



Evaluation of the physical classroom by students and professors: a lens model approach

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Summary

A method for linking classroom evaluations to specific physical properties and for comparing the evaluations of different groups is described and illustrated. Thirty-five college classrooms were photographed and shown to 20 professors and 51 undergraduate students, each of whom evaluated the *friendliness* of and their overall *preference* for all the classrooms. Seven physical properties of the classrooms were reliably assessed by independent observers. Using a modified Brunswik lens model, the relations between the physical properties and the evaluations by the two groups were established and compared. Between 40 and 57 per cent of the variance in the evaluations could be explained from only three classroom properties: view to outdoors, seating comfort and seating arrangement. Evaluations by the students and professors were surprisingly similar, an encouraging sign for classroom designers.

Keywords: classrooms, evaluation, professors, students, lens model, Brunswik

Students spend thousands of hours in classrooms, and therefore classrooms automatically are among the most important physical structures in society. Although much has been written about classroom environment in the sense of organizational structure or social environment (e.g. Byrne, Hattie and Fraser, 1986; Yuen-Yee and Watkins, 1994), much less has been written about the physical environment of the classroom.

That is not to say the topic is untouched; especially during the open-classroom and open-education debates, the physical setting of the classroom was examined

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(e.g. Proshansky and Wolfe, 1974). Others have investigated the physical setting of the classroom in terms of student privacy (e.g. Ahrentzen and Evans, 1984; Pedersen, 1994) or performance (e.g. Wollin and Montagne, 1981), the influence of the classroom's physical arrangement on visitors' impressions of the teacher and students (e.g. Weinstein and Woolfolk, 1981) or how the physical classroom influences student and teacher behaviour (e.g. Hooper and Reid, 1985; Loughlin, 1977).

However, an important goal of classroom design (among others, of course) is to create a space that students and educators like. This rather obvious goal has not received the attention it deserves, with some exceptions. Sommer and his associates (Sommer and Olsen, 1980; Wong, Sommer and Cook, 1992) created and have continued to monitor a 'soft' university classroom (with fabric wall decorations, covered seats and carpeting). Students found it pleasing and their participation in classroom discussions was enhanced, compared to a traditional, 'hard' classroom. Axia, Baroni and Peron (1990) reported that greater experience with classrooms was related to more favourable reactions to different kinds of classroom physical arrangements.

So far, however, surprisingly little published research has appeared on the question of which (if any) specific elements of classrooms are linked to student and teacher preferences. One exception (Cohen and Trostle, 1990) was a study of kindergarten and first-grade classrooms. The present study examines student and professor evaluations of university classrooms, and also illustrates a method by which the specific physical bases of these evaluations might be identified. Although this study focuses on university classrooms, professors and undergraduate students in one particular region, the method could be applied to classrooms at any educational level in any culture.

The Brunswik lens model

Long ago, Brunswik (1956) developed the lens model as a paradigm for studying environmental perception. The model is a probabilistic representation of the way perceivers use environmental cues to draw inferences about the environment. Only recently has the lens model been applied to judgements of architecture (e.g. Gifford *et al.*, 2000). The present study makes use of the lens model by measuring classroom physical cues such as whether the room has a view of the outdoors and the type of seating arrangement and relating these objective features to student and professor evaluations.

The traditional lens model includes **ecological validity** on its left side, that is a set of links between a 'true' measure of the environment and some observable properties. On the other side of the lens model is **cue utilization**, that is the links between the observable properties and individuals' evaluations. For this study, the lens model is modified so that both halves depict cue utilization, one side for each of two groups whose evaluations are being considered. This is because there is no 'true' score in the present circumstances; instead there are two sets of evaluations. The modified lens model permits a clear, graphic method of comparing the cue utilization policies of two groups, in this case, undergraduate students and professors (see Figure 1).

