# Access to the outdoors: using photographic comparison to assess preferences of assisted living residents

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## Abstract

Older adults in long-term care facilities have been found to value spending time outdoors, and studies suggest they may potentially derive health benefits. To better understand how the physical environment supports outdoor usage in assisted living, findings from a previous study using verbal assessments (focus groups and written surveys), were further examined with visual assessment techniques. Using multi-stage cluster sampling, facilities ($n = 14$) and residents ($n = 133$) were randomly selected from all larger facilities (50+ resident capacity) in a 12-county region of south central Texas. Residents were asked to choose the image they preferred in each pair of large color photographs depicting outdoor areas and transition zones at a variety of assisted living facilities. In each pair, a single environmental variable was digitally modified in one of the images, to represent one of six constructs being tested. Data were analysed by how many of the four possible examples subjects chose for each construct. Responses significantly favored the hypothesized constructs, and generally supported the relevant behavioral research and design literature. By isolating individual elements, this study helped identify specific environmental features preferred by residents, for possible application toward facility design. Paired photographic comparison was found to be a feasible way to test environmental preferences in assisted living residents.
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## 1. Background and context

Contact with natural environments is increasingly found to have significant therapeutic potential for older adults. Among other mechanisms, this may operate by providing avenues for physical activity and by increas-

ing exposure to nature elements and higher light levels (see Kaplan, 1983; Hartig and Evans, 1993; Ulrich, 1999, for overviews). Residents in assisted living facilities and other long-term care settings have been found to place great value on outdoor access, and administrators have confirmed the usefulness and value of outdoor space for residents (Cohen-Mansfield and Werner, 1999; Keane et al., 2003). The majority of published design guidelines recommend that usable outdoor space be provided in facilities as an essential component of

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a therapeutic environment (e.g., Zeisel, 1999; Regnier, 2002).

Surprisingly, amid such overwhelming support, the outdoor areas at facilities are commonly reported as being under-used. The reasons for underusage are not entirely clear, although climate, weather, and health conditions certainly limit residents' potential for outdoor usage. Another reason that is commonly proposed to explain underusage is that outdoor areas and interface zones may not be designed to accommodate the behavioral needs of frail elderly residents (e.g., Hiatt, 1980, 1982; Bite and Lovering, 1984; Regnier, 1985; Cooper Marcus and Barnes, 1999). Even though expert design recommendations are available, these may be poorly understood or difficult to apply for various reasons.

In a previous study (Rodiek, 2003), residents reported that various features of the physical environment tended to influence their use of outdoor areas. The features listed below were among those identified as encouraging outdoor usage, and were examined further in the study reported here:

1. *Paths:* an abundance of walkways to access outdoor landscaped areas.
2. *Comfort:* substantial shade and seating along the walkways.
3. *Greenery:* abundant vegetation, and the appearance of "a small park".
4. *Views:* access to views looking beyond the facility boundaries.
5. *Windows:* the presence of windows adjacent to outdoor entries.
6. *Transition:* developed areas near entries for previewing outdoor spaces.

The present study hypothesized that *residents would prefer visual images depicting these features for which verbal preference had been expressed*. Photographs depicting the hypothetically preferred conditions were shown in comparison with the same scenes lacking those conditions, by the use of digital modification. In comparing visual and verbal preferences, Tahvanainen et al. (2001) have noted that verbal and visual methods often yield comparatively different results, possibly due to terminology formulated by researchers rather than users. In this study, images were based directly on key features that had been identified by users in the previous verbal study. Preferences were assessed for each

of the above listed environmental features, using four different photographic examples of each, depicted in real-world settings.

The features tested are among those that are commonly described as desirable by architects and landscape architects, and considered to promote resident well-being (e.g., Zeisel et al., 1977; Carstens, 1993, 1998; Regnier, 1994, 2002; Tyson, 1998). In the design-based literature, the importance of these features is typically substantiated by a combination of practice experience, general environment-behavior principles, and therapeutic goals established for older adults in long-term care settings. However, little empirical investigation has been done to confirm *resident preference* for these features, and no studies were found that systematically tested outdoor preferences using visual assessment methods with assisted living residents. Kane et al., (2003) propose that the preferences of long-term care residents be considered the "gold standard" in assessing quality of life issues, because many inherently subjective aspects can be evaluated only by users. A main purpose of the current study was to extend the evidence base on these commonly held assumptions, from the perspective of residents. This method tested only visual preferences, without the accompanying sensory cues such as fresh air, sounds, or fragrances, that are an integral part of a natural environment, and are considered to have therapeutic benefit (Messer, 1996). However, most examples in this study compared images of nearly identical scenes, and the non-visual sensory stimuli would have been similar if subjects had actually been present in both settings.

## 2. Methods

The geographic region chosen for this study was a contiguous 12-county area covering about 10,000 square miles and containing approximately four million residents. This region contains primarily small- and medium-sized towns with rural/agricultural and petroleum-based economies, but also contains Houston, the fourth largest city in the U.S., with its surrounding urban-influenced communities. Although assisted living facilities (ALFs) are found in many sizes, from as few as six residents (the smallest size requiring Texas state licensing), to facilities having more than 200 residents, this study targeted medium and large-sized

facilities for two main reasons: (1) it seemed likely that larger facilities might have more serious problems with outdoor access, and (2) the size assured adequate residents for random selection. For this study, all facilities licensed by the state for 50 or more residents were considered eligible.

