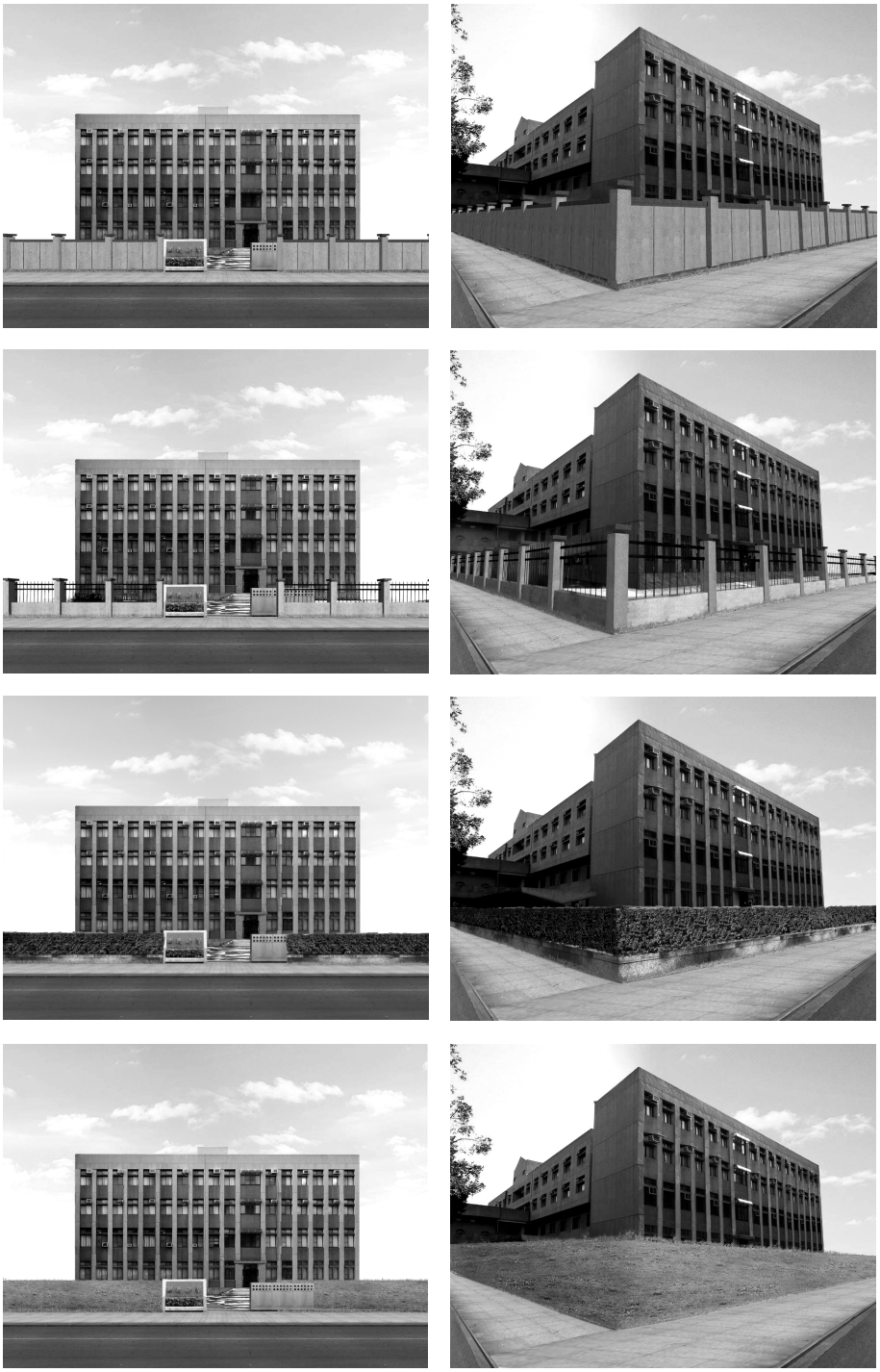

FIGURE 2. Four prototypes of a simplified fence design.

conditions in Taiwan. In cases of economic hardship, fence design is simplified for both walls and railings. In cases of economic prosperity, and in line with Taiwan's democratic

FIGURE 3. Four prototypes of an elaborate fence design.

liberation, solid walls exhibit decorative paintings, and the patterns of railings become more diverse.