Although lens models might be constructed for groups who are unfamiliar with the setting in question, this study deliberately examined the reactions of two groups of evaluators who have an important stake in the quality of university

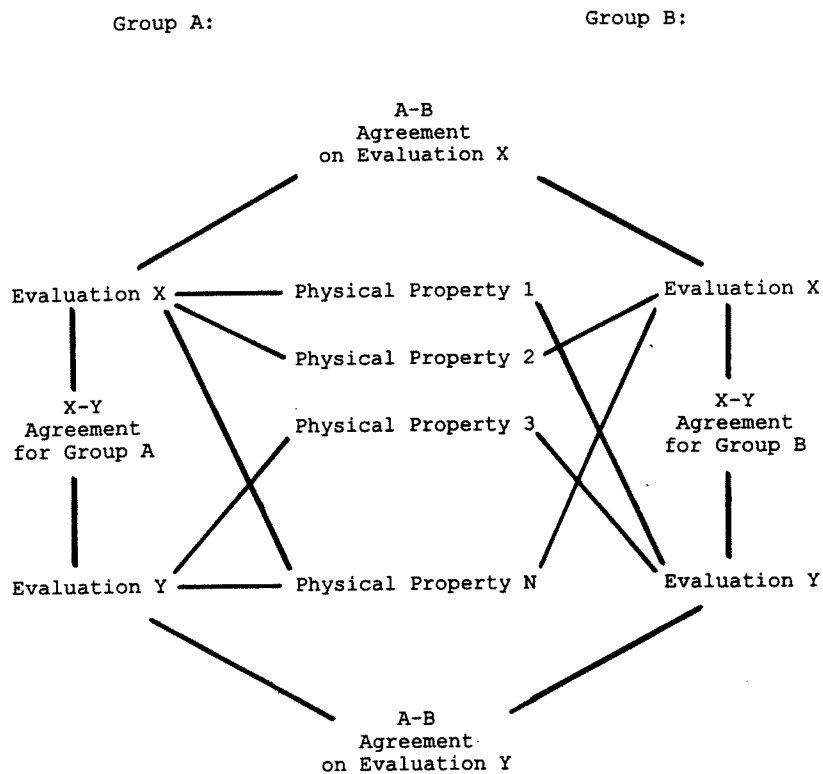


FIGURE 1 The modified lens model with hypothetical significant links between evaluations and physical properties shown as straight lines, and possibly significant agreements between groups and evaluations as the top and bottom slanted lines

classroom environments. Objective properties of the classrooms will be related to these groups' evaluations of the **friendliness** of the classrooms, and how **preferable** each is.

The overall hypothesis is that various objective features of classrooms will reliably predict evaluations by the students and professors of the classrooms' friendliness and preferability. Specific hypotheses are more difficult to pose in the absence of previous research, but one might hypothesize that rooms with views to outdoors are seen as more friendly, that rooms with seating arrangements that should encourage more interaction (sociopetal arrangements: Osmond, 1957) are seen as more friendly and that more decoratively complex rooms will be judged preferable.

Whether students and professors will agree about which classrooms are friendly or preferable, and whether the two groups rely on the same physical features to draw their conclusions, remains to be seen. It must even be established that professors and students agree among themselves on the friendliness and preferability of classrooms.

Method

Participants

Three groups, a total of 73 individuals, participated. One group consisted of 51 university introductory psychology students who were solicited through the use of a Psychology 100 research subjects pool. They earned credit towards the final grade in their introductory psychology course for participating. A second group consisted of 20 university professors who volunteered to participate. Each person in these two groups evaluated all 35 classrooms in the study on the friendliness and preference dimensions. A third group, consisting of two undergraduates who were not part of the 51 who evaluated the classrooms' friendliness and preferability, each rated seven physical properties of all 35 classrooms, as a reliability check to the experimenter's ratings of the same classroom properties. Following their participation, all volunteers were given a brief explanation of the study, encouraged to ask any questions and, upon completion, they were thanked for their participation in the study.

Classrooms

The 35 college classrooms were selected from the campuses of one medium size and one large university. The goal was to obtain a fairly wide, representative sample of classrooms. They ranged in size from small seminar rooms to large lecture halls, with and without windows and with various seating arrangements, and from spare to ornate in their decor. Two 10 cm × 15 cm colour photographs were taken of each classroom. Each pair of photographs showed a classroom from the front left and from the rear right corners of the room (see Figures 2 and 3). Where possible, all available lighting was utilized for the photograph by opening blinds and curtains and turning on lights. The aim of the photographs was to capture as much of each classroom as possible from the two perspectives.