Thirty-four facilities of this size were found in the selected region; of these, 31 agreed to be included in the sampling frame. Although all were licensed for at least 50 residents, the actual census of some was considerably less, due to the prevailing occupancy rate and the fact that some new facilities were not yet filled to capacity. Also, the 'memory care' or dementia units of several facilities were purposely excluded from this study, and participants were chosen only from the units designated as cognitively functional by administrators. Of the 31 facilities in the sampling frame, the largest non-dementia assisted living population found was 106 residents, and the smallest had only 13 (a newly built facility).

Sampling of facilities was stratified by urban–rural location to ensure adequate representation of rural facilities. For purposes of this study, the urban-influenced communities surrounding Houston were considered as urban areas, whereas separate smaller towns and cities (less than 150,000 residents) in outlying rural areas were included in the rural stratum. Nearly all the larger sized ALFs in this region were found in the area surrounding Houston, whereas smaller sized ALFs were found in both urban and rural areas. The rural stratum for this study consisted of all three eligible ALFs found in the non-urban areas (all were located in small cities, rather than in the countryside). The urban stratum consisted of 11 facilities selected randomly from the 28 eligible facilities located in urban locations (all in the Houston area), making a total of 14 facilities sampled.

Most of the participating facilities were built fairly recently. At the time the data were collected (2003), one facility was 14 years old, but with this exception, the mean age of the facilities was only 4.2 years, and one had been completed only a few months before conducting the study.

### 2.1. Sampling of residents

All residents who were functionally able to access the outdoors and complete the survey require-

ments were considered eligible, including residents in wheelchairs and power scooters, as long as they could navigate independently using their assistive devices. Residents with some difficulty seeing and hearing were considered eligible, and assistance was available to help them if needed. In terms of cognitive ability, the only residents excluded were those individuals considered by their facility director to be incapable of meaningful response on the survey forms. Excluding dedicated dementia units, there was a total population of 1738 residents reported in the sampled facilities; of these, about 89% of residents met the eligibility criteria as assessed by facility administrators, resulting in a sampled population of 1541 residents. A random sample of from 7 to 12 (eligible) residents was gathered from each facility. A few weeks in advance, all subjects were invited to participate, and they were reminded again by staff on the morning of the study. Substitutions were randomly selected for those who were unable to participate at the time the study took place, resulting in 133 subjects (participation rate 93%). Approximately 77% of the participants were female, compared with 74% in the sampling frame. The age of subjects ranged from 63 to 99, with a mean age of 83.97.

### 2.2. Approach to photographic comparison

This study's main intent was to measure whether residents preferred visual images depicting environmental conditions which had been preferred in the previous verbal study. The conditions to be compared were presented as pairs of photographs taken at different assisted living and nursing facilities located in the same geographic region as the study facilities. In each pair of photos, *both images were identical, except for digital editing* (addition or removal) of *only the hypothetically preferred feature* in *one* of the images (see Figs. 1–9). Four pairs of photographs were produced as examples of each concept, making a total of 24 paired comparisons. This method of comparing nearly identical photorealistic images was chosen because it made it possible to separate the effects of discrete environmental variables (Hands and Brown, 2002; Tress and Tress, 2003). Non-relevant random aspects such as differing visual composition, shadows, etc., were less likely to confound the variable in question, unlike methods where different photos are compared (Karjalainen and Tyrvainen, 2002). This approach also reduced reliance
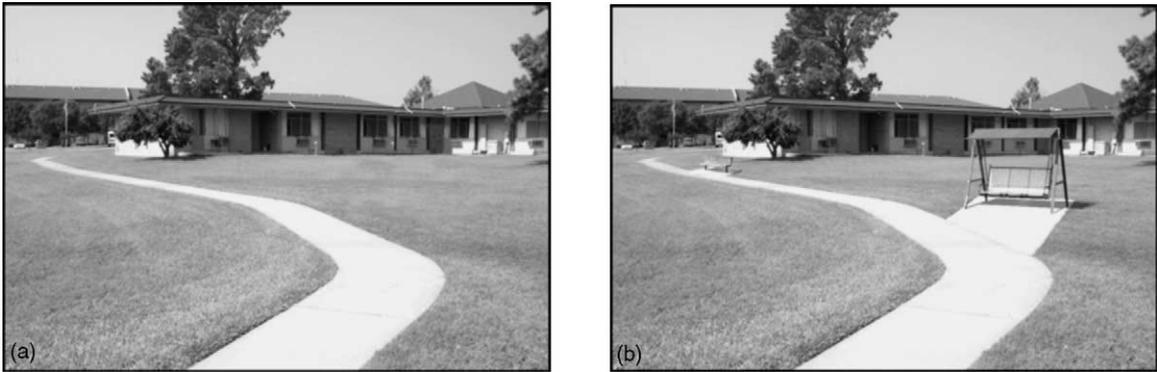
Fig. 1. (a and b) An existing walkway to which two benches have been added – one covered with a canvas top. This is an example of the construct "comfort". (Hypothetically preferred example is shown on the right side (b) in this figure.)
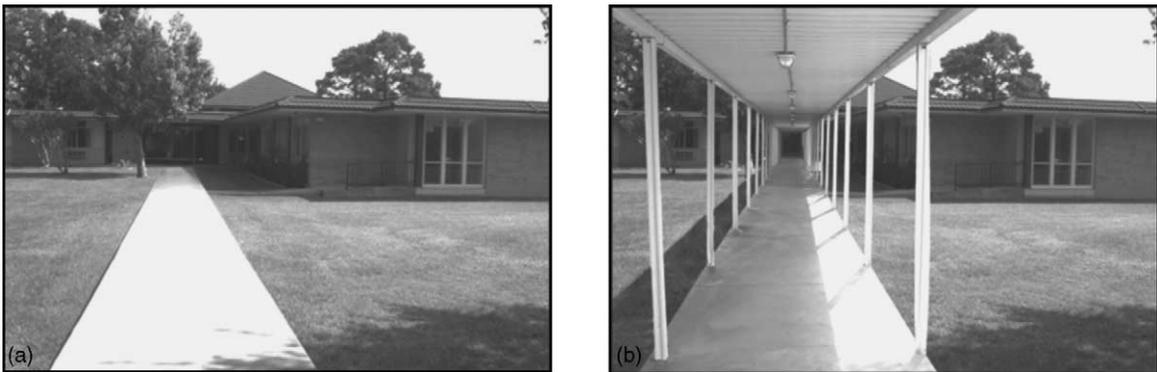


