Exploring Associations between the Work Environment and Creative Design Processes

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Abstract. Creative thinking is a critical activity in design work, and it can be influenced by the climate of a space that designers work in, either individually or in groups. Designers experience different emotions during creative design processes, and these emotions can influence their levels of both creativity and productivity, so modifying the environments in which design work is done can impact on creative design outcomes. In this paper we report some first empirical research that investigates associations between environment, emotion and creative design work undertaken using different creativity and design techniques.

Keywords: creativity, environment, emotion, and design

1 Introduction

Characteristics of workspace are similar to body language and both reflect the attitudes of people to work and afford different behaviors of the people in that space. Indeed, space designers argue that an environment that is more creative can foster the people’s creativity [2]. Not only can the characteristics of a space directly afford more creative behavior, for example through collaborative working around shared artifacts [16], but the qualities of the space can influence peoples’ emotions so that they are more predisposed to be creative [1]. In this paper we empirically explore the link between environment, emotion and creative outcomes in a collaborative creative tasks.

We have previously investigated emotions in collaborative design work by observed post-graduate design students during face-to-face creative tasks over a 5-week period. Results revealed that, at the beginning of each session, most students reported more negative and uncertain emotions such as unsure, confused and frustrate, whilst most students at the end of the same creative tasks reported emotions such as progress, relief, funny and productive. Designers’ emotions appeared to change during creative work, but reasons for these changes were unclear, leaving scope for more empirical research.
Therefore, in this paper, we report a more rigorous empirical investigation of people’s emotions during a collaborative creative task in two different environments, one designed to provoke emotions that have been identified to enhance creativity, the other to provoke emotions that inhibit creativity. The next two sections summarize past research that associates creativity with emotion and environments, then the paper reports results from the empirical investigation that indicate that effect of space on creative climate appears to diminish over time in the presence of other stimuli. The paper ends with future research directions implied by the results.

2  Emotion and Creativity Research

There has been much research motivated by discovering associations between emotion and creativity from different perspectives. For example, someone who is relaxed, happy, in a pleasant mood, is a more creative, more able to overlook and cope with minor problem. In contrast when people are anxious, they are more focused [12]. One of the most significant studies in this field is a meta-analysis by Bass et al. [1], who harvested the collection of associated research in 25 years of emotion and mood–creativity research. The result of this analysis contains three fundamental classifications of hedonic tone, activation, and regulatory focus. Creativity is enhanced most by positive mood states that are activating and associated with an approach motivation and promotion focus (e.g., happiness), rather than those that are deactivating and associated with an avoidance motivation and prevention focus (e.g., relaxed). Activating emotions lead to more creativity than do deactivating emotions, most likely because activation stimulates creativity rather than deactivation undermines it. Activating moods with positive tone lead to creative performance through enhanced cognitive flexibility and inclusiveness while activating moods with negative tone lead to creative performance through enhanced cognitive perseverance and persistence. These conclusions would suggest that, to support more creative thinking in design work, designers need to use techniques, tools and environments that encourage enhanced cognitive flexibility and inclusiveness based on activating moods with positive tone.

3  Associating Environment and Creativity through Emotion

One of the most established descriptive models of creative problem solving is the 4Ps model [5]. The purpose of the model is to provide a complete description of the factors that can affect creative problem solving, and the 4Ps represent person, product, process and press. Of these, press is often the least considered in a creative process. The creative press refers to the context in which creativity take place, including its environment, place, situation and climate. It can also refer to the environment the person is in, the product is produced or the process takes place, and explain the interaction between the person and situation that can promote or inhibit creativity [5].
Consider the example of a café that only focuses on the creative food and drink that it serves is unlikely to succeed. The success of the café is equally likely to be influenced by its environment – the smell, music, atmosphere, lighting and seating. Research has identified that even modest background noise can generate enough distraction to encourage people to think more imaginatively. Consciously or not, people feel and internalize what the space tells us about how to work, influencing their emotions as a precondition for more effective creative thinking [14]. In this paper we claim that the environment has the capacity to enhance the creativity of designers by encouraging emotions that enhance cognitive flexibility and inclusiveness based on activating moods with positive tone, as depicted graphically in Figure 1. However, evidence for this claim was lacking, so we undertook a first exploratory study to seek evidence for the claim.

4 A First Exploratory Study

We undertook the study to investigate the effect of physical environment on emotions that encourage emotions that enhance cognitive flexibility and inclusiveness and creativity of designers. Previous work has indicated that physical elements of an environment can impact on creativity potential. Elements of a physical environment that have been shown to enhance creativity previously include its spatial 3D form, the use of natural materials, warm colors, texture and glass, and a view on nature [10]. In contrast, cold colors and manufactured and composite materials have negative effects on creativity [2]. Therefore we developed two environments – a positive space that was designed using these elements deliberately to encourage creativity – and a negative space that was designed using the same elements to discourage creativity.