Each pair of photographs was mounted on a 26 cm × 17 cm card, with the front view photograph placed directly below the rear view photograph. The cards were labelled from 1 to 35, without further identification.

The questionnaire

To evaluate the classrooms, each participant was given a short questionnaire to answer. It stated that the study's purpose was to understand the perceptions of different classroom user groups, explained the two perspectives from which the photographs on each card were taken and described the two evaluations to be made: friendliness and overall preference. These were 10-point Likert-type scales that ranged from zero ('very unfriendly', 'very unpreferable') to nine ('very friendly', 'very preferable'). Friendliness was defined on the questionnaire as: 'how warm, comfortable, etc., the room makes you feel, in your own opinion'. Overall preference was defined as: 'a global rating of all factors that you consider important to the classroom environment'. Two sets of 35 spaces for the evaluations to be made followed.

Design and procedure

For the students, the 35 pairs of photographs were arranged in numerical order around a large (3 m × 5 m) table. Groups of approximately six students

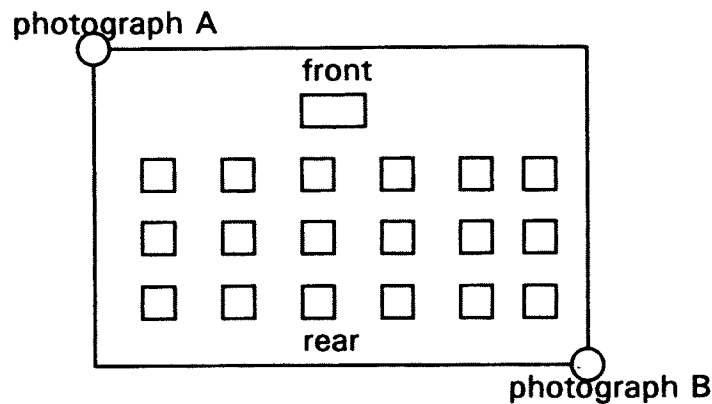


FIGURE 2 Positions from which classroom photographs were shot

participated at a time. They were encouraged to begin rating the classrooms in any order, to reduce order effects, but were reminded to record their evaluations in the appropriate positions on the questionnaire. The students first completed all their friendliness evaluations, then completed another circuit of the table to rate their overall preference for each classroom. Professors followed the same procedure, but each completed the task in his or her own office. They were also encouraged to begin their evaluations at any point in the series of pictures, to reduce order effects.

It is important to note that the specific physical properties of the classrooms that were investigated, described in the next section, were not mentioned to the students and professors; the evaluators were simply shown the photographs and asked to make the friendliness and preference evaluations.

Physical properties of the classrooms

Following pilot discussions with university and college students who were not among the evaluators in the study, seven physical characteristics of post-secondary classrooms were selected as physical properties of classrooms that might relate in a statistically significant way to the perceived friendliness and overall preference of classrooms. The 35 classrooms exhibited varying degrees and amounts of each property; thus, each classroom could be assessed ranked on each of the seven physical properties (see Table 1). All ratings were done from the photographs, so that the classrooms and their properties were assessed from the same source from which the students and professors experienced them.

Two of the seven physical properties (type of seating arrangement and whether there was a view to outdoors) were so clearly objective that they were coded by a single observer, the experimenter. One of these was seating arrangement, which varied along a sociofugal–sociopetal continuum (Osmond, 1957) from arrangements that tend to encourage relatively less interaction among students (sociofugal) to arrangements that tend to encourage relatively more interaction among students (sociopetal). This was scored as one of three actual, typical arrangements, in increasing order of sociopetality: (a) individual seats, all facing forward, (b) table seating, with all seats facing forward or (c) table seating, with seats surrounding the table. The second objective property was



FIGURE 3 Some of the 35 classroom photographs.