Fig. 2. (a and b) An existing walkway with white metal awning added, as an example of "comfort". (Hypothetically preferred example is shown on the right side (b) in this figure.)
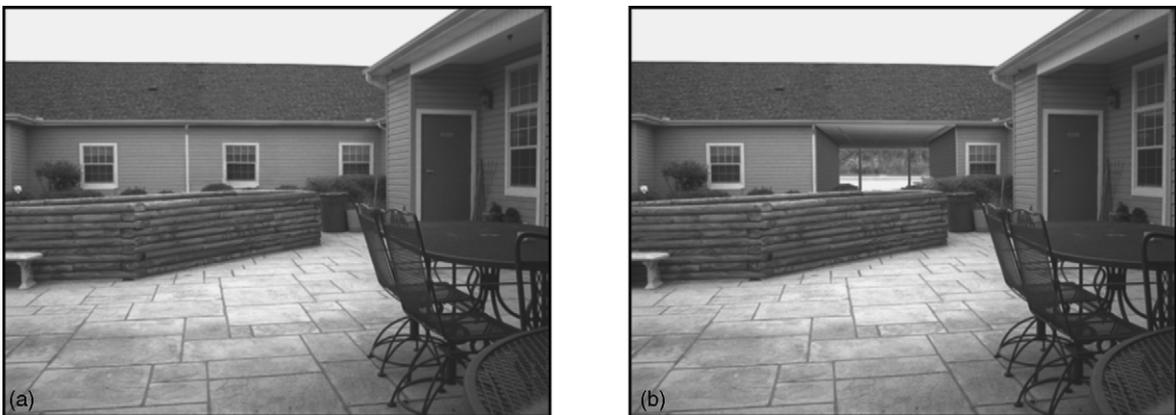


Fig. 3. (a and b) A courtyard that is entirely enclosed by walls of the building, in comparison with one that has an opening to an area beyond. This is an example of "views". (Hypothetically preferred example is shown on the right side (b) in this figure.)

Fig. 4. (a and b) A walking area for residents with bark chips and a lamppost in one image, and grass and a tree in the other. This is an example of "greenery". (Hypothetically preferred example is shown on the right side (b) in this figure.)



Fig. 5. (a and b) Two alternative types of fencing around an outdoor usage area. The wood fence is ornamental but cannot be seen through, while the metal fence is less attractive, but allows a view to the areas beyond. This is an example of "views". (Hypothetically preferred example is shown on the right side (b) in this figure.)



Fig. 6. (a and b) Two versions of transition areas to outdoor spaces. One has a small sitting area developed beside it, and the other has only the hallway. This is an example of "transition". (Hypothetically preferred example is shown on the right side (b) in this figure.)

Fig. 7. (a and b) Two different levels of visibility at the entry to an outdoor area. One permits the outdoors to be previewed from indoors, even from a wheelchair. This is an example of "windows". (Hypothetically preferred example is shown on the right side (b) in this figure.)



Fig. 8. (a and b) A landscaped area with flowering trees. In one image, residents can move freely among the trees; in the other image, they cannot reach the trees without walking on the grass. This is an example of "paths". (Hypothetically preferred example is shown on the right side (b) in this figure.)



Fig. 9. (a and b) One outdoor landscaped area that can be accessed by residents using walkways, and one that cannot. The walkway connects to another path leading to the other side of the building. This is an example of "paths". (Hypothetically preferred example is shown on the right side (b) in this figure.)

on expert judgement to evaluate the environmental and affective characteristics of the images.

Criteria proposed by Sheppard (1989) and Smardon et al. (1986) stipulate that to be valid, visual simulations must be easy to understand, credible, accurate, unbiased, and representative. In addition to these criteria, this project stipulated an important additional criterion: that images featuring the hypothetically preferred features must represent *potentially feasible* 'design solutions' to environmental problems (i.e., alternatives which could be built within ordinary facility budget and space constraints – not 'the hanging gardens of Babylon').

## 2.3. Production of images and digital image editing

Photographs were taken with a digital camera from standing (not wheelchair) eye level, and were guided by the recommendations of Shuttleworth (1980) on maximizing the validity of photographs as landscape surrogates. When possible, the viewing angle included the nearby ground surface in the foreground of the frame, to help place the viewer in the scene. To enhance the immersive quality of the images, photos attempted to show depth of field by providing depth cues such as perspective and overlap, and by including foreground, middle ground, and background in each view, to the extent possible. For this study, most photographs were taken in overcast weather, to minimize the prevalence of strong shadows. Following an approach taken by Nasar (1981), the photographs for this study were selected to represent a range of long-term care facilities typically found in the study's geographic region, but avoiding the actual facilities involved in the study. Variations in landscape and architectural style were sought rather than avoided, in order to illustrate the constructs in a broad variety of settings. Individual photos were selected primarily on the basis of (a) how typical they were of similar-sized facilities in this region, (b) how clearly they depicted (or lacked) the environmental component in question, and (c) how susceptible they were to having the hypothesized element added or removed.

