The Potential Role of the Physical Environment in Fostering Creativity

Janetta Mitchell McCoy & Gary W. Evans

To cite this article: Janetta Mitchell McCoy & Gary W. Evans (2002) The Potential Role of the Physical Environment in Fostering Creativity, Creativity Research Journal, 14:3-4, 409-426, DOI: 10.1207/S15326934CRJ1434_11

To link to this article: https://doi.org/10.1207/S15326934CRJ1434_11

Published online: 08 Jun 2010.

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ABSTRACT: Two studies investigated the role of specific interior design elements on creativity. In Study 1, a photographic structured Q sort was used to determine where participants would feel most creative and least creative. Content analysis of the photographs by independent raters scaled each setting according to size, shape, light, internal organization of objects, and characteristics of bounding surfaces. Analyses identified 5 environmental characteristics that independently predicted greater perceived creativity: (a) complexity of visual detail, (b) view of natural environment, (c) use of natural materials, (d) with fewer cool colors used, and (e) less use of manufactured or composite surface materials.

In Study 2, tests of actual creative performance were administered in 2 different settings. One setting had been rated relatively high in creativity potential, and the other setting was rated relatively low in creativity potential by the original participants in Study 1. Creative performance of an independent sample was greater in the setting that had been rated higher in creativity potential by participants in Study 1.

Creativity is the ability to fluently solve problems with original, innovative, novel, and appropriate solutions (Amabile, 1989; Guilford, 1967). The focus of creativity research has been on personal characteristics—to the exclusion of potential contributions by the physical setting (Amabile, 1983a; Barron, 1969; Guilford, 1968; MacKinnon, 1962; Stein, 1974; Torrance, 1966). Yet many creative thinkers themselves have recognized the potential role of the environment to influence creativity. The purpose of this study is to examine the potential role of interior design elements in fostering creativity.

Dubos (1971) suggested that people confined to a “featureless environment” suffer intellectually and emotionally and that “the potentialities of human beings can become fully expressed only when the (physical) environment provides a wide variety of experiences” (p. 339). Theories about the restorative qualities of nature also allude to creativity as a process that is enhanced by contact with natural elements (Kaplan & Kaplan, 1989).

The creative process is generally defined as four phases: (a) the accumulation of a knowledge base; (b) incubation of that knowledge; (c) recognition or vision of an innovative solution to a problem; and (d) the transformation of that vision into a useful, creative product. Creativity as achievement is the production of works that are novel or innovative in the public sense.

Personality, however, is only a portion of the portrait of creativity. Guilford (1967) and Torrance (1966, 1968) posited that there must be a result associated with creativity—a product. Guilford and Torrance each developed widely accepted rating scales for the creative product based on degrees of innovation, originality, flexibility, novelty, and fluency. Rogers (1954), reinforced by Bruner (1962), suggested that usefulness...
was an essential criteria of creative achievement. Realizing that creative products differ across domains, Amabile (1982, p. 997) added that a product is creative to the extent that “appropriate observers independently agree it is creative.”

One clue to environmental design characteristics salient to creativity emanates from Amabile’s work on organizational qualities that influence creativity (Amabile & Gryskiewicz, 1988). She found that respondents had common perceptions of ideal conditions that would be stimulants to creativity within organizations. The conditions identified a priori were as follows:

- Freedom—a sense of control over one’s own work and ideas
- Challenge—a sense of having to work hard on challenging tasks and important projects
- Resources—access to appropriate resources, including people, materials, facilities, and information
- Supervisor—a leader or manager who sets appropriate goals, values individual contributions, and serves as an intelligent, enthusiastic role model
- Coworker—communications with peers are open, trusting, and constructive
- Recognition—feedback leads to appropriate recognition and reward
- Unity and cooperation—a cooperative, collaborative atmosphere in which there is a lively flow of ideas around a shared vision
- Creativity supports—creativity is encouraged, and mechanisms exist to foster creative expression

Common perceptions of obstacles to creativity within organizations identified a priori were as follows:

- Time pressure—too much work to do in the allotted time
- Evaluation—excessive negative or threatening evaluation procedures
- Status quo—an emphasis on following stated rules; avoiding risks
- Political problems—excessive, destructive competition; territoriality

Amabile’s work is limited by the lack of reference to physical characteristics in the environment that might encourage or impinge on conditions. However, others have observed that the physical work environment reflects and contributes to the social conditions within organizations that foster problem solving (Becker, 1990; Becker & Steele, 1995; Steele, 1986).

Consideration of these conceptual models and scant empirical data on conditions conducive and inimical to creativity led us to posit the following underlying dimensions of physical settings salient to creativity:

