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Facilitating creative thinking in the classroom: Investigating the effects of plants and the colour green on visual and verbal creativity

Sylvie Studente[a,*], Nina Seppala[b], Noemi Sadowska[a]

[a] Regent's University London, United Kingdom
[b] University of Lincoln, United Kingdom

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ABSTRACT

We report upon a study concerned with the effect of exposure to live plants, views to nature and the colour green upon visual and verbal creativity. The study reported in this paper was undertaken with 108 business students at a British University who were randomly allocated to one of the three conditions. The control group were placed in a classroom with no plants present and blinds drawn to block view to natural settings, the first experimental group were placed in a classroom with no plants present, blinds drawn to block views to nature but completed the creativity tasks on green paper. The second experimental group were placed in the same room as the other groups, but were surrounded by live plants and had views to nature through the large classroom windows. All participants completed two creativity tasks; a visual creativity task and a verbal creativity task. Visual creativity was assessed using a modified version of Amabile's Consensual Assessment Technique (Amabile, 1982). Verbal creative was assessed using a modified scoring method of Guilford's alternative uses task developed by Silvia et al. (2008). Findings indicate that access to natural views, plants and the colour green increase visual creativity, but have no impact on verbal creativity in classroom settings. The results suggest that creativity is domain specific and any practical measures taken to enhance creativity need to be aligned with the target domain.

1. Introduction

The research area of enhancing creativity in educational settings is an area of growing interest (i.e. Fasko, 2000; Feldhusen & Goh, 1995; Sternberg & Lubart, 1991; Hennessey & Amabile, 1987; Guilford, 1967; Pithers & Soden, 2000). Creativity research has identified a number of environmental, situational and personal factors which affect an individual's ability to be creative (i.e. Mumford, 2003; Runco, 2004; Simonton, 2003). This paper reports upon a study which examines the effects of plants and the colour green upon visual and verbal creativity. Previous research has identified that creative thinking can be enhanced by situating individuals in natural settings (Atchley, Strayer, & Atchley, 2012; Atchley et al., 2012; Shibata & Suzuki, 2002) and that exposure to the colour green can also enhance creative performance (Lichtenfeld, Elliot, Maier, & Pekrun, 2012). However, research into these areas has been sparse and to date has not been linked to the possible beneficial effects

* Corresponding author at: Faculty of Business and Management, Regent's University London, Inner Circle, Regent's Park, London NW1 4NS, England, United Kingdom.
E-mail address: Sylvie.studente@regents.ac.uk (S. Studente).

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to be garnered in the classroom. Others (e.g. Friedman & Forster, 2010) have looked at the impact of colour in expanding or constricting cognitive functions. We build on this research and expand it by studying the impact of exposure to nature and the colour green on creativity and, more specifically, the outcomes of creative functions.

Creativity is widely defined as a behaviour or product that is both novel and useful (Sternberg & Lubart, 1991). Studies in the area of creativity research have acknowledged that creativity is a field of research which is divided into four parts; the person, the product, press or the creative process (Rhodes, 1961; Boden, 2004; Csikzentmihalyi, 1996). This widely accepted framework denotes that creativity can be viewed from one or more of these four perspectives (Runco, 2011; Simonton, 2003). In this paper we report upon a study with a core focus on 'creative products'. In this context, creative products are understood as responses to an open-ended problem. Our focus is upon investigating conditions which are conducive or prohibitive for creative thinking in the classroom with regard to views to nature, plants and the colour green.

2. Background motivation

2.1. Towards an understanding of creativity

Although no universal definition of creativity exists due to its inherently subjective nature, a widely accepted definition is that creativity involves: "the ability to produce work that is both novel and appropriate" (Sternberg, 1998). Traditionally, creativity was viewed as a phenomena attributed to gifted individuals. A more contemporary and widely accepted perspective is that creativity is possessed by all (Weisberg, 1993). It is also understood that creativity does not exist in isolation, but rather is influenced by individual differences and environmental factors (Amabile, 1996).

The ability to be creative is often perceived as involving divergent thinking as opposed to convergent thinking, the latter concerning itself with predictable, logical cognitive operations (De Bono, 1967). It is owing to this reason that divergent thinking and the ability to view situations in a new and novel way are strongly associated with creativity. Divergent thinking is associated with producing several solutions to an open ended problem (Guildford, 1967). As well as classifications of different ways of thinking involved in creativity, differing categories of creativity have also been identified as verbal creativity and visual creativity (i.e. Dau-Gaspar, 2013; Zhu, Zhang & Qiu, 2013; Zadeh, Sook-Lei, & Dandekar, 2012). The term 'Visual Creativity' is often defined as the production of novel and useful visual forms such as; drawing, painting and photography (Dake, 1991). The term 'Visual Creativity' is often used synonymously with the term 'Figural Creativity' (Hetrick, Lilly, & Merrifield, 1968; Dziedziewicz et al., 2013). 'Verbal Creativity' is defined as the production of novel and useful responses in verbal forms such as written and spoken words (Torrance, 1962). A number of studies have been conducted to investigate the similarities and differences between visual and verbal classifications of creativity (i.e. Ulger, 2015; Petsche, 1996; Kozhevnikov et al., 2013). Whilst some scholars have reported a significant correlation between visual and verbal creativity (Ulger, 2015; Hota, 2003), others have reported that no correlation was found (Saw DeMers, 1986; Roskos-Ewoldsen, Intons-Peterson, & Anderson; Palmiero, Nakatani, Raver, Belardinelli, & vanLeeuwen, 2010).