Selected photos were then digitally edited using Adobe Photoshop 7.0. Added elements were photo-based rather than computer-generated, to match the level of realism in the original photo. Operations such as 'stretch' and 'clone' were used when needed; shadows, reflections, etc., were touched up if necessary to correspond with modifications in the image. Non-spectacular elements were chosen to represent the hypothesized components (see examples of photographic comparisons, Figs. 1–9). Care was taken to avoid using more aesthetically attractive elements in the *hypothesized* image (i.e., hypothetically preferred) than those that were replaced in the *non-hypothesized* image. In some cases, deliberately unattractive elements were used as the hypothesized elements, to over-compensate for possible unconscious bias (e.g., the covered walkway in Fig. 2 was deliberately the least aesthetic of the walkway images that were available).

Because the compared images were identical except for a single feature, the task of evaluating the attractiveness of compared features during image production was reduced in complexity. Preliminary assessment of the relative attractiveness of different elements was based on criteria presented by Cranz (1987), Carpman and Grant (1993), and Cooper Marcus and Barnes (1995). These studies describe qualities that appear to influence the preference of elderly or healthcare residents for outdoor features, such as a preference for greenery and flowers, or varied color, texture, and patterns. Initial evaluations of images for this study were made by consensus of the image production team. Preliminary versions of the images were pre-tested with non-sample elderly, and the final versions were adjusted based on their responses to specific qualities in the images.

In the final images, digital modifications were performed in equal number on the hypothesized and non-hypothesized images to reduce possible bias due to digital manipulation artifacts. In other words, half the examples added the preferred feature, and half removed it. At intervals during the development process, images were pre-tested with non-sample elderly, to assess the magnitude of difference they were able to detect in comparisons. Initial consultation with the caregiver industry had emphasized the importance of creating easily recognized visual differences, to avoid causing undue frustration in participants that might lead to invalid responses.

## 2.4. Presentation of photographs

Projected color slides were initially considered as the medium most likely to maximize the immersive

quality of the images. However, preliminary testing found that residents greatly preferred photographs they could hold in their hands for more careful inspection. Problems with slides were related to glare from the projection screen, the difficulty of some residents in focusing their vision at the projection distance, and postural discomfort from looking at a slight upward angle to view the screen. It was also noted that the brightness and saturation of images appeared to be quite different from slightly different viewing angles. Therefore, instead of slides, large ($8\frac{1}{2}$ in. $\times$ 11 in., or A4 size) color images were presented in bound booklets. Images were printed using a color Hewlett-Packard 6100 inkjet printer on Epson Heavyweight Matte Finish paper, and were printed single-sided so images could not bleed through the paper. The resultant images were highly saturated and glare-free (important for elderly viewers). Images were printed at moderate resolution (200 dpi), because of the low visual acuity of most viewers, and because extremely high resolution prints might draw attention to any minor irregularities resulting from digital editing. When nearly complete, an expert in digital manipulation examined the images for artifacts that would distinguish original from modified images, and estimated that differences would be undetectable by non-professional viewers. The final images were nearly full-coverage on the pages and were surrounded by a non-reflective black border. Pages were bound together and edges colored in black to minimize visual distraction.

In total, 24 pairs were presented (48 images), using 4 examples of each of the 6 environmental components described above. Images were presented in bound booklets (plastic comb binding) that individual participants could place on the table in front of them. Each pair of facing pages in landscape (horizontal) format presented a single paired comparison, with the two images placed one above the other. All booklets presented the same sequence of comparisons, in which the order had been randomized so that examples of all six features occurred in all parts of the booklet. In each booklet, half the hypothetically preferred images were at the top, and half at the bottom. This order had been randomly selected, and was reversed in half of the booklets (i.e., Form A and Form B had the top and bottom images reversed).

## 2.5. Response instruments and pre-testing

In the introductory discussion, subjects were asked to consider the photos as representing a residential facility they (or a friend) might live at, and were asked *where they would rather be*. This approach was expected to "encourage responses on what it would be like to be actively engaged *in* and *with* the landscape, rather than merely a passive viewer *of* the landscape" (Ward Thompson, 1998, p. 29). Using a similar approach, Brown et al. (1999) had asked persons with mobility limitations to "assume that the setting would pose no particular accessibility problems . . . [and] to indicate how much they would like to be in the setting" (p. 212). Although the earliest response formats pre-tested asked subjects how much they *liked* the scenes depicted, during data collection the experiential aspect was emphasised.

During instrument development, various response formats were pre-tested with small convenience samples from similar facilities not included in the study. A main goal was to develop a methodology that would allow most residents to record their responses independently, without one-on-one interaction with research assistants, to reduce the possibility for investigator bias, and to allow more residents to be surveyed.

The original intent was for subjects to evaluate *both* photos in each pair using an interval or Likert-type scale. However, when different versions of this were tested, subjects rapidly became fatigued and had substantial difficulty assigning independent values to the images; after their first few responses, the answers of most subjects appeared to be meaningless. Advisors from the caregiver industry suggested this approach strained the cognitive and attentional abilities of most residents.

To improve on this method, subjects were then asked to first decide which image they preferred, and afterward, to indicate how much they *preferred it over the other image*. This approach was pre-tested with several different versions of scale, ordinal, and Likert-type response formats. For example, participants were asked whether they preferred the image 'a little more', 'somewhat more', 'much more', etc., by checking or circling words and/or numbers, or making tick marks along a horizontal line with descriptors at both ends. All formats of this type appeared to cause some level of confusion or fatigue in the subjects. This was evident

when, after completing a few comparisons, most subjects tended to either ignore this question or to select "much more" for all their subsequent responses. (Kane et al. (2003) have also noted many older adults have difficulty coping with the complexity of Likert responses, and Castle and Engberg (2004) have noted the tendency to use only the upper end of response formats.) Therefore, all attempts to measure the extent of preference were abandoned in favor of a binary preference measure in which residents simply designated which of the two scenes they preferred, when imagining themselves in the setting.