- Nature—As a recurrent theme in the literature, nature has been a dominant element in restorative environments (Kaplan & Kaplan, 1989). Theories about the restorative qualities of nature allude to creativity as a process that is enhanced by contact with natural elements. Creative personalities are sensitive to sensuous experiences (Barron, 1969; MacKinnon, 1962); multiple sensory stimuli available in a natural environment may be conducive to creative behavior (Ackerman, 1991; Ulrich, 1993).
- Challenge—Creative tasks are engaging when they are challenging. An environment that is intricate or complex, offering a promise of more information if explored, is high in challenge (Kaplan & Kaplan, 1989). The concept of challenge as a contributor to the enhancement of creativity is consistent with creative personality characteristics as described by MacKinnon (1962) and Barron (1969): (a) value for intellectual and cognitive matters and (b) critical, skeptical, flexible attitudes toward ideas. It is also consistent with Rogers’s (1954) assessment that the creative personality enjoys toying with elements and concepts, as well as Amabile’s (1989) identification of work setting characteristics supportive of creativity.
- Freedom—Just as the creative person is open to experience, the freedom to choose and explore is characteristic of an environment that supports creativity (Amabile, 1989). A free environment also allows diversion and, reflecting flexibility, offers a degree of personal autonomy. The sense of freedom may be necessary to support the rebelliousness, mood fluctuation, and unconventional thought processes identified by MacKinnon (1962) and Baron (1969) as prerequisites for creative thought. Likewise, providing a sense of freedom in the environment to support creative behavior may reinforce the conditions of psychological safety and freedom described by Rogers (1954).
- Support—Support implies agreement between psychological and physical conditions required for the
task function. Categorized separately by Amabile (1989) as resources, supervisor and coworker assistance, recognition, and unity and cooperation, a supportive environment provides nonjudgmental acceptance and understanding (Rogers, 1954), while also offering relevant information and an opportunity to function at the task required. Just as the social environment provides support, the physical environment may reflect and reinforce that support.

- Coherence—Coherence is implied in Amabile’s (1989) model by the concept of a supervisor who sets appropriate goals, serves as a guiding role model, gives feedback and appropriate recognition, as well as providing encouragement toward a mutually agreed creative direction. Legible and familiar environments that offer spatial distinction and clear definition are coherent. They also allow the viewer to predict appropriate behavior for the observed conditions (Kaplan & Kaplan, 1989; Lynch 1960).
- Threat—Just as an environment may be overtly unsafe, threatening may also imply subtle judgmental surveillance, evaluation, or supervision (Amabile, 1989). Time pressure, evaluation, and political problems each represent a potential threat to psychological safety. The design of the physical environment can either enhance or inhibit efficiency of task performance. Just as hierarchical design may contribute to competition for status, it may also contribute to conditions of perceived evaluation (Steele, 1986).
- Status quo—As described by Amabile (1989), an environment that values the status quo is in direct conflict with conditions that enhance creative behavior, especially freedom and challenge. It would also appear to be inconsistent with the rebellious, critical, skeptical, and flexible nature of the creative personality as described by MacKinnon (1962) and Barron (1969). Therefore, it may follow that a rigid environment in which conformity is apparent, that has boundaries not intended for change or manipulation, and that overtly exhibits restriction and rules would be inimical to creative behavior.

Two studies were conducted to evaluate the potential of the physical environment to foster creativity. Study 1, derived from the preceding conceptual framework, tested a set of interior design elements believed to be relevant to creativity potential. Study 2 validated a portion of the theoretical model in an analysis of actual creativity performance.

### Study 1

#### Overview and Objectives

The primary objective of Study 1 was to identify the physical characteristics of interior environments in which people perceive they would be most creative. In addition, we evaluated whether differences in perceived creative potential could be predicted by salient physical characteristics associated with the seven conceptual dimensions (e.g., nature, challenge, freedom, support, coherence, threatening, and status quo) described previously. A three-step process was initiated to address the objective of Study 1.

1. Photographic stimuli development—Representative sampling of the seven theoretical dimensions was achieved by a two-step process. The senior author photographed a large number of sites explicitly trying to fill a matrix of low, medium, and high conditions for each of the seven conceptual dimensions. The second step, to enhance ecological sampling, required independent raters to evaluate every slide on each of the seven theoretical dimensions. From these ratings, a smaller sample of settings was selected that were representative of the seven respective theoretical dimensions.

2. Creativity potential ratings—The second procedure involved a Q sort in which a different group of participants ordered the theoretically rated settings in terms of creative potential.

3. Environmental design analysis—To tie the theoretical constructs to precise physical design features, a different group of independent raters scored each setting for a list of environmental design physical characteristics. These characteristics were categorized as spatial form, light, internal organization of objects, and characteristics of bounding surfaces.

#### Method

##### Participants

Sixty participants (65% women, $M = 18.6$ years) for the creativity potential Q sort were recruited from large undergraduate psychology classes at a nearby college. Extra credit toward the final grade in their individual courses was offered.
Photographic Stimuli Development

Using the seven theoretical dimensions identified as variables within the physical environment (i.e., nature, challenge, freedom, support, coherence, threat, status quo) that might affect creativity, we developed a working matrix to ensure that multiple levels of the elements would be photographed. Because social environments have been shown to substantially influence creativity (Amabile, 1983a, 1983b), many different social settings were also represented: classrooms, waiting rooms, libraries, offices, living rooms, hallways, dining facilities, sports facilities, and retail stores. To ensure variety in design and treatment, photographs were taken in eight different towns and cities in the United States and Canada. Multiple photographs of similar environments were processed to ensure that the seven theoretical dimensions were equally represented. A standard 35-mm camera with a semiwide-angle lens was used with Kodak Elite 400 film for color slides.

The initial pool of 1,200 photographs was processed and scrutinized by the authors for photographic quality and for content of the theoretical dimensions. From this pool, the authors selected 385 photographs as adequate representation of the theoretical framework across a wide range of settings. Low, medium, and high examples of each of the seven theoretical dimensions were approximately equally represented across the 385 photographs.