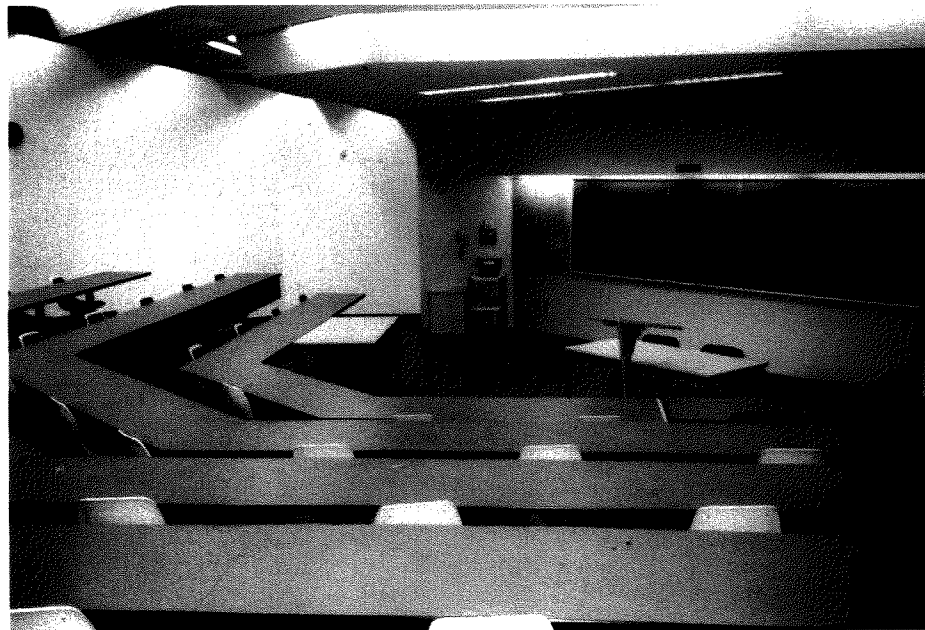
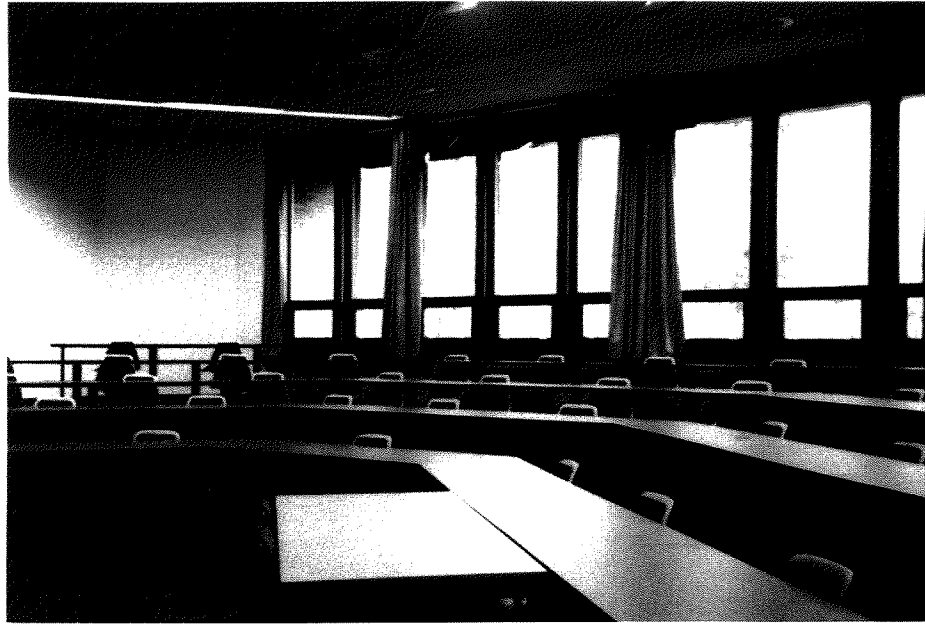