4.1 The Positive Space

The design of the positive space drew on previous investigations on the role of interior design on creativity [4-10]. The space included colorful, round-shape furniture at different heights, a bed and vivid cushions that could support people standing, sitting in different positions and lying. The intention was to create a feeling of being at home, as depicted in Figure 1. Other features of the positive space included hanging handmade lanterns to decrease the ceiling height, colorful pictures with positive themes such as food, nature, happiness, excitement, and people, pot plants, and windows to provide views of nature.
4.2 The Negative Space

In contrast, the design of the negative space was intentionally untidy and full of digital equipment. The space also included grey curtains that obscured any view of nature, few warm colors, a square table and chairs in a limited space, and pictures depicting negative content such as war, cemetery fighting people and sad portraits depicted using neutral colors, as shown in Figure 2.

Figure 1. Images from the positive space with warm color, indoor plants and a view of nature from the window.

Figure 2. Images from the negative space showing more neutral colors and pictures and no view to the outside.
4.3 Methodology

The participants were six post-graduate students familiar with creativity techniques who worked in two design groups of three, one in the positive space and one in the negative space. The members of each group were asked to redesign a supermarket car park service from the event take shopping to your car from customer making payment at checkouts to placement in car of shopping purchased.

A facilitator divided each workshop into 4 segments of 20 minutes each. During each segment the group undertook a different task with a different technique. The first segment involved data collection – each group used a laptop connected to a projector to search the Internet for information about supermarkets and supermarket services. The second segment was open-ended, non-critical brainstorming to generate and document as many new ideas as possible [11]. Each group was given post-it notes, marker pens and blank paper during this segment. The third segment involved constraint removal [13]. During this segment, each group brainstormed multiple constraints on the supermarket car park service, selected constraints to eliminate, diminish or re-interpret, and then generated new ideas in the less-constrained ideas spaces. Again the ideas were documented on post-it notes using marker pens. During the final segment, each group undertook one or more desktop walkthroughs to enact future possible service designs [15]. To undertake these walkthroughs, each group was given objects that included Lego pieces and Plasticine as well as paper and post-it notes.

The design process of both groups was video and audio-recorded, and all design outcomes were documented. After the workshop, two experts independently reviewed the video and audio-recordings to assess and categorize the creative climate of each group during each segment of each workshop. Assessment was undertaken using 10 established dimensions of a creative climate developed to determine how the social behavior of a group in different climate could influence the individual’s behavior [3]. Isaksen [6] identifies 10 most important dimensions that influence a creative climate: (i) challenge and involvement - how challenged, emotionally involved, and committed people are; (ii) freedom - how free are the people to decide how to do their work; (iii) idea time – to what extent do people have time to think things through before acting; (iv) dynamism - the eventfulness of life in the organization; (v) idea support – what resources are available to give new ideas a try; (vi) trust and openness – to what extent do people feel safe speaking their minds and offering different points of view; (vii) playfulness and humor – how relaxed is the workplace; (viii) conflicts – the degree to which people engage in interpersonal conflict; (ix) debates – the extent to which people engage in debates about issues, and; (x) risk taking – the extent of the acceptance of failure. Table 1 summarizes the typical qualities of creative and non-creative climates against each of these dimensions.