Twenty-four independent raters recruited from the human subjects pool of a local university scored the second pool of photographs representing the theoretical framework. Raters of the second photographic pool were divided into groups of four to six raters; each group required approximately 2 hr to review 120 slides. Different rater groups viewed different subsets of slides such that each photograph was rated by at least four raters from two different groups. Slides were presented in random order. After an initial practice period, each slide was projected for approximately 1 min. Raters were encouraged to rate each slide independently. The rater’s task was to evaluate each slide on a 3-point checklist (Table 1) that described each of the theoretical elements.

The means and standard deviations of the raters’ scores were used to evaluate the theoretical content of each slide. Photographs chosen for the Q sort of creativity potential (next section) included the 38 images with the highest mean scores ($M > 2.50$) and lowest standard deviations ($SD < 0.67$) on the seven dimensions and the 37 images with the lowest mean scores ($M < 0.50$) and lowest standard deviations ($SD < 0.67$). These 75 slides were converted to 4 × 6 prints and duplicated to make 15 identical Q sort decks.

Creativity Potential Ratings

Q methodology was used to investigate variables within the physical environment predictive of creativity performance. Q technique has proven to be a reliable and sophisticated method of rank-ordering subjective responses. It also permits the assignment of values to individual settings for statistical analysis. The Q sort is particularly well suited for judgments about visual materials and is not highly dependent on verbal or linguistic interpretations (Stephenson, 1988).
Location of the test was a classroom with which all the participants were familiar. Each participant was seated at an individual desk and provided a deck of 75 mounted photographs that had been thoroughly shuffled to ensure random viewing of the images. Participants were asked to sort the photographs into a normal distribution of 11 piles ranging from 0 (an environment that one would be least likely to choose) to 10 (an environment that one would be most likely to choose; Kerlinger, 1986). Framed from the conceptualization that creativity is the ability to fluently generate original, innovative, novel ideas (Guilford, 1967) and appropriate solutions (Amabile, 1989), the Q sort was based on the following question.

If you had a very special problem to solve and needed to generate a lot of new ideas, where would you most likely choose to go?

A creativity potential score was assigned to each setting determined from its mean score from the Q sort. A high mean suggested the setting had high creativity potential, whereas a low mean suggested the setting had low creativity potential.

Environmental Design Analysis

The initial ratings of the photographs linked perceptions of the settings to theoretical constructs of creativity. To ground these theoretical constructs to design, a detailed content analysis of each photographed setting from the Q sort was required.

A team of researchers including an architect, an urban planner, an interior designer, and an environmental psychologist met to review and discuss the categories of physical elements present in the photographs. Based on this discussion and a review of the physical contents of the 10 settings rated highest and the 10 settings rated lowest in creativity potential, we developed a terminology for describing physical elements of the photographed settings. This terminology required that each photographed setting be analyzed based on the physical characteristics of spatial form, light, internal organization of objects, and characteristics of bounding surfaces.

These physical characteristics were also derived from the original theoretical dimensions. Nature was represented in a setting by the use of natural materials and nature content of views. Sensory stimulation was available in the complexity and variety of the shapes and internal organization of the setting. Challenge was provided in a setting based on the complexity of its internal organization, the level of its perceived flexibility, and the content of the view offering a promise of more information. A sense of freedom was communicated through the internal organization of the setting that appeared to offer choices of autonomy in movement or action within an atmosphere of safety. Support from a setting was reflected in a layout configured to encourage social interaction as well as organized and lighted to facilitate functional performance. A coherent setting offered spatial legibility and internal organization familiar and recognizable to its apparent function or purpose. Threat was reflected in the level of visual exposure, actual or symbolic surveillance, and manifestations of control or authority. A setting emphasizing status quo communicated inflexibility or nonadaptability in the internal organization and surface materials.

Working independently, two trained raters, who were not aware of the creativity potential scores of the settings, conducted a physical content analysis of each photograph from the Q sort based on the physical elements terminology. Qualitative physical elements, such as shape, complexity, light, and internal organization were evaluated on a scale of 7 to 1, as detailed in the following sections. Quantitative characteristics, such as amount of view, texture, or materials were measured (by an independent person, also blind to the photographs’ creativity ratings) as percentages of the total photograph.

Spatial form. Spatial form was defined as the structural size and shape of the interior space represented in the photograph. Size was ordinarily measured by comparing the perceived size of the photographed space with the perceived size of all the others. Each photograph was given a score from 7 (largest space) to 1 (smallest space).

The shape of the setting was measured in each photograph based on rectilinearity and complexity (multiple shapes). For rectilinearity, a score of 7 indicated the shape of the room was square or cubelike with dimensions of walls, floors, and ceilings perceived to be very similar. A score of 1 indicated the shape of the room was elongated with an extreme ratio of either the floor or wall. Interobserver reliability was calculated with Ebel intraclass correlation ($r = 0.89$).
For complexity of structural elements, a score of 7 indicated that there were so many shapes visible in the photograph that the environment could be overstimulating or confusing. A score of 1 indicated that there were few shapes visible so that the environment could be considered bland (Ebel \( r = 0.93 \)).