FIGURE 3 continued

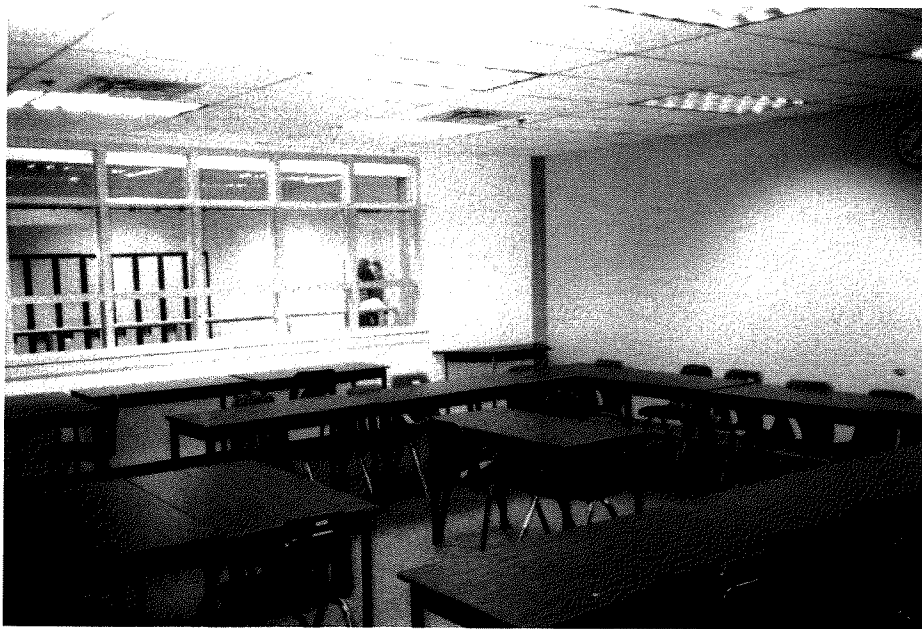
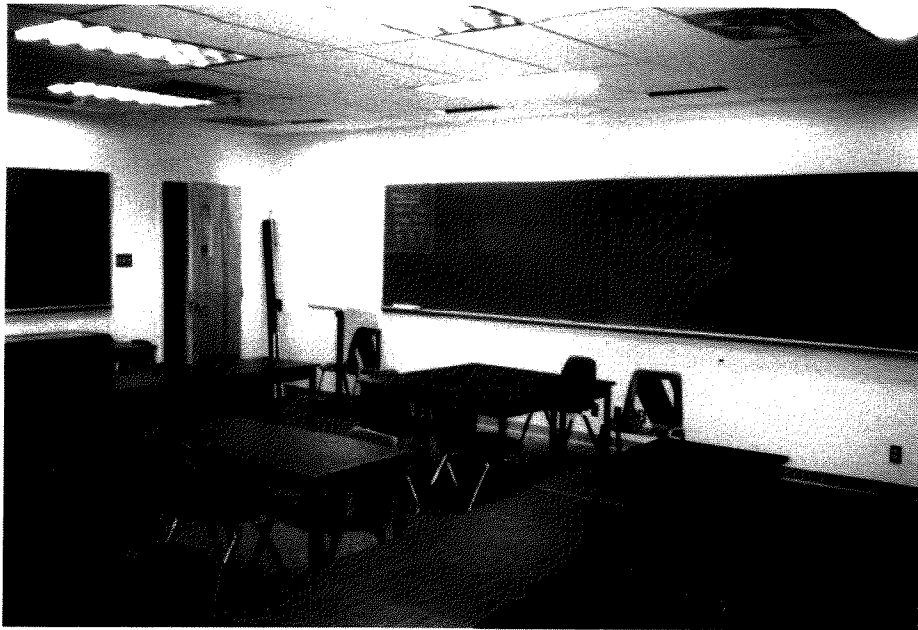


FIGURE 3 continued



FIGURE 3 continued

TABLE 1 The seven physical properties of the classrooms

<i>Property</i>	<i>Description and scoring</i>
Brightness	Amount of light (both natural and artificial) that illuminates the classroom <i>Scoring:</i> photographs ranked from 1 (least bright) to 35 (brightest)
Seat comfort	Amount of cushioning and/or degree of ergonomic design for seats <i>Scoring:</i> four categories (1, rigid; 2, minimally ergonomic; 3, more ergonomic; 4, padded)
Interior complexity	Variation of textures and materials used for walls and ceiling; also the amount of user supplied adornments (i.e. paintings, pictures, maps, etc.) <i>Scoring:</i> three categories (1, simple; 2, moderate; and 3, high complexity)
Room size	Physical size of the classrooms <i>Scoring:</i> ranked from 1 (smallest) to 35 (largest)
View to outdoors	Any window view to outdoors <i>Scoring:</i> two categories (1, no view; 2, view)
Seating arrangement	Seating arrangements that promote or discourage communication with other students <i>Scoring:</i> three categories (1, individual forward-facing seats – non-interactive; 2, table with forward-facing seats – non-interactive; 3, tables with seats all around – interactive)
Seat grade (steepness)	Approximate seat grade or steepness of the student seating <i>Scoring:</i> four categories (1, no grade; 2, slight; 3, moderate; 4, steep grade)

whether the classroom had a window through which the outdoors could be viewed.