<table>
<thead>
<tr>
<th>Climate dimension</th>
<th>Creative climate</th>
<th>Non-creative climate</th>
</tr>
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<tbody>
<tr>
<td>Challenge</td>
<td>Involved, intrinsically motivated, contribution to the success, dynamic, electric, inspiring</td>
<td>Feeling of alienation and indifference, apathy, lack of interest and interaction</td>
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<tr>
<td>Freedom</td>
<td>Initiative and sharing</td>
<td>Strict guidelines and roles</td>
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<tr>
<td>Idea time</td>
<td>Using time for elaborating and developing new ideas that are not planned in the task</td>
<td>Idea pressure</td>
</tr>
<tr>
<td>Dynamism</td>
<td>Energetic, Enthusiasm</td>
<td>Apathy, unconcern, boredom</td>
</tr>
<tr>
<td>Idea support</td>
<td>Constructive space, Accepting ideas kindly, listen and encouraging people, trying new ideas</td>
<td>Refusing ideas by counter-argument, fault finding, obstacle raising to new ideas</td>
</tr>
<tr>
<td>Trust/openness</td>
<td>Emotional safety, no fear of reprisals and ridicule, open and straightforward communication</td>
<td>Afraid and Scared of being robbed of their ideas</td>
</tr>
<tr>
<td>Playfulness/humor</td>
<td>Spontaneity and ease, relaxing atmosphere for jokes and laughter</td>
<td>Gravity and seriousness, stiff, gloomy and cumbrous</td>
</tr>
<tr>
<td>Conflicts (Focusing on people and their relationship)</td>
<td>Respecting and mature manner, controlling emotions and impulses</td>
<td>Dislike or hating other people in group</td>
</tr>
<tr>
<td>Debates (Focusing on issues and ideas)</td>
<td>Involving encounters, exchanges or clashes among ideas, challenging each other’s thinking</td>
<td>Following authoritarian pattern without questioning</td>
</tr>
<tr>
<td>Risk taking</td>
<td>The tolerance of uncertainty and ambiguity</td>
<td>Caution and hesitant mentality, preferring safe side and no decisive action</td>
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The two experts rated each of the four segments of each workshop – data collection, brainstorming, constraint removal and desktop walkthrough against each of the 10 dimensions on an integer scale 0-5 guided by the definitions defined in Table 1. This generated a total of 40 ratings for each workshop. The experts were guided to provide quantitative ratings using qualitative descriptions. For example, a 0 on any dimension indicated that the climate quality was not observed at all in that segment, 3 indicated that the climate quality was observed often in the segment, and 5 indicated that the quality was observed throughout the segment. The reported final rating for the segment was the mean of the two dimension ratings if the difference between the ratings was 0 or 1. However, if the difference between the two expert ratings in each dimension for each segment was greater than 1, the two experts were requested to view the video of the segment again to reconsider their rating for that segment. If the difference in the segment/dimension rating was still greater than 1, the experts were asked to discuss together and resolve the difference in the rating.

### 4.4 Results

Both design groups undertook all of the activities in all 4 segments of each workshop, and both groups produced at least one possible solution for the supermarket car parking service. In this sense both workshops were a success. Observations revealed that there was no formal facilitator or leader in each group, although one individual in each group appeared to take an informal leadership role. While neither was formally
acknowledged as group leader, their groups appeared to defer to them on issues such as which were the best ideas and how the dynamics of the session should proceed. However, throughout both, members of the design groups often needed encouragement to share ideas.

We analyzed the ideas generated during the brainstorming and constraint removal segments in both workshops. The design group in the positive space generated 17 ideas in the brainstorming segment and 23 ideas in the constraint removal segment, whereas the group in the negative space only generated 7 and 9 ideas in the two spaces respectively. The desktop walkthroughs also differed. The group in the negative space designed the service around an underground supermarket below a natural space – a service that was more novel than practical for most supermarkets. In contrast, the group in the positive space designed the service in which customers collected their shopping when exiting the car park – a more practical service design. The workshop outcomes indicated quality and quantity differences emerging from design groups in the positive and negative spaces.

Members of both design groups exhibited moments of joy and moments where joy was lacking. Observations of members of the design group in the positive space tended to move about more than those in the negative space and to exhibit more joy, although when the artifacts were brought into the negative space the group working there appeared to visibly become more joyful, to increase inter-personal interaction and to come up with more ideas.

The agreed expert assessments of the climate of each workshop segment are presented in four spider diagrams in Figures 3-6 – the ratings of the design group in the positive space are depicted in blue and the ratings of the design group in the negative space are depicted in red. The first of the diagrams in Figure 4 shows the ratings of the design group in the positive space are depicted in blue and the ratings of the design group in the negative space are depicted in red. The first of the diagrams in Figure 4 shows the ratings of the design group in the positive space were rated as having a more creative climate on 9 of the 10 dimensions. The comparison of the ratings reveals that the design group in the positive space was rated as having a more creative climate on 9 of the 10 dimensions. When the people in the design group came to the positive space, they appeared to find the room not only exciting but also both welcoming and positive. Some appeared to behave as if they were in their own house, and one even took her shoes of, suggesting a place that was comfortable and hospitable for them. Moreover, the climate’s support for idea support and for debate was rated as much higher than for the design group in the negative space. The assessments suggest that noticeable differences between the climates of the two design teams in this first segment of the workshop.
Figure 3. Mean climate ratings for the data collection segment of creativity workshops

Figure 3 shows the ratings of the segment with the brainstorming technique against the 10 climate dimensions. The comparison of the ratings reveals that the design group in the positive space was rated as having a more creative climate on 7 of the 10 dimensions. In contrast to the data collection segment, the design groups were rated as having the same creative climate for idea-time and for debate, whilst the experts rated the design group in the negative space as having greater support for handling conflicts. The rated differences between the two design groups was less than during the data collection segment. That said, during brainstorming, the design group that was in the positive space appeared to behave more creatively and to think with more originality. It exhibited greater divergent thinking and generated more ideas. The experts observed more collaborative behavior and support. The members of this group paid attention to the positive pictures and this appeared to help inspire them to come up with a wide variety of new solutions. In contrast, the design group in the negative space was less engaged in all aspects of the brainstorming task.