Even with this relatively simple response process, there was concern that many subjects would make mistakes if they had to record their responses on a separate form, keyed to the booklet with numbers or letters. Mistakes were encountered frequently when this type of response form was pre-tested, and seemed related not only to the cognitive ability of residents, but also to problems with hearing and understanding oral instructions. Therefore, residents were asked to indicate each response by attaching a 'Post-it' sticky note to the image they preferred in each pair. This direct approach worked well, and had the added advantage of not requiring subjects to write, which is difficult or laborious for many assisted living residents.

## 2.6. Data collection

At each facility, subjects typically were seated in a group of approximately ten around a table, and each individual was given a booklet containing the images. The two forms of the booklet (with top and bottom images reversed) were alternated with adjacent seating. Acoustics were controlled as well as possible, and the principal investigator explained the process with examples, demonstrating how to place the sticky notes on the preferred pictures. Independence of the responses was achieved by asking participants to refrain from discussion during the process, which they were able to do, perhaps because they were concentrating on the visual images. Staff and research assistants gave clarification and functional assistance as needed, but had been instructed to avoid influencing resident responses in any way. Subjects made their selection with the sticky notes, using tabletop pop-up dispensers to compensate for lack of manual dexterity. Subjects at nine of the fourteen facilities were also invited to write a few words on the sticky

notes, to explain their choices. About 25% of these residents added comments on the examples. This step was omitted at five of the facilities because greater time constraints in their resident schedule did not permit the extra time it took. This qualitative data helped monitor whether residents were correctly placing notes on their intended choices, and also helped confirm what aspects of the images residents were responding to. Although about one fourth of the subjects required some level of encouragement or assistance during the activity, the overall process was successful for nearly all participants – only one had to leave without completing the study. Most subjects completed the set of 24 comparisons in about 20–30 min without noticeable fatigue, and many remarked they had enjoyed the process. All sessions took place over a 4-week period in late summer, 2003.

## 2.7. Data analysis

After each session, response data were manually retrieved from the booklets, entered on Scantron forms, and analyzed with both SPSS 11.0 and Microsoft Excel. The percentage of four example pairs where the subject selected the hypothesized photo was recorded for each of the six features, and henceforth will be referred to as the *measure of preference*. The differences in the measures of preference were also calculated pair-wise for all possible feature pairs in order to determine potential differences between features. These measures of preference (and differences in measures of preference) were treated as ratio scales, taking on possible values of 0%, 25%, 50%, 75%, or 100%. It is worth noting that unlike Likert-type measures of preference, these scales require no philosophical argument for their ratio/numeric status, since they are calculated as the percentage of the four examples where the hypothesized photo was preferred.

The multi-stage cluster strategy used in sampling residents and facilities increased the complexity of the analysis. For univariate analyses, unbiased estimates of the mean and standard error were calculated for each measure of preference as well as all preference differences using the following formulas:

$$\hat{\mu} = \sum_{j=1}^{2} \sum_{i=1}^{n_j} \left( \frac{M_j}{M} \right) \left( \frac{N_j}{M_j} \right) \left( \frac{M_{ij}}{n_j} \right) \bar{X}_{ij}$$

$$S\hat{E}(\hat{\mu}) = \sqrt{\sum_{j=1}^{2}\left(\frac{M_j}{M}\right)^2\left[\left(\frac{N_j-n_j}{N_j}\right)\left(\frac{N_j}{M_j}\right)^2\frac{s_{\mathrm{B}j}^2}{n_j} + \left(\frac{N_j}{M_j}\right)^2\frac{1}{N_jn_j}\sum_{i=1}^{n_j}M_{ij}^2\left(\frac{M_{ij}-m_{ij}}{M_{ij}}\right)\frac{s_{ij}^2}{m_{ij}}\right]}$$

where $\bar{X}_{ij}$ = sample mean measure of preference for Facility $i$ in Stratum $j$ ($j=1$ indicates rural, $j=2$ indicates urban), $s_{ij}$ = sample standard deviation for the measures of preference for Facility $i$ in Stratum $j$, $M_{ij}$ = total number of eligible residents at Facility $i$ in Stratum $j$, $m_{ij}$ = sampled number of residents at Facility $i$ in Stratum $j$, $M_j$ = total number of eligible residents in stratum $j$, $N_j$ = total number of eligible facilities in Stratum $j$, $n_j$ = sampled number of facilities in Stratum $j$, $M$ = total number of eligible residents in both strata, and

$$s_{\mathrm{B}j}^2 = \frac{1}{n_j-1}\sum_{i=1}^{n_j}\left(M_{ij}\bar{X}_{ij} - \sum_{i=1}^{n_i}\frac{M_{ij}}{n_j}\bar{X}_{ij}\right)^2$$

When comparing female and male preferences, these formulas had to be modified slightly, as the total number of eligible residents in all facilities for each gender was unknown, and there was an insufficient sample size for the males in the rural stratum ($m_{ij}=1$). In these cases, preference measures were averaged within gender and facility, and the difference in gender means was calculated for all $n=11$ urban facilities only. Thus, the estimates of the mean gender difference in preference was calculated as

$$\hat{\mu}_{\mathrm{d}} = \frac{1}{11}\sum_{i=1}^{n_j=11}(\bar{X}_{i\,\mathrm{male}} - \bar{X}_{i\,\mathrm{female}})$$

$$S\hat{E}(\hat{\mu}_{\mathrm{d}}) = \sqrt{\left(\frac{28-11}{28}\right)\frac{s_{\mathrm{d}}^2}{11}}$$

where $\bar{X}_{i\,\mathrm{male}}$ and $\bar{X}_{i\,\mathrm{female}}$ are the mean preference measure in Facility $i$ (in urban stratum) for females and males, respectively; and

$$s_{\mathrm{d}}^2 = \frac{1}{11-1}\sum_{i=1}^{n_j=11}[(\bar{X}_{i\,\mathrm{male}} - \bar{X}_{i\,\mathrm{female}} - \hat{\mu}_{\mathrm{d}})]^2.$$