The other five properties, although fundamentally objective, were less clearly so; therefore, a second observer, who was not among the student or professor evaluation groups, and who was unaware of the study's hypotheses, was asked to rate the five remaining properties of all 35 classrooms as a reliability check for the experimenter's ratings. These five properties were brightness, seat comfort, aesthetic complexity, room size and seat grade or steepness (see Table 1). An additional (third) observer provided ratings on all 35 classrooms for three of these same five properties (brightness, aesthetic complexity, and seat comfort) to increase their inter-rater reliability. All ratings were done from the photographs and were based on the written definitions of the physical properties in Table 1.

Results

Reliabilities and psychometric properties

Physical properties

All seven properties had reasonable variability over the 35 classrooms. Twenty classrooms had the all-individual-seats-facing-forward arrangement, seven had

the tables-with-forward-facing-seats arrangement and eight had the tables-with-seats-around-the-table arrangement. Twenty-four classrooms had views to outdoors; 11 did not. Agreement between the raters of the five rated physical properties was assessed as intra-class correlation (ICC: Shrout and Fleiss, 1979, formula ICC(3, k)). These ICCs ranged from 0.70 to 0.93 (see Table 2), with an *r*- to *Z*-corrected mean ICC of 0.85, which was considered quite adequate. Thus, the ratings of these five properties were combined by averaging across raters (see Table 3).

Professors and students

To what extent did student evaluators agree among themselves? The intra-class correlation for their friendliness evaluations was 0.86, and that for their preference evaluations was 0.85. Agreement among professors was 0.89 for friendliness and 0.85 for preference. Thus, the two groups strongly agreed among themselves about the classrooms' friendliness and preferability. Because this study aimed to understand the evaluations of these groups (as opposed to individual students or professors), evaluations of friendliness and preference were averaged across each group for each classroom. Thus, each classroom had a single, reliable friendliness and overall preference evaluation score for each of the two user groups.

Friendliness and overall preference

As might be expected, classroom friendliness and overall preference are strongly related. The correlation between students' ratings of friendliness and overall preference was strongly positive ($r = 0.81$). Professors' ratings of friendliness and preference also were strongly correlated ($r = 0.79$). One could argue, therefore, that the two evaluations should be combined, and that would be a reasonable procedure. However, we chose to report results for each evaluation separately because friendliness and preference are not necessarily the same, conceptually, even if they are strongly related statistically in this instance.

The correlates of friendliness and preference: lens models

The elements of the lens model are now in place: independent and reliable measures of several physical properties and independent, reliable observer evaluations. First, correlations between the students' mean friendliness scores and each of the seven classroom physical properties were computed. Recall that the physical properties were not mentioned to the evaluators when they made their ratings.

TABLE 2 Inter-rater reliability for the physical properties

<i>Classroom physical property</i>	<i>No. of observers</i>	<i>Reliability (ICC)</i>
Room size	2	0.93
Seat grade (steepness)	2	0.93
Interior complexity	3	0.79
Seat comfort	3	0.76
Brightness	3	0.70

Note:

Seating arrangement and view to outdoors were rated only by the experimenter because they were so clearly scorable.

TABLE 3 Means and standard deviations of the professor and student evaluations

	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>SD</i>
Students' evaluations of:				
Friendliness	3.65	6.39	4.97	0.69
Preference	4.04	6.49	5.13	0.61
Professors' evaluations of:				
Friendliness	2.60	6.25	4.27	0.89
Preference	3.10	6.30	4.75	0.87

Note:

Averaged across the 35 classrooms. *Ns* = 51 students and 20 professors. Scores on both scales could range from 0 to 9, where 0 is least friendly and preferred and 9 is most friendly and preferred.