Questionnaire

The questionnaire was comprised of four parts:

(1) *Participants' personal information:* These questions referred to the participants' gender, the total length of time the participants had spent studying or working at the school, and information about dangerous occurrences at the school;
(2) *Evaluation of fence functions:* These questions referred to participants' assessments of the protective, social, visual, and imagery functions of fences. For each function, two questions were presented. The leading statement for the eight evaluated characteristics was "To what extent do you consider the fence to have the following characteristics?" A five-point Likert scale was used for measurement (1 = extremely weak, 5 = extremely strong);
(3) *Preference for fences:* This question referred to the degree to which participants liked particular fences: "To what extent do you like the fence?" A five-point Likert scale was used for measurement (1 = dislike greatly, 5 = like greatly); and
(4) *Choice of fences:* This question referred to the likelihood of a participant choosing a specific fence: "To what extent is it likely that you would choose this fence for your school?" A five-point Likert scale was used for measurement (1 = extremely unlikely, 5 = extremely likely).

Data Collection

First, to select the elementary schools, one school was randomly sampled from each administrative district. The principals of these schools were then contacted by phone to acquire their consent to participate in the study. If a request was denied, the procedure was repeated until one school in each district had agreed to participate in the study. The participation of students and staff was entirely voluntary.

As staff were independent adults and possessed sufficient reading abilities, they could complete the questionnaire without individual assistance. Captive group surveys were used to collect the data from them. The surveys were conducted at the selected elementary schools on dates and at venues chosen by the schools. The questionnaires and photos of fences were handed out to the participants at the same time. Research staff then explained the procedure. Once staff fully understood the procedure and questionnaires, they were asked to fill out the questionnaires. As for the collection of data from the students, to ensure their full understanding of the questionnaires, the surveys were conducted on an individual, face-to-face basis. Research staff first explained the procedure to students and then assisted them in filling out the questionnaires. For both students and staff, the sets of fence photos (simplified and elaborate fences) to be evaluated were randomly chosen.

RESEARCH RESULTS

Out of 308 student participants, there were slightly more females (51.6%) than males. A majority of the students (81.8%) had studied at their schools for five to six years. Most of them (80.5%) had never heard of any dangerous events occurring at their schools. Out of 242 staff participants, females were dominant (86.0%). More than half (57.0%) of them had worked at their schools for more than seven years, followed by those who had worked at their schools for five to six years (16.9%). Most of them (62.6%) had never heard of any dangerous events occurring at their schools.

TABLE 1. The mean differences between students' and staff's functional evaluations of four fence types.

Fence function	Fence type	Group	Mean	*t*	*p*
Protective	wall	students	3.63	5.269	0.000
		staff	3.32		
	railing	students	3.12	8.521	0.000
		staff	2.59		
	hedge	students	2.61	3.596	0.000
		staff	2.36		
	mound	students	2.05	2.618	0.009
		staff	1.86		
Social	wall	students	2.14	5.136	0.000
		staff	1.86		
	railing	students	3.02	3.621	0.000
		staff	2.87		
	hedge	students	3.87	4.837	0.000
		staff	3.62		
	mound	students	4.15	6.488	0.000
		staff	3.85		
Visual	wall	students	3.10	8.114	0.000
		staff	2.51		
	railing	students	3.10	4.872	0.000
		staff	2.77		
	hedge	students	3.59	4.626	0.000
		staff	3.29		
	mound	students	4.05	6.402	0.000
		staff	3.59		
Imagery	wall	students	3.18	7.643	0.000
		staff	2.70		
	railing	students	3.20	2.400	0.017
		staff	3.05		
	hedge	students	3.22	0.967	0.334
		staff	3.16		
	mound	students	3.77	6.493	0.000
		staff	3.43		

The findings of independent *t*-tests (Table 1) indicated that significant differences existed between the students' and staff's assessments of the four fence types in terms of their protective, social, and visual functions. As for the imagery function of fences, the two groups exhibited significant differences with regard to walls, railings, and mounds but not hedges. That is, students were more confident than staff that hedges, walls, railings, and mounds fulfilled the functions of protecting the school, allowing interaction with the community, and providing an attractive element. Students were also more confident than staff that walls, railings, and mounds fulfilled the function of constructing a school image. However, the two groups had similar ideas regarding the effect of hedges on a school's image.

The results of independent *t*-tests (Table 2) also revealed that students' and staff's preferences for and choices of fences exhibited significant differences except with regard to hedges. That is, students' levels of liking and likelihood of choosing walls, railings, and mounds were stronger than staff members'. However, students and staff did not differ in their preference for and choice of hedges.