**Light.** Analysis of light included an evaluation of both quantity of light and quality of light. For the quantity of light within each environment, a score of 7 indicated the room was very brightly lit, as would be expected on a sunny day—too bright to be comfortable. A score of 1 meant the room was so dimly lit that it was difficult to see the objects within it (Ebel \( r = 0.98 \)).

For quality of light within each environment, a score of 7 indicated the room was evenly lit, with no shadows. A score of 1 meant the room was heavily shadowed (Ebel \( r = 0.97 \)).

**Internal organization of objects.** Describing the internal organization of objects, the overall qualitative effect of the furniture and visual detail were each evaluated on a scale of 7 to 1. Scores for effect of furniture indicated its ability to promote social interaction. A score of 7 indicated furniture facilitated a highly sociopetal condition. A score of 1 indicated a sociofugal condition, or no objects that could facilitate social interaction (Ebel \( r = 0.89 \)).

Visual detail indicated the number or degree of objects placed or built into the room intended to add aesthetic interest. A score of 7 meant the room was highly detailed (it could be overstimulating and confusing), whereas a score of 1 indicated the room was devoid of detail (Ebel \( r = 0.88 \)).

**Characteristics of bounding surfaces.** Finish materials, texture, and transparency defined the characteristics of the bounding surfaces. These characteristics were measured as percentages of the photographed image by using a transparent grid. The grid contained 20 equal rectangular sections (1 rectangle equaled 5% of the photograph), and each of the rectangular sections was diagonally bisected, creating 4 small triangular sections (1 triangle equaled 1.25% of the photograph). To test for interobserver reliability, Kappa was used.

Materials were identified as either manufactured or composite, natural, or living plant life. Manufactured or composite material was defined as any element within the space that was not immediately identifiable as being in a “natural” state. Manufactured or composite materials could be aggregates, processed or totally man-made materials. Examples are drywall, plastic laminate, glass (but not the view beyond), terrazzo, carpet, synthetic fibers (i.e., nylon or olefin), vinyl, and steel (\( k = 0.66 \)).

Natural materials were considered to be any element grown or mined from the earth, though it may have been finished or enhanced. An example is wood that has been lacquered and polished but retains enough of its visual and textural quality to be easily identifiable. Other examples could be marble, granite, copper, natural fibers (such as wool, cotton, or silk), and leather (\( k = 1.0 \)).

Living plant life was considered only if it was potted and growing within the photographed space. Plant life as part of a view is evaluated in a later section on transparency. Artificial plants were not identified as part of any of the photographs. The percentage of manufactured or composite, natural, or living plant material in each photograph was determined by the amount measured from the grid (\( k = 1.0 \)).

**Color.** In an attempt to reduce bias due to color fashion and personal preferences, colors were evaluated based solely on their perceived color temperature—warm or cool. Warm colors were any reflected values that were determined to be in the yellow, red, or red violet spectrum. Cool colors were those determined to be in the green, blue, or blue violet spectrum (\( k = 0.34 \)). The grid technique was used to calculate the percentage of cool and warm colors in each photograph.

**Texture.** The amount and degree of texture in an environment were evaluated on a proportional scale and required two steps. First, the degree of texture contributed by an object was evaluated on a scale of 7 to 1. Second, the proportion of the picture represented by that texture was calculated. A score of 7 represented the roughest texture (i.e., cobblestone, or a natural stone wall; \( k = 1.0 \)). A score of 6 represented less roughness (i.e., brick; \( k = 1.0 \)). A score of 5 represented a rough stipple texture (i.e., concrete; \( k = 1.0 \)). A score of 4 indicated less texture (i.e., wood grain; \( k = 0.82 \)). A score of 3 indicated a smoother texture (i.e., drywall,
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Transparency. Transparency was the available view from the photograph. View was defined as visual access either to the exterior environment or to an adjacent interior environment. Using the grid technique, the percentage of view from the bounding surfaces in each photograph could be measured. Categories of views were built, natural, or obscured. A built view would indicate visual access of another room, another building, or a parking lot \( (k = 0.66) \). A natural view indicated a view of living plants, trees, hills, or the sky \( (k = 1.0) \). An obscured view meant although there was an opening intended to provide visual access beyond the bounding surfaces, for some reason the objects of the view were indistinguishable \( (k = 0.66) \). No view meant there was no visual access to any area outside the immediate setting \( (k = 0.66) \).

Results

The data analysis was designed to identify physical elements of interior environments that could predict the potential creativity enhancement of a setting. Initially, we described the zero-order correlations between the physical element ratings and creativity potential (Table 2). This was followed by a stepwise regression analysis to identify the best set of independent design elements that predicted creativity potential (Table 3).

Spatial Form

As shown in Table 2, the correlation analyses indicated no association between size and rectilinearity of shape with creativity potential. However, higher complexity was associated with more perceived creativity potential in a space.

Light

Neither quantity nor quality of light was significantly related to the creativity potential of settings.

Internal Organization of Objects

Both furniture and visual detail were found to be highly correlated with creativity potential. Furniture, rated for its potential to promote social interaction, suggested that a high degree of social potential also implies a high degree of creativity potential. High levels of visual detail significantly enhanced perceived creativity potential of a setting.