Thus, any statistically significant correlations found represent associations between classroom properties and the evaluations that may or may not have been salient to the evaluators (but certainly were not made salient by the experimenter), but nevertheless are statistically significant associations made by the evaluators across the sample of 35 classrooms.

The student evaluations of greater classroom friendliness were statistically significantly correlated with having a view to the outdoors ($r = 0.68, p < 0.001$). Their overall preference for classrooms also was statistically significantly correlated with having a view to the outdoors ($r = 0.58, p < 0.001$). More sociopetal (interaction-encouraging) seating arrangements were also correlated with both student friendliness and preference ratings ($r = 0.48, p < 0.003$ and $r = 0.35, p < 0.039$, respectively). Finally, greater seating comfort was linked to evaluations of greater friendliness and preference for students ($r = 0.37, p < 0.047$ and $r = 0.47, p < 0.004$, respectively).

Collectively, how well were the student evaluations explained by these statistically significant relations? Multiple regression, using the three significant properties as predictors of the friendliness evaluations, resulted in a multiple *R* of 0.76, indicating that 57 per cent of the variation in student evaluations of friendliness could be accounted for by the three physical properties. As for overall evaluation, the multiple *R* was 0.71, and 51 per cent of the overall preference evaluations was accounted for by the same three properties.

Next, the professorial evaluations were correlated with the physical properties. Evaluations of greater classroom friendliness and preference both were strongly correlated with having a view to the outdoors ($r = 0.64, p < 0.001$ and $r = 0.70, p < 0.001$, respectively). The correlation between professors' preference ratings and seating comfort was also significant ($r = 0.34, p < 0.043$). Professors' friendliness ratings correlated strongly with more sociopetal seating arrangements ($r = 0.48, p < 0.004$).

The professor evaluations were also well explained by these factors. Multiple regression, using only the two significant properties as predictors of the friendliness evaluations, resulted in a multiple *R* of 0.74, indicating that 55 per cent of the variation in professorial evaluations of friendliness could be accounted for by only the classrooms' outdoor views and type of seating arrangement. The professors' overall evaluation multiple *R* was 0.63, and thus, 40 per cent of the overall preference evaluations was accounted for by view and seat comfort.