Figure 4. Mean climate ratings for the brainstorming segment of creativity workshops
Figure 5 shows the ratings of the third segment in which the constraint removal technique was used against the 10 climate dimensions. Members of each design group brainstormed obvious constraints on the supermarket service such as shopping weight and supermarket layout then systematically removed or diminished each constraint to generate and document new ideas. However, unlike in the first two segments, the ratings reveal less difference in the creative climate of the two design groups than was identified in the first two segments. The design group in the positive segment provided a more constructive space for idea generation, however the two workshops were rated as having similar creative climates for half of the 10 dimensions, and the design group in the negative space was rated as being more dynamic than the group in the positive space.

**Figure 5.** Mean climate ratings for the brainstorming segment of creativity workshops

Finally, Figure 6 shows the ratings of the final segment in which both groups undertook desktop walkthroughs against the 10 climate dimensions. The design group in the negative space was rated as having a more creative climate on 4 of the 10 dimensions while the design group in the positive space was not rated as more creative on any single dimension. The experts perceived that the atmosphere of the design group in the negative space changed during the desktop walkthroughs.

**Figure 6.** Mean climate ratings for the desktop walkthrough segment of creativity workshops
One possible reason for this result was the introduction of playful artifacts for the desktop walkthrough such as Lego and Plasticine that appeared to stimulate, motivate and encourage the members of the design group to create more ideas, as can be seen in Figure 8. Even in the positive space, participants appeared to lose interest as the time passed, which indicates that it might be helpful to introduce ongoing changes in order to maintain people’s interest and activation levels.

In general across both workshops, members of the design groups appeared to be generally happier when using exploratory creativity rather than transformational creativity techniques. Exploratory creativity is the search of a well-defined creative space, in contrast to transformational creativity that seeks to change this search space. The experts observed more dynamic, openness, playfulness and movement in both groups when using the exploratory brainstorm and desktop walkthrough techniques than when using the transformational constraint removal technique.

![Desktop Walkthrough in positive space](image1)

![Desktop Walkthrough in negative space](image2)

**Figure 8.** Images from the desktop walkthroughs in both design groups

### 4.5 Formative Study Conclusions

Results from the study reveal that the design group in the positive space was observed to have a more creative climate than the design group in the negative space, however the difference between the groups appeared to diminish over time. It seems that even the design group not only needed continual injections of excitement into the space, but also new ways to reinforce the comfortable and relaxed atmosphere. Maintaining the primary emotion of surprise appears to be important to maximizing creativity and creative climate. Surprise also forms an element of other creativity-inducing emotions such as amazement and astonishment. As surprise diminishes negative, low arousal emotions such as boredom set in, bringing with them a reduction in creativity. Joy is another primary positive emotion that has the potential to enhance creativity and which is also associated with 7 creativity enhancing secondary emotions. It appeared
that joy was often lacking from the processes we observed. Increasing joy is a challenge, which if met, should help to improve creativity.

The different creativity techniques deployed in each segment appeared to influence the creative climate. Our results suggest that the desktop walkthrough technique was an important influence on the climate and its use in both design groups increased the level of interaction, involvement and communication compared to the other techniques. The design group in the negative space became more positive with this technique, suggesting that artifacts such as Lego do become part of the environment.

5 Discussions and Future Work

Our first formative evaluation of the effect of a physical environment on the creative climate of designers revealed some unexpected findings. Whilst the positive space did have an enhancing effect on the perceived creative climate of the design, this effect appeared to be short-lived. During the workshops, differences between the creative climates of the design groups disappeared. Moreover, there appeared to be an effect of the different creativity techniques on creative climate that, over time, appeared to be as important as the physical space. In particular, the desktop walkthrough technique, which introduced playful objects and physical movement into the spaces, appeared to have a more important effect on creative climate than the environment after one hour of a workshop. The importance of surprise in creative work and environments should not be under-estimated. Not only is surprise recognized to be an important determinant of creativity [9], but it also forms of an element of other creativity-inducing emotions such as amazement and astonishment. Therefore, designing physical environments to support creativity over continuous design processes both needs to encourage frequent surprise events and incorporate the effect of creativity techniques to foster surprise and influence emotion.

The effect of time on creative group performance will be investigated in future studies. Previous research indicates that there is a limited effect of the group on the creative outputs of groups – the interaction in-group level over time changes only slowly [8]. In our study, time appeared to influence the group climate differently. In the negative space, changing the techniques over time made the group more active, whilst in the positive space, the participants became less focused over time.

Our next goal is to design a space that differentiates space for divergent and convergent thinking with specific characteristic of each environment for a creative design. It aims to have a qualitative study to find out which types of emotions—that produce by environment—could promote creativity outcome for divergent and convergent thinking. Our main question concerns the effect of visual features of the environment on emotional responses of designers to trigger creativity.
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