Characteristics of Bounding Surfaces

Manufactured or composite materials had a strong negative correlation with creativity potential whereas natural materials had a positive correlation, implying that enhanced creative performance is perceived in a room in which some identifiable natural material can be found. All environments that received a high score of creativity potential (Figure 1) had some amount of exposed wood or stone—except one. Although all surfaces in that one space were totally constructed of manufactured or composite materials (drywall, steel, and plastic laminate), the space had a very large and obvious view of the natural environment outdoors—and a high score for creativity potential.

Color

Cool colors had a significant negative correlation with creativity potential. Environments with a primarily cool color temperature were not perceived to be conducive to creativity.

Texture

The degree of texture (on a scale 1 of 7) and the proportion (percentage) of different textures in each photograph were analyzed. The amount of texture of wood grain was found to be positively associated with creativity potential.

Glass

The presence of glass appeared to enhance ratings of creativity potential.

Transparency

As expected, view and natural view correlated strongly with creativity potential.
Table 2. **Correlation of Creativity Potential with Content Analysis Variables**

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</table>
| 24 Obscured View                     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   *p < .01. **p < .001.
Role of the Physical Environment

Initially, stepwise regression was utilized to determine the best set of independent predictors in a hierarchical mode. This procedure also helped reduce multicollinearity of the final elements measured. This subset of predictors was utilized in a forward delineation procedure to identify a set of independent significant predictors. In some cases, scatter plots were created to investigate possible curvilinearity between the independent variables (e.g., complexity) and creativity potential scores. No curvilinear plots (cubic or quadratic) were identified. Table 3 describes the five attributes of the physical environment identified from the multiple regression as significant, independent predictors of the creativity potential scores. This predictive model is highly significant, $R^2 = .678$, $F(5, 69) = 29.15$, $p < .0001$.

The five physical elements shown in Table 3 explain significant, independent portions of the creativity potential score. Regression coefficients and significance tests are all as if last entered. Evaluated independently, increases in visual detail, wood grain texture, and natural view are perceived to enhance creativity potential. Inversely, increases in cool color temperature and manufactured or composite materials are negatively associated with perceived creativity potential.

Table 3. Regression of Content Analysis with Creativity Potential

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$B$</th>
<th>Beta</th>
<th>t(69)</th>
<th>sig t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Detail</td>
<td>.342</td>
<td>.507</td>
<td>7.13</td>
<td>.0001</td>
</tr>
<tr>
<td>Texture 4</td>
<td>.014</td>
<td>.266</td>
<td>3.66</td>
<td>.0005</td>
</tr>
<tr>
<td>Natural View</td>
<td>.011</td>
<td>.251</td>
<td>3.33</td>
<td>.0010</td>
</tr>
<tr>
<td>Cool</td>
<td>−.006</td>
<td>−.214</td>
<td>3.05</td>
<td>.0050</td>
</tr>
<tr>
<td>Manufactured/Composite</td>
<td>−.009</td>
<td>−.176</td>
<td>2.24</td>
<td>.0500</td>
</tr>
</tbody>
</table>

Figure 1. The effect of five characteristics on creativity potential.
Discussion

The primary goal of Study 1 was to determine if people’s perceptions of creative potential for interior physical settings could be linked to physical design elements explicit to the settings. Using the design elements identified from the multiple regression analysis (Table 3) and the correlational analysis of creativity potential (Table 2), five characteristics common to environments rated high in creativity potential and three characteristics common to environments rated low in creativity potential emerged from this study and are summarized in Table 4.

Table 4. Environmental Characteristics of Physical Settings That Influence Creativity Performance

<table>
<thead>
<tr>
<th>High Creativity Potential</th>
<th>Low Creativity Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial complexity</td>
<td>Cool color temperature</td>
</tr>
<tr>
<td>Visually detailed</td>
<td>No view</td>
</tr>
<tr>
<td>View of natural environment</td>
<td>Manufactured/composite material</td>
</tr>
<tr>
<td>Use of natural material</td>
<td></td>
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<tr>
<td>Sociopetal design</td>
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</tbody>
</table>

Environments high in perceived creativity potential most frequently were visually interesting, as had been speculated by Amabile (1983a), Guilford (1967), and Stein (1974). Such environments tended to be highly complex, both spatially and ornamentally. They tended to have extended views; natural materials were liberally present. These spaces had some provision for promoting social interaction, as in Figure 2.

As shown in Figure 3, complexity of spatial design was demonstrated by multiple shapes in walls and ceilings. Complexity of visual detail was added with the use of personal items, books, artwork, lamps, and a variety of treatments on the bounding surfaces. As indicated in other research, creativity can be stimulated by complex, challenging situations presented in a coherent context (Amabile, 1990; Barron, 1969; Bruner, 1962). The findings of this study suggest that creativity potential also lies in exposure to physical settings that are high in complexity and challenge. These results were unexpected because we hypothesized that a moderate amount (i.e., curvilinear rela-

Figure 2. Complex physical environments with views, natural material, and opportunities for social interaction were considered high in creativity potential ($x = 6.82, SD = 1.83$).
tion) of complexity and visual detail would be most conducive to the creativity potential of a setting.

Natural views were preferred, but even an obscured view contributed more to creativity potential than no view at all. Natural views occurred only in the highest quartile of the mean scores for creativity potential. These findings are congruent with the speculation that views of restorative environments may foster creativity (Ulrich, 1993). Perhaps this is due to the fascination produced by nature views that capture one’s attention, reduce mental fatigue, and restore cognitive capacity (Figure 4; Kaplan & Kaplan, 1989).