In addition, the findings of analysis of variance (ANOVA) tests showed that students' evaluations of fence functions and their preferences for and choices of fences exhibited significant differences. Post-hoc (Scheffé) analyses were then used to examine the differences between students' evaluations across the four fence types (Table 3). The results indicated that stu-

TABLE 2. The mean differences between students' and staff's preferences for and choices of four fence types.

Preference/ choice	Fence type	Group	Mean	*t*	*p*
Preference	wall	students	3.11	8.959	0.000
		staff	2.49		
	railing	students	3.17	4.087	0.000
		staff	2.87		
	hedge	students	3.33	1.729	0.084
		staff	3.21		
	mound	students	3.54	4.919	0.000
		staff	3.15		
Choice	wall	students	3.33	5.973	0.000
		staff	2.81		
	railing	students	3.53	4.281	0.000
		staff	3.15		
	hedge	students	2.97	0.672	0.502
		staff	2.91		
	mound	students	2.77	3.564	0.000
		staff	2.41		

TABLE 3. The mean differences between students' evaluations of the four fence types.

Fence function	Fence type	Mean	F	Mean difference
Protective	wall	3.63	225.058**	W > H**, M**, R**
	railing	3.12		R > H**, M**
	hedge	2.61		H > M**
	mound	2.05		
Social	wall	2.14	802.743**	M > H**, W**, R**
	railing	3.02		H > W**, R**
	hedge	3.87		R > W**
	mound	4.15		
Visual	wall	3.10	105.857**	M > H**, W**, R**
	railing	3.10		H > W**, R**
	hedge	3.59		
	mound	4.05		
Imagery	wall	3.18	54.894**	M > H**, W**, R**
	railing	3.20		
	hedge	3.22		
	mound	3.77		
Preference/choice				
Preference	wall	3.11	16.489**	M > H*, W**, R**
	railing	3.17		H > W*
	hedge	3.33		
	mound	3.54		
Choice	wall	3.33	36.038**	R > H**, M**
	railing	3.53		W > H**, M**
	hedge	2.97		
	mound	2.77		

Note. W = wall, R = railing, H = hedge, M = mound, * $p \leq 0.05$, ** $p \leq 0.001$.

dents considered walls the most effective fence for protecting students, staff, and school property from outside danger and intrusions, while mounds were considered the least effec-

TABLE 4. The mean differences between staff's evaluations of the four fence types.

Fence function	Fence type	Mean	F	Mean difference
Protective	wall	3.32	155.418**	W > H**, M**, R**
	railing	2.59		R > H*, M**
	hedge	2.36		H > M**
	mound	1.86		
Social	wall	1.86	568.073**	M > H**, W**, R**
	railing	2.87		H > W**, R**
	hedge	3.62		R > W**
	mound	3.85		
Visual	wall	2.51	86.139**	M > H**, W**, R**
	railing	2.77		H > W**, R**
	hedge	3.29		R > W*
	mound	3.59		
Imagery	wall	2.70	45.379**	M > H**, W**, R**
	railing	3.05		H > W**
	hedge	3.16		R > W**
	mound	3.43		
Preference/choice				
Preference	wall	2.49	34.512**	H > W**, R**
	railing	2.87		M > W**, R*
	hedge	3.21		R > W**
	mound	3.15		
Choice	wall	2.81	21.580**	R > W*, M**
	railing	3.15		H > M**
	hedge	2.91		W > M**
	mound	2.41		

Note. W = wall, R = railing, H = hedge, M = mound, * $p \leq 0.01$, ** $p \leq 0.001$.

tive. However, they believed that mounds were the most effective at providing social opportunities with communities, and walls were the least effective. In addition, they considered mounds the most effective at enhancing the beauty and representing the uniqueness of schools, with both walls and railings performing the worst in this regard. They also believed that mounds functioned better than hedges, walls, and railings in creating a positive school image. Overall, students liked mounds the most and walls and railings the least. However, they were most likely to choose railings and walls as their school fences and least likely to choose hedges and mounds.

ANOVA results also suggested that staff's evaluations of fence functions and their preferences for and choices of fences exhibited significant differences. Post-hoc (Scheffé) analyses were used to examine the differences among staff's assessments of the four fence types (Table 4). The findings indicated that staff considered walls to be the most effective at maintaining the safety of students, staff, and school property; mounds were considered the least effective. However, staff believed that mounds functioned most effectively to facilitate social relationships between schools and communities, provide visually pleasing and unique school environments, and create constructive school images. They considered walls the least effective in terms of these functions. In addition, staff liked hedges and mounds the most and walls the least. Staff were most likely to choose railings and hedges for their school fences and least likely to choose mounds.