Given the sampling method and corresponding formulae presented above, unbiased estimates of preference could be produced for the target population of the study. In other words, the results of the analyses may safely be considered a statistically fair representation of the behaviors and preferences of all potentially eligible residents of medium to large-sized assisted living facilities in the sampled region.

## 3. Results

The main purpose of the univariate statistical analyses was to determine if the subjects preferred images that included the hypothesized environmental features. Because the measure of preference was calculated as the *percentage of the four examples where the hypothesized photos were preferred*, preference ratings greater than 50% were considered to indicate a general preference for the feature. A one-sample *t*-test was used to determine whether the mean preference measure was greater than 50% for each of the features. Table 1 and Fig. 10 show that for all six features, there was strong evidence for such an effect, as $p<0.001$ in almost all cases. The residents preferred the hypothesized features an average of 77.78% (for *greenery*) to an average of 86.83% (for *views*).

A secondary purpose of the analysis was to determine whether certain features were more clearly preferred than others. Paired t tests were performed to establish any differences between preference measures, and none were found at the $\alpha=0.10$ level (see Table 2).

Table 1
Preference for photocomparison images (depicting hypothetically preferred features)

| Feature | Estimated mean measure of preference | Standard error | $t$ |
|---|---|---|---|
| Views | 86.83 | 6.899 | 5.338[***] |
| Paths | 84.21 | 6.899 | 4.958[***] |
| Windows | 83.81 | 6.894 | 4.904[***] |
| Transition | 82.45 | 6.866 | 4.726[***] |
| Comfort | 79.61 | 6.942 | 4.265[***] |
| Greenery | 77.78 | 6.922 | 4.013[**] |

Mean, standard error, and one-sample *t*-tests for Ha: $\mu_{\mathrm{preference}} > 50\%$.
[**] *p*-value (one-sided) < 0.01.
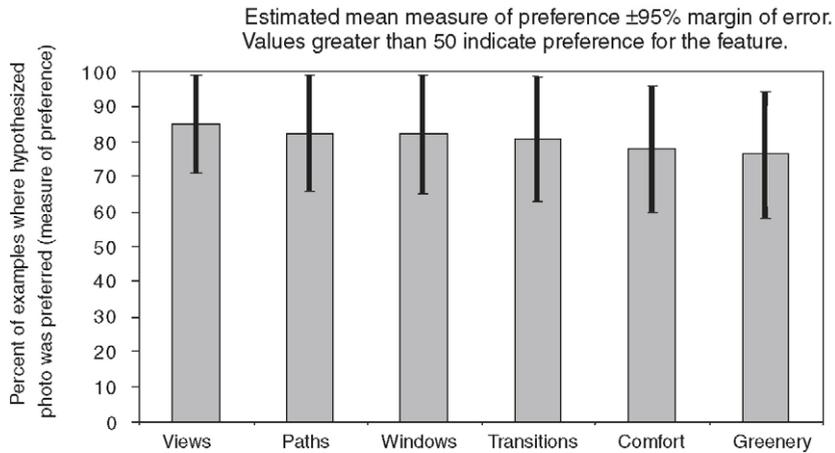[***] *p*-value (one-sided) < 0.001.

Fig. 10. Preference for photocomparison images (depicting hypothetically preferred features).

When the measures of preference were compared across genders, males were overall found to choose the hypothetically preferred images slightly more than females. Males chose the hypothesized images approximately 86% of the time compared with females at approximately 80%, and males were significantly more likely than females to choose scenes with comfort features, greenery, and windows. The only images that females chose more often than males, by a slight margin, depicted the construct *views*. However, all these differences were relatively minor compared with the clear preference of both genders for the hypothesized features (Table 3, Fig. 11).

When differences in preference were compared by age, the only difference that was found was a slight tendency for paths to be less preferred by older residents (see Fig. 12). This might be due to older residents feeling less able to use the paths with advancing age, and

Table 3
Gender differences in preference for environmental features/constructs

| Feature | Mean difference in measure of preference (male − female) | Standard error | $t$ |
|---|---|---|---|
| Views | −2.126 | 4.074 | −0.39267 |
| Paths | 3.076 | 6.059 | 0.5077 |
| Windows | 7.600 | 4.409 | 1.7236[*] |
| Transition | 6.671 | 5.150 | 1.2952 |
| Comfort | 11.020 | 4.074 | 2.7045[**] |
| Greenery | 10.151 | 2.410 | 4.2109[***] |

Mean, standard error, and one-sample $t$-tests for $\hat{\mu}_d > 0$, comparing preference across genders.
[*] $p$-value (one-sided) < 0.10.
[**] $p$-value (one-sided) < 0.05.
[***] $p$-value (one-sided) < 0.001.