A natural view from a window may be a method of achieving exposure to the natural environment while remaining present in the interior physical environment. Verderber (1986, p. 451) suggested “the window symbolizes freedom—a release, however brief, from the immediate world to a different more expansive world.” The sense of freedom, complexity, openness, and coherence experienced in the natural environment that reduces cognitive fatigue could very well be the same sense of freedom, complexity, openness, and coherence that Rogers (1954) posited as conducive to creative performance.

An unexpected finding was the importance of the type of finish and visible construction materials. Environments high in creativity potential incorporated obvious but not exclusive use of natural materials. Sometimes the proportion of natural material to manufactured or composite materials was quite small, but it was always obvious. Primarily the observed natural material was wood. Perhaps the use of natural materials substitutes for exposure to natural environments, supporting research by Heerwagen and Orians (1986) that without windows, office workers will attempt to create window substitutes with natural decor.

The significance of the presence of wood was confirmed by the emergence of the texture of wood as a strong predictor variable. The combination of a preference for complexity, natural materials, and variety in bounding surfaces makes the importance of texture such as wood grain a logical prediction. Because humans have such a strong biological affinity for nature (Kaplan

![Figure 3.](image-url) Highly complex, challenging environments were judged to be high in creativity potential (x = 6.26, SD = 1.96).
& Kaplan, 1989; Ulrich, 1993), the presence of wood and wood grain may itself produce positive affect.

Although not identified as a significant independent predictor from the multiple regression analysis, sociopetal furniture arrangement did show a strong zero-order correlation with the creativity potential mean scores (Table 2) and appears to be an important contributor to the overall creativity potential score. Furniture is an integral part of any interior environment. Its presence alone appears to be an indicator of some creativity potential, perhaps due to the viewer looking for comfort, but perhaps more important is its ability to promote social interaction: a sense of cooperation, and even collaboration—ingredients identified as important to organizational creativity (Amabile, 1989). The presence of furniture with its sociopetal arrangement may be a cue that the visitor is welcome and could receive social support in that environment.

**Characteristics of Environments With Low Perceived Creativity Potential**

Environments perceived low in creativity potential were consistently windowless, finished in manufactured or composite materials, and with overall cool colors. Although the rooms were sometimes shabby from age and use, they would not necessarily be deemed ugly or to have been designed in artistic bad taste. Rather, the effect, as noted by the raters, was “uninviting” and “bland.” There was no incentive to spend time in these spaces (Figure 5).

In some studies, windowlessness has been shown to increase feelings of risk and to lower performance (Hughey & Speer, 1990; Scuri & Skene, 1990). Other studies suggest that windows are needed as a provision for access to sunlight and sensory change (Heerwagen, 1990). Windows are also a way of controlling ambient environmental conditions. Amabile (1989) discussed the deleterious effects of rigid or status quo environments on creativity. The inability to open or look out the window may contribute to the perception of a nonflexible environment and a loss of freedom and openness to experience.

The negative effect of manufactured or composite material may symbolize a rigid environment (Becker, 1977). Metal, plastics, and concrete are designed to be impermeable and unchangeable.
Role of the Physical Environment

Study 2

Are settings perceived as high in creative potential actually conducive to creative activities? Based on the results of Study 1, a preliminary follow-up study was conducted to determine if the perceived creativity potential of a setting could actually affect creativity performance. Tests of creative performance were administered to groups of participants in two settings: one setting that rated high in creativity potential and one that rated low in creativity potential based on ratings from Study 1.

Settings

Both settings were located on a college campus in buildings frequented by students. Both settings functioned primarily as access to other spaces, but each was also intended as a place for students to pause or spend time in addition to simply passing through. One was furnished with tables and chairs, whereas the other had no furniture. Both were relatively new, in good repair, and well maintained. Several settings with higher and lower creativity potential scores were rated in Study 1. We were logistically constrained, however, to choose two locally proximate settings to conduct the tests. Moreover, we wanted to match setting function to keep the focus squarely on physical interior elements.

Setting 1 (Figure 6) was rated high in creativity potential in Study 1 ($M = 7.08$, $SD = 1.95$). It was an entrance foyer separating the old section of a university library from a newer portion that contained mostly offices. Although the floor plan was basically a simple rectangle, the ceiling height was four stories high, circular stair landings protruded from the west wall, and recessed windows from the north and south walls overlooked the space. There was no natural view, but the ample skylight provided direct sunshine and distinct shadows throughout the day. The south wall was painted stucco, but all other surfaces were natural material. The north wall was highly textured exposed stone from the original building, the floor was slate, and natural wood was used liberally in the

Figure 5. Settings experienced as windowless and finished with manufactured or composite materials were consistently rated as low in creativity potential ($x = 2.98$, $SD = 1.98$).

Though certainly strength and permanence have value in built environments, a tempered mix of permanence with the malleable or manufactured or composite with natural materials appears to be more conducive to creativity. The exclusive use of manufactured or composite materials, by their very nature, also tended to produce environments with little texture or visual complexity.