TABLE 5. The effects of fence functions on students' and staff's preferences.

Fence function	Students			Staff		
	Beta (β)	t	p	Beta (β)	t	p
(Constant)		2.427	0.015		-1.881	0.060
Protective	0.150	5.531	0.000	0.169	6.635	0.000
Social	0.029	0.991	0.322	0.046	1.633	0.103
Visual	0.556	20.369	0.000	0.663	23.634	0.000
Imagery	0.201	7.815	0.000	0.160	5.920	0.000

TABLE 6. The effects of fence functions on students' and staff's choices.

Fence function	Students			Staff		
	Beta (β)	t	p	Beta (β)	t	p
(Constant)		4.718	0.000		-0.232	0.816
Protective	0.338	10.642	0.000	0.424	12.028	0.000
Social	0.179	5.186	0.000	0.006	0.154	0.878
Visual	0.221	6.904	0.000	0.311	8.001	0.000
Imagery	0.161	5.348	0.000	0.103	2.766	0.006

In addition, the findings of multiple regression analyses (Table 5) revealed that of the four fence functions, only the protective, visual, and imagery functions were effective variables for predicting students' and staff's fence preferences. That is, the protective, visual, and imagery functions of fences had an impact on students' and staff's appreciation of fences, while the social function did not. Furthermore, the visual function was the dominant factor affecting both students' and staff's preferences for fences.

The results of multiple regression analyses (Table 6) indicated that the four fence functions were effective variables for predicting students' fence choices, and the protective, visual, and imagery functions were effective variables for predicting staff's choices. That is, all four fence functions affected students' choices, while only the protective, visual, and imagery functions had an impact on staff's choices. For both groups, the protective function of fences was the major factor affecting their choices.

DISCUSSION AND SUGGESTIONS

The research results reveal similarities and differences between students' and staff's evaluations of the four fence types. With regard to the differences, students' overall ratings of the protective, social, visual, and imagery functions of fences were higher than staff's, except for hedges with regard to imagery assessments. Students' levels of liking and likelihood of choosing walls, railings, and mounds were also higher than staff's. This may be due to the fact that students may be innocent and more easily intrigued by a new event, namely, the survey. They were more likely to show interest in the images of the four fence types and, therefore, rated their functions more favorably. Staff are responsible for the educational and managerial affairs of their schools. Consequently, their standards for evaluating fence functions may be stricter than students'. Students and staff also had different considerations when making fence choices. Students took all four functions of fences into account, while staff only considered the protective, visual, and imagery functions. This could be due to the fact that students have no stereotypical ideas concerning the functions of fences. All four functions played important roles in affecting their fence choices.

However, in Taiwan, a conservative attitude toward education is prevalent among primary school teachers. Research has shown that elementary school teachers tend to limit the content of teaching and learning to within school boundaries even though they believe that community resources can enrich educational outcomes (Hsu, 1998; Jian, 2006; Tseng, 2003). Therefore, when they selected fences, they likely did not consider the importance of fences' visual penetrability and environmental benefits, factors contributing to the social interaction between schools and communities.

As for the similarities between students' and staff's evaluations, the two groups assessed the imagery function of hedges the same way. Their levels of liking and likelihood of choosing hedges were also the same. The results confirm past findings that people generally have a predisposition for plants (*e.g.*, Hartig, 1993; Kaplan and Kaplan, 1989; Knopf, 1987; Ulrich, 1983, 1993) and positively appraise environments with plants (*e.g.*, Herzog and Stark, 2004; Purcell, *et al.*, 1994; Ulrich, 1983). Furthermore, students and staff rated walls the highest and mounds the lowest with regard to their protective function. However, they gave mounds good appraisals and walls bad appraisals regarding social, visual, and imagery functions. In other words, while students and staff strongly affirmed the defensive nature of solid walls, they did not approve of the social, visual, and imagery functions of walls. At the same time, while students and staff appreciated the intangible functions of mounds, they were not confident about their ability to ensure the safety of students, staff, and school property.

Students and staff also strongly liked mounds and disliked walls. Furthermore, both groups chose railings as their most likely fence option and mounds as their least likely. The findings suggest that a disparity exists between participants' choices and preferences. In other words, students' and staff's preferences for mounds were not positively correlated with their fence choices. It is noteworthy that mounds have not yet been adopted anywhere in Taiwan. The results suggest that participants have a strong appreciation of a new, creative fence type composed of natural elements such as vegetation and earth. However, they still cannot depart from the traditional concept of fences as barriers and tools for defense.