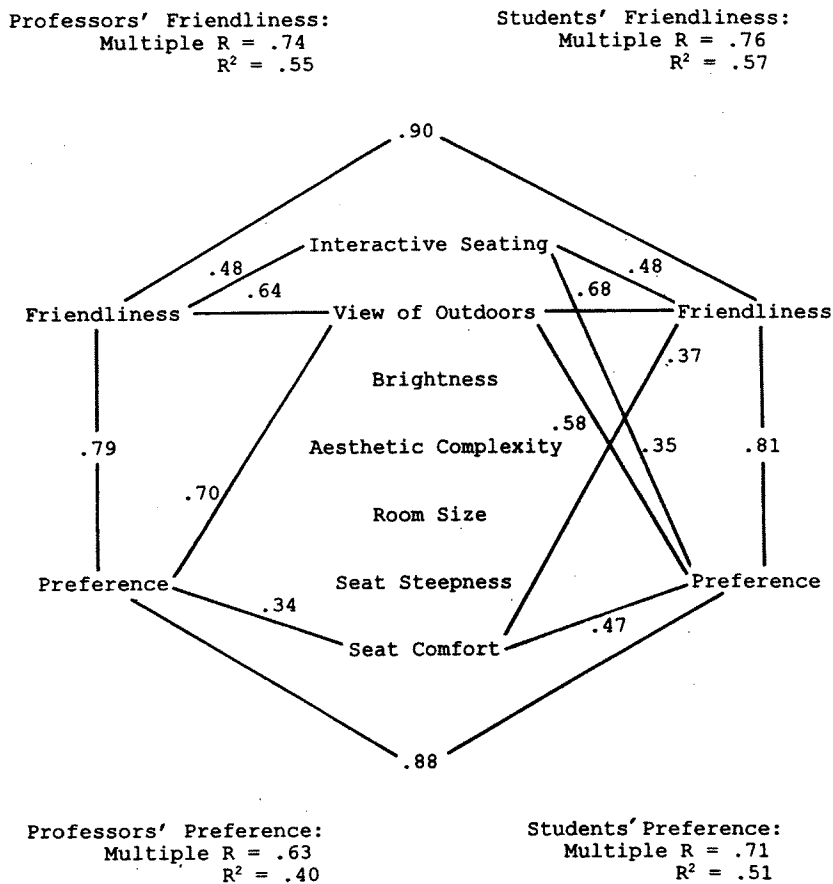


FIGURE 4 The lens model for students and professors

Professor and student agreement

Do students and professors evaluate classrooms similarly? The overall ratings of friendliness and preference by professors and students were correlated. Professors' friendliness ratings correlated with students' friendliness ratings with highly significant results ($r = 0.90$, $p < 0.001$). The correlation between professors' preference ratings and students' preference ratings was also very strong ($r = 0.88$, $p < 0.001$). The results are summarized in Figure 4.

The strong agreement between the students and professors presumably occurred because the two groups tended to base their evaluations on similar sets of environmental cues. Of the six significant cues used by the students for their two evaluations, the professors used four. The only differences were that the student evaluations of friendliness were significantly related to seat comfort, whereas the professors' were not; and the student preference evaluations were related to seating arrangements, whereas those of the professors were not. Even

these differences were slight; the correlations were just on either side of the $p = 0.05$ level of significance: for the seating arrangement/preference correlations, the students' were 0.35 ($p = 0.039$), whereas the professors' were 0.30 ($p = 0.081$). For the seat comfort/friendliness correlations, the students' were 0.37 ($p = 0.031$), whereas the professors' were 0.32 ($p = 0.064$).

Discussion

This study illustrates how specific, objective elements of the physical classroom may be linked to preference and friendliness evaluations of classrooms. The results are limited to these 71 evaluators, this set of 35 university classrooms and to seven physical characteristics of those classrooms, but the strong links found suggest that the method would be useful for studying any classroom with any set of educators and students. Only seven physical properties of the classrooms were studied, but the strength of the links of three of these properties to the evaluations lends optimism to the possibility that many more environmental cues might also be so linked, and that evaluations of classrooms by educators and students could be explained even better than in this study.

The level of agreement between the professors and the students was very high. One might not have expected this, given the differences between the groups in age, role and typical location in the classroom, and other demographic differences. But the agreement is very encouraging, because it means the two groups apparently are satisfied by the same classroom characteristics. Designers who wish to please users of classrooms need not consider two distinct or competing sets of physical properties; they need not compromise or build to suit one of the two groups at the expense of the other.

More specifically, the results suggest that students and faculty prefer rooms that have sociopetal seating, a view to the outdoors and comfortable seats. All three of these factors are important for students' evaluations of both friendliness and overall preference; professor evaluations of friendliness omit seating comfort and their evaluations of overall preference omit sociopetal seating arrangements. However, it is not that the professors hold the opposite view about these two properties; they are merely silent on them.

The lack of importance of certain physical properties is worth noting. Our pilot group of students thought that brightness, room size, aesthetic complexity and seats placed on a grade would affect evaluations. These factors did not, however, significantly affect the evaluations of either students or professors. Perhaps these factors would affect other kinds of evaluations; one direction in which this line of research could be expanded is towards judgements of, say, the comfortableness of the classroom, or its emotion-eliciting qualities (e.g. how frightening or calming the room is).

Certainly other physical features of classrooms must influence student and professor evaluations, and future research should examine these. For instance, this study exclusively addressed the visual aspect of environmental evaluation. Future research could examine non-visual approaches to evaluation (e.g. classroom acoustic qualities), and doing so would diversify understanding of both the sources of user evaluations of classrooms. However, this study clearly shows that the modified lens model is a useful way of accounting for evaluations in terms of physical properties, and for comparing the evaluation policies of different groups of building users. The paradigm could be extended to non-visual features of

classrooms or, in public school settings, examination of parents' evaluations, or even janitors' evaluations. Furthermore, the lens model method can be used in any culture; one might expect that different classroom forms in different societies would have different physical properties that predict local evaluations. However, the modified lens model can be adapted to any culture or age group.

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