In summary, untrained college students can apparently assess what settings will appear to either facilitate or inhibit creativity. Trained, independent raters’ assessments of physical characteristics of these spaces yielded a set of independent predictors that can account for a sizable proportion of the variance (68%) in subjective ratings of the creativity potential of settings, made by a different set of people.

\[1\] Although it is possible that this variable affected our results, it is highly unlikely because the students chose to sit on the floor in both settings while they completed the creativity tests.
architectural details. Outlining the north and south wall were planters filled with live plants and blooming flowers. Four plastic laminate-topped square tables, each with four wooden chairs, were placed near the planter.

Setting 2 (Figure 7) was rated moderately low in creativity potential \( \left( M = 3.55, SD = 1.67 \right) \). It was an entrance foyer also acting as a waiting area on the mezzanine level above the entrance to an auditorium of a university building. One side of the space was a solid wall with regularly spaced doors leading to offices and classrooms; the other side was a railing that overlooked the entrance to the auditorium. At the far end of the corridor was a window wall, but from the mezzanine overlook, outside details and view were obscured by glare. The surfaces were all manufactured or composite materials; all were smooth or highly glossed and in a monochromatic color palette. The light from the end of the corridor caused a glare on the highly polished terrazzo floor.

**Method**

**Participants**

Twenty participants (12 women and 8 men, \( M = 17 \) years) were recruited from a pool of high school students in a precollege summer session of an undergraduate psychology class. They received extra credit toward their final grade for participating. None of them were familiar with either setting to be tested, and none had participated in Study 1.

**Procedure**

Two methods of testing creative performance were used. *The Torrance Test of Creative Thinking* (TTCT; Torrance, 1966) is a standardized test in booklet form in which each participant is asked to think of and record interesting, unusual, and clever ideas. For making collages (Amabile, 1989; Amabile & Gitomer, 1984), the participants were each supplied with identical packets of glue and precut colored paper and asked to express themselves in interesting, unusual, and clever ways.

The 20 participants were randomly divided into two groups that completed the creativity tests in both settings in counterbalanced order. First, the TTCT was administered; after a break, they were asked to make the collages. Four students were dropped from the analysis because they participated in only one testing session.

**Results and Discussion**

The TTCT was scored and analyzed based on the TTCT scoring guideline. Means and standard deviations of scores for fluency, flexibility, and originality were calculated for each participant for each day. The collages were rated by six independent raters on a 5-point scale for flexibility, fluency, innovation, originality, and aesthetics. Interrater reliability was acceptable \( Ebel r = 0.78 \). As recommended by the respective test authors, total scores were utilized as the basic index of creativity for both the TTCT and the collages. As can be seen in Table 5, actual creative
Role of the Physical Environment

Figure 7. Setting 2 for Study 2 was rated low in creativity potential ($x = 3.55, SD = 1.67$).

Table 5. Creative Performance

<table>
<thead>
<tr>
<th>Test for Creative Performance</th>
<th>High Creative Setting</th>
<th>Low Creative Setting</th>
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<tbody>
<tr>
<td>TTCT</td>
<td>8.94</td>
<td>9.24</td>
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<tr>
<td>Collage</td>
<td>15.24</td>
<td>10.04</td>
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</table>

A two (high or low creative setting) $\times$ two (setting order) mixed analysis of variance was run to analyze the main effects of setting, order, and their interaction. Because neither interaction for collage making or TTCT was significant, the main effects of setting collapsed across setting order were evaluated. Creative potential significantly enhanced creativity performance on the collage measure, $F(1, 15) = 7.38, p < .01$. The TTCT was insensitive, however, to the setting variable, $F(1, 45) < 1.0$. As can be seen in Table 5, more creative collages were produced in a setting previously evaluated (in Study 1) as high in creative potential in comparison to a setting previously evaluated as low in creativity potential (in Study 1). Torrance scores are known to improve with practice (Cooper, 1991), as is the case with $M = 8.44$ in the first session and $M = 9.16$ in the second session, $F(1, 15) = 10.21, p < 0.01$. Order did not improve collage scores, $F(1, 15) = 1.08$, n.s.

General Discussion

Study 1 indicates that untrained individuals can identify settings varying in perceived creative potential. Furthermore this occurred from among a large set of settings systematically sampled to represent a broad spectrum of theoretically derived dimensions. This approach to representative sampling of settings is important because it provides a more accurate assessment of the potential impact of environmental variation on human responses (Evans, 1999; Stamps, 1996; Winkel, 1987).

Independent ratings of physical characteristics of the settings associated with perceived creative potential included spatial complexity, visual detail, natural views, use of natural material, sociopetal design, cool colors, and use of manufactured or composite material. These significant physical predictors of creativity performance appear to be influenced in the predicted direction for Amabile’s collage index. For the TTCT, there is no impact. Higher scores in Table 5 indicated better creativity performance.
fit well with several of the original conceptual dimensions of creative enhancing environments.

Biophilia, our biological affinity for natural environments, has been associated theoretically with creative performance (Ulrich, 1993). Exposure to restorative elements such as fascination also replenishes cognitive capacity (Kaplan & Kaplan, 1989). This study suggests that people perceive that contact with nature, such as views of natural environments or exposure to natural materials, will promote creative performance. Contrasting the scores for creative potential of the settings high in natural material and natural views with the scores of environments devoid of natural material (primarily manufactured or composite materials) further suggests the importance of natural views and natural material to settings high in creativity potential. Both provide visual and tactile stimuli as reminders of the larger natural environment, and perhaps its restorative qualities.