The need for defense can be explained by urban residents' higher levels of risk perception and fear of victimization (LaGrange, *et al.*, 1992; Miethe and Lee, 1984; Skogan and Maxfield, 1981) and the vulnerability of females and children to be victimized (*e.g.*, Finkelhor and Dziuba-Leatherman, 1994; Grisso, *et al.*, 1999; Moracco, *et al.*, 2007). For the present research, the study area was Taipei, the capital of Taiwan, and the majority of the participants were female adults or children. Thus, students and staff greatly favored mounds, but they chose railings for their school fences because of the apparently defensive nature of railings. Such a finding also explains why safety concerns are the most often raised issue regarding the implementation of "fenceless schools" in Taiwan (Chen, 1997; Hsu, 2005). Moreover, the visual function was the primary concern of students and staff when determining fence preferences, whereas the defensive function was their main consideration when choosing fences.

It appears that both groups would like fences with significant uniqueness and aesthetic appeal, yet they chose those with the capacity to block out intruders. Therefore, design measures that enhance security without sacrificing aesthetics should be implemented in the design of elementary school campuses. To ensure the protective function of fences, a variety of crime prevention methods should be adopted. Approaches to crime reduction can be categorized into three methods: risk avoidance, risk management, and target hardening (Fisher, 1993). Research has shown that these protective measures can actually decrease potential targets' attractiveness to those planning criminal activities (Miethe, 1995). However, most elementary schools in Taiwan tend to only use the approach of target hardening (*i.e.*, defensive fences) to safeguard schools. School authorities should learn how to maintain campus safety by making the most of a variety of defensive mechanisms. Overemphasizing the protec-

tive function of fences often leads to neglecting their other important functions, as well as the other approaches to crime prevention.

In fact, even with respect to target hardening, modern technology has enabled electronic surveillance systems to build virtual walls, set up a user's face bank, locate unexpected users, trace targets dynamically, and provide an alarm in dangerous conditions. Such systems can efficiently carry out the protective function of traditional fences. As to the risk avoidance approach, students should be told how to avoid threatening situations, such as being alert to strangers and reporting their appearance on campus and not staying alone on the fringes of the campus. Regarding the risk management approach, schools should teach students defense skills and provide them with defense tools, such as whistles.

From the viewpoint of environmental design, appropriate campus design can also effectively strengthen school security. The design of smaller-scale campuses allows staff to manage the school environment and watch students more conveniently, which consequently provides a better safeguard against crime. In the past two decades, the low birth rate in Taiwan has resulted in an obvious decrease in student numbers in elementary schools, especially in urban areas. Therefore, the design of small-scale campuses or the transformation of large campuses into smaller ones is not only beneficial to crime prevention but also solves the problem of insufficient student numbers in large schools. Another design approach is to place administrative suites so that they face the main entrance. Such a layout provides staff with the best opportunity to observe people and events and can prevent intrusions on campuses.

To ensure the visual function of fences, the color, form, material, and texture of fences should be effectively manipulated. Studies have revealed that well-coordinated colors and forms in spaces can create a pleasant atmosphere and mood (Noack, 1996; Walden, 2009). Generally, light, colorful spaces have a more positive impact on children than dull and dreary ones (Bell, *et al.*, 1996; Gifford, 2002). In addition, school buildings with unconstrained forms that are varied but not overly complex and detailed are preferred by children (Noack, 1996). Therefore, a harmonized, bright color scheme and modified geometric forms should be used for fence design for elementary schools. Furthermore, past findings have suggested that children are attracted to natural elements (Marcus and Francis, 1990), and learning environments that are full of sensory information have a positive influence on advancing children's developmental and educational processes (Cohen and Trostle, 1990). The choices of material for elementary school fences should therefore take advantage of natural materials such as plants and boulders, and the texture of fences should be rich and safe to encourage the visual and tactile experience of children.

In this study, computer-generated images were used as visual surrogates. There are limitations to the research. The four fence prototypes in the study reflect traditional and reformative thoughts on fence design. However, this study could not include all possible types of fences. In addition, the observation of these simulated images was from a set viewing angle and height rather than different viewing positions related to the varied heights of students and staff. Subsequent research could examine the effect of fence height on perceivers' evaluations. In addition, the differences between participants in urban and rural areas could be investigated in terms of their perceptions of different fence types. For the application of fence design, the feasibility of "hybrid fences" (fences combining two or more types) could be further explored.

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