Table 2
Comparison of preference for different environmental features/constructs

| Mean difference in measure of preference ($p$-value, one-sided) | Views | Paths | Windows | Transition | Comfort | Greenery |
|---|---|---|---|---|---|---|
| Views | – | 1.89 (0.395) | 3.42 (0.315) | 3.74 (0.300) | 5.22 (0.233) | 8.43 (0.126) |
| Paths | | – | 0.98 (0.445) | 2.35 (0.371) | 4.57 (0.262) | 8.02 (0.138) |
| Windows | | | – | 0.69 (0.461) | 4.11 (0.284) | 7.37 (0.157) |
| Transition | | | | – | 3.07 (0.335) | 5.39 (0.230) |
| Comfort | | | | | – | 1.54 (0.414) |
| Greenery | | | | | | – |

No features significantly different at the $\alpha = 0.10$ level. Mean difference and one-sided $p$-value for paired tests, comparing preference between features.
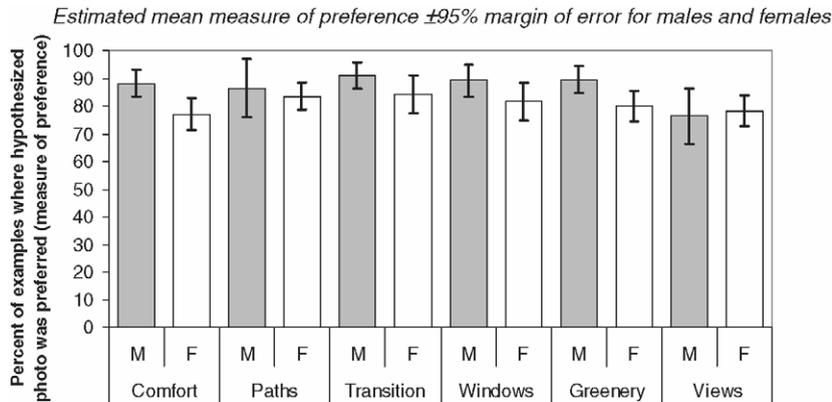
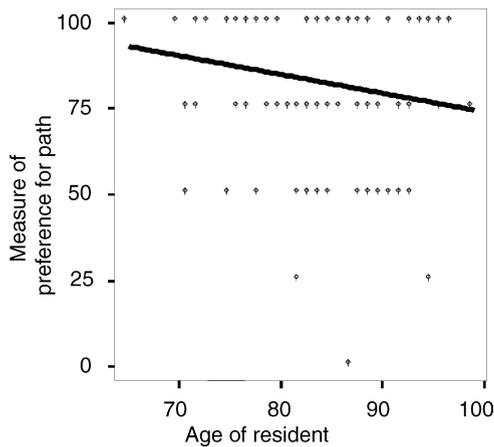Fig. 11. Gender differences in preference for environmental features/constructs.



Fig. 12. Reduction in preference for paths with advancing age.

therefore responding more to the scenic aspects of the images, rather than imagining themselves in the scene.

## 4. Discussion and conclusion

Results of this study support the findings of the previously discussed verbal survey, in that subjects significantly preferred the photos showing the hypothetically preferred environmental features. The results also generally support the relevant design guidelines found in the practice-based literature, that describe these features as important in designing for outdoor usage at long-term care facilities. The brief qualitative comments recorded by some residents provide additional insight into how residents perceived these environmental features. Nearly, all written comments referred to relevant aspects of the images, such as "more places to walk", "more trees", "benches to rest", "doesn't make you feel closed-in", "different views", etc. This suggests that residents were indeed responding to the hypothetically preferred aspects of the images, and supports the validity of the methodology used in this study. It should be noted, however, that the written comments came primarily from more cognitively intact residents, and might not reflect the reasons of less cognitive residents for selecting these images.

Overall, the methods used in this study were found to be satisfactory. The process was engaging enough to hold the interest of subjects, and streamlined enough so adequate examples could be tested without fatiguing residents. Directly applied sticky notes proved to be a successful way to record responses for the preferred images, and almost certainly reduced the number of errors that would have been made by elderly subjects using separate response forms. This method provided a low-cost and expedient way to assess preferences in a population that is challenged by limited functional, cognitive, and attentional capacities.

A slight reduction in response level as subjects proceeded through the booklets is evident in Fig. 13. Although the response rate was still adequate with 24 questions, a larger number might have over-fatigued the subjects. Also, it seems likely that the more frail and impaired residents would be those most likely to fatigue earlier, suggesting that studies using higher numbers of comparisons may less adequately assess
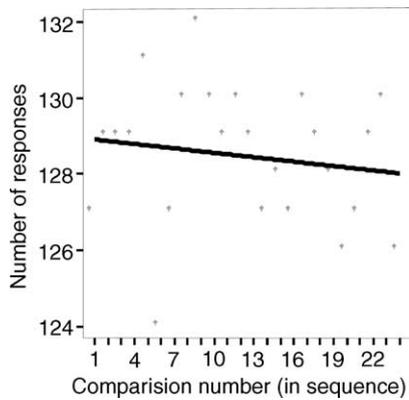
Fig. 13. Reduction in response level with subsequent photocomparisons.

the preferences of subjects with higher levels of impairment. Because all six constructs were distributed evenly throughout the book, fatigue-related response rates should not be reflected in the overall preferences found here. Future studies might reverse the order of images (from front to back) in the two alternate forms of the book, although this might introduce secondary confounding factors, interacting with the top–bottom reversal.

### 4.1. Limitations and improvements

The potential for random bias in this study design was reduced by the fact that compared images were identical except for a single variable. However, there were many possible ways to modify even narrowly selected features, and investigator bias might have unconsciously influenced the style, form, color, or composition of the manipulated elements. To reduce systematic personal and cultural bias, the digital modifications had been produced in equal numbers by three research assistants from different backgrounds (China, India, and Turkey), so cultural influences would be balanced by input from the others, as well as by the principal investigator (USA).