High levels of spatial and visual complexity enhance the creativity potential of places. Offering both visual interest and opportunity for discovery, challenging settings may provide intellectual and cognitive stimulation consistent with values of the creative personality, hence fostering creative behavior.

The personal freedoms of autonomy, openness to experience, and engaging in unconventional thought processes may be fostered in settings in which windows and natural views permit distraction, in which the bounding surfaces are varied and offer a choice of workplaces, and in which multiple functions may be performed.

Individual encouragement, cooperation, collaboration, and social support have been shown to promote creative performance in organizations (Amabile, 1989; Becker, 1993; Eysenck, 1994). It was not unexpected, therefore, that settings displaying sociopetal furniture arrangement and design were perceived as more supportive of creative thought.

MacKinnon (1962) and Barron (1969) described the creative personality as rebellious, critical, skeptical, and flexible. This study suggests that people perceive that a static environment is one that does not permit freedom of movement and change, is not adaptable to their task requirements, and is, therefore, low in creativity potential.

Although the specific physical characteristics of settings that are perceived to facilitate creativity generally fit well with our theoretical dimensions, there are several anomalies as well. Two of the dimensions did not seem relevant.

Cues of spatial distinction and definition of purpose are provided through the unambiguous organization of objects within a setting and with appropriate characteristics of the bounding surfaces. When settings are high in creativity potential, it should be clear where work and social gatherings are permitted. It should be equally clear where both work and social interaction are discouraged.

Symbols of surveillance, rigid supervision, and evaluation were hypothesized to be rejected as promotional of creative behavior. Likewise, settings that implied hierarchical organization should have been rated as inimical to creativity potential. Our data did not support either of these theoretical formulations.

Although challenge, as predicted, was found to be relevant, the linear functions conceived for complexity and visual detail were surprising. We had expected an inverted U-shaped function with moderate levels of detail and complexity most predictive of creative potential. At least for the range of visual details and complexity sampled in this set of interior environments, the more challenge, the better. Because the results of Study 1 relied on photographic simulations and were restricted to judgments of perceived creativity potential in a setting, a second experiment was conducted to measure actual creative performance in a real setting.

Study 2, although preliminary in nature, provides partial support for the hypothesis that settings perceived to affect creativity may, in fact, function as perceived. The collage results clearly support this prediction. The TTCT results may have been less sensitive to the manipulation because of the strong effect of order on the measure.

Construct validity of the initial theoretical elements is an important limitation of Study 1. Although many researchers have written at length about creativity, it continues to be an elusive concept—difficult to identify and even more difficult to measure. Every effort was put forth to construct the initial theoretical framework with valid measures, but it is not possible to say with certainty that these items do in fact reflect the creativity potential of environments.

Another major limitation of the method is the reliability of the photographic image. Although Pitt and Zube (1979) and Kaplan and Kaplan (1989) have provided convincing evidence that photographs may be
used reliably in perception and evaluation of outdoor environments, judgment of the interior environments herein was based on the image of only a portion of a whole room. Not shown due to the limitations of technology were the physical properties of the remainder of the room and other adjacent spaces. Moreover, non-photographable properties, such as air temperature, ventilation, odors, and noise levels could not be taken into consideration. In addition, because the intention of the study was the evaluation of the built environment, few of the photographs included people. All of these limitations related to our simulation technique could influence perception of the creative potential of places.

Within this study, hundreds of photographs were processed. The variety and types of environments recorded are representative of many places where people spend time, but in no way are intended to be a comprehensive or exhaustive exploration of creativity potential environments. An appropriate future study would be to investigate the creativity potential of different environments designed for the same social purpose, for instance, to compare only classrooms or offices. This type of study could help eliminate the possible confounding impact of social context on creativity potential. Note, however, that the physical environment was related in Study 2 to creativity performance within settings of the same social context.

There are distinct elements of the physical environment perceived to influence creativity performance for a group of young college students. There may be a difference in creative performance due to the characteristics of the setting. If human responses to physical settings include enhanced levels of creativity performance, the implications are vast. For example, it is critically important to know if the creativity of children is affected by the quality and characteristics of their physical environments. Research could investigate physical setting dimensions that affect children at different ages as well as the effect of different lengths of exposure. In addition to age and length of exposure, the roles of cultural and socioeconomic diversity in responding to creative potential in the environment are worth pursuing. For some, elaborate university libraries may be viewed as intimidating or inaccessible, whereas others may find them familiar and conducive to creative thought. Cultural differences may be evidenced not only by architectural styles, but also though the use of dimensional elements, such as view or use of natural materials.

Understanding the impact of exposure to different levels of creativity potential over time may allow designers to more knowledgeably add stimulating environments to buildings. For instance, in this study, hallways were typically considered to have low creativity potential. Yet, people spend a lot of time traveling through hallways in schools and other public buildings; these are places of potential serendipitous social encounters. Designing these settings to promote creative behavior may include making such encounters more likely as well as more conducive to social exchange. Appropriately informed designs of temporal environments have the potential to be unobtrusive, subliminal stimulants of creativity. The study of creativity has largely been the province of educational, social, and personality psychologists. The time is ripe for environmental design researchers to get into the act.

References