In an effort to counterbalance unconscious researcher bias in developing the images, the attractiveness of hypothetically preferred features was deliberately minimized, as can be seen in Figs. 1 and 2, where the added seating and shading devices were as plain and unattractive as possible, lacking the levels of texture and refinement that have been found to ap-

peal to older adults (Marsden and Kaplan, 1999). As a final step in development, many (not all) of the images used in this study were reviewed by non-sample elderly during pre-testing, and their feedback was incorporated into further development of images. Future studies using this method might more systematically assess image characteristics with representative user groups during development.

Although the hypothetically preferred features were carefully chosen to be as plain as possible, nonetheless in most cases this resulted in the preferred image having slightly greater visual complexity than the non-preferred image, whether the preferred feature had been added to or removed from the original scene. It could be argued that many of the hypothesized features such as greenery and paths tend to automatically increase the visual complexity of outdoor settings. Nonetheless, to assess the extent to which residents' favorable responses were due in part to the visual complexity of the scene, future studies might compare the hypothesized features with equally complex visual elements unrelated to the constructs. Although the present study cannot assess the association of visual complexity with preference, virtually all the written comments that were received (placed with sticky notes on the preferred images) made reference to the hypothesized construct in the image. This provides some confirmation that subjects were responding, at least cognitively, to the hypothesized constructs.

Including subjects with higher levels of disability accomplished an important research objective, but also increased the amount of assistance subjects needed during the process. Even with the direct and streamlined response method that was used, about one-fourth of the subjects needed some level of assistance, and typically 1 or 2 of these (out of 10) needed continual assistance to complete the survey. At most sessions, 2 or 3 assistants were available for 10 residents, which was marginally adequate to monitor all those who needed help. Future studies using this method with a similar population might provide a minimum of 3, or even 4, assistants (researchers and staff) for every 10 residents.

The inclusion of subjects who had taken part in the earlier verbal preference survey (repeat subjects) was *not* found to have a significant effect on their preference for the hypothetically preferred images, even when the subjects who had participated in the focus group sessions (assumed to have more impact than

questionnaires) were compared separately. While this might be attributed to deficiencies in short-term memory, an equally likely explanation is that their environmental preferences were fairly stable, and therefore not substantially influenced by conversations with others.

While the photo booklets were quite satisfactory, and the large images were easy for residents to see, this method might be improved by binding the booklets in landscape format, with images to be compared on facing pages side by side, instead of one above the other. This method had been considered, but not tested, during development. Vertical placement was chosen instead, because of the psychological implications associated with right-and-left-sidedness. In retrospect, side to side placement might make comparison easier for subjects, and would be worth pre-testing in future studies.

### 4.2. Implications

Although not all environmental features can be depicted in still photos, this methodology appears to be an effective way to compare many environmental features. In this study, the method was used to compare the *presence or absence* of desirable features, but it could also be used to more finely compare *preference for different variations* of particular features. For example, do residents prefer flowers at ground level or in raised planters? What types of views do they prefer, and how much openness or privacy should be provided? Simulations of this type are frequently used by design professionals when presenting alternative concepts to clients, and photo-realistic representations are often considered most effective with non-professional users (Sheppard, 1989). Small-scale versions of this method could be used at individual facilities, to allow residents and families to give input on specific environmental features, before spending money on outdoor areas that may fail to satisfy the preferences of users.

Although simulations are not actual experiences, they have been found to elicit similar responses to the same scenes viewed in person (Nasar, 1981). By confirming some of the environmental features preferred by residents, this study has implications for practical application. It seems likely that incorporating these preferred features into facility design would better meet resident needs and may lead to increased outdoor usage. For example, in the previous study, res-

idents said they wanted frequent benches and shade along outdoor walkways, as they may unexpectedly need to stop and rest while walking (this feature is also widely addressed in the literature: e.g., Pynoos and Regnier, 1991; Brawley, 1997; McBride, 1999; Heath and Gifford, 2001). If walkways do not provide enough benches or shade, it seems likely that many residents will be discouraged from taking outdoor walks as often as they might like to. Figs. 1 and 2 show modest comfort features that were digitally 'added' to make existing conditions more hospitable for residents. These images were significantly preferred, in spite of being somewhat unattractive. If the shade and seating elements had been designed more attractively, or supplemented with suitable plant materials, they might have been preferred even more.

Likewise, because older adults generally prefer to stay on paved surfaces, providing walkways through interesting parts of the landscape would give residents more variety in their outdoor experience, and possibly a greater sense of freedom (see Figs. 8 and 9). Opening up views, even brief glimpses, to areas beyond the facility walls might give residents a secure way to connect with the world outside the institution, even if the views are rather ordinary (Figs. 3 and 5). Providing more greenery is likely to satisfy a basic human desire for contact with nature elements, which may be especially strong because residents spend virtually all their time indoors, in the same environment. Moreover, numerous studies in the environment-behavior literature suggest that people are more likely to use outdoor spaces if they can preview them from indoors, and if they have a place to linger just inside the entry, while they make up their minds to go out (Figs. 6 and 7).

These may seem like obvious design principles; however, examination of a substantial number of long-term care facilities reveals that these principles are commonly neglected even in new, relatively affluent facilities. The fact that many of the *less preferred* photos in this study depicted *existing conditions* at facilities (that were easily modified to include the preferred features), suggests that current facility environments could be better designed to support the behavioral needs of residents regarding outdoor access. For example, the barren outdoor space in Fig. 4a is an existing condition that was modified with grass and a single tree to produce an image preferred by 93% of respondents. If preferred features are found to increase the usability

of outdoor areas, the resultant outdoor usage may also increase the health and well-being benefits that potentially are available to frail elderly residents.

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