2.2. Creativity and education

The research area of enhancing creativity in educational settings is an area of growing interest (i.e. Fasko, 2000; Feldhusen & Goh, 1995; Sternberg & Lubart, 1991; Hennessey & Amabile, 1987; Guilford, 1967; Pithers & Soden, 2000; Runco, 2008; Shaheen, 2010). Research in this area has explored a number of facets from teaching creative thinking techniques in the classroom (i.e. Torrance, 1962), developing cognitive tools for creative thinking (i.e. Wissink, 2001; Candy & Edmonds, 2000), designing learning environments conducive to creativity (Piirto, 2005; Hennessey, 2004; Waugh, 2003) to the assessment of creative thinking (i.e. Runco, 1989; Torrance, 1971). Although approaches towards creative education differ in focus, they all acknowledge that a student's creativity can be stimulated by providing assignments which involve both convergent and divergent thinking (Karnes et al., 1961; Davis & Rimm, 1985). In addition, research also suggests that providing students with insight problems within which they are required to brainstorm uses of everyday objects in unusual ways can assist with facilitating problem restructuring which in turn facilitates the creative process (Jacobs & Dominowski, 1981; Martinsen, 1995).

Creativity research has identified a number of environmental, situational and personal factors which affect an individual's ability to be creative (i.e. Mumford, 2003; Runco, 2004; Simonton, 2003). Runco & Johnson, 2002 state that in terms of education, the creative development of students is largely dependent upon the environment in which they exist. Extending upon this point we seek to investigate the effect of plants and the colour green upon creative thinking. Prior research into these areas is discussed below.

2.3. Psychological and physiological effects of plants and natural settings

There is a growing body of research exploring the effects of views to nature and the inclusion of plants and greenery on people (i.e. Shibata & Suzuki, 2004). Research in the area reports that access to the natural environment has both physical and psychological benefits (Grinde & Patil, 2009) such as; promoting health and recovery (Bell, Greene, Fisher, & Baum, 2001; Kaplan, 2001), promoting well-being in the work place (Heerwagen & Orians 1986; Shibata & Suzuki, 2001), reduction of tension and stress (Ulrich et al., 1991), and increased attention and focus (Taylor, Kuo, & Sullivan, 2001). Atchley et al. (2012)

report that creative thinking can be improved through situating individuals in natural settings. Atchley et al. attribute this to exposure to natural stimuli such as greenery which is low-arousing and emotionally positive.

Shibata & Suzuki, 2002 report similar findings from a study within which participants performed better on creative tasks when situated in rooms decorated with foliage such as plants than those without. Shibata & Suzuki conclude that nature provides a source of inspiration and stimulation for creativity. Similar findings are also reported by Hesselink et al. (2004) whose study identified an enhancement of creative task performance by participants situated in rooms with foliage compared to those situated in rooms without.

These positive effects of plants on task performance may be attributed to by the relaxing connotations of views to nature and plants (Williams & Cary, 2002; Ulrich, Lunden, & Etinge, 1993). In regard to creativity literature, a number of scholars emphasise that creative thinking is impaired under stressful conditions (Talbot, Cooper, & Barrow, 1992; Farr & Ford, 1990; Amabile, 1983), and that creative ideas arise when an individual is in a state of relaxation (Claxton, 1998; Lehrer, 2012; Kaplan, 2012). This may also explain the positive effects of plants upon creativity. However, these findings have yet to be linked to education in terms of benefits for classroom learning.

2.4. The colour green and creativity

Scholars have reported there exists little research conducted into the psychological effects of colour (Fehrman & Fehrman, 2004; Whitfeild & Wiltshire, 1990), except for that relating to colour preferences (i.e. Franklin et al., 2010; Hurlbert & Ling, 2007). There are however researchers who have demonstrated that the colour red can be perceived as a cue for danger (Elliot & Maier, 2007). In contrast, the colour blue is associated with peace and tranquillity and has been shown to increase creativity (Mehta and Zhu (2009). For example, when participants were asked to design new children's toys after being shown pictures of different toy parts, the participants were more creative when the parts had been coloured blue rather than red (*ibid.*). Friedman & Forster, 2010 argued that this is because colours can tune the scope of attention by signalling the nature of the situation as a threatening or a calm situation.

Contemporary research has suggested that similarly to the colour blue, the colour green has a positive influence on creativity. An example arises from a study conducted by Lichtenfeld et al., 2012 who report that a brief glimpse of the colour green prior to completing a task enhances creative performance. Research has identified that physiological responses to the colour green include a feeling of calmness, peace and positive emotions (Clarke & Costall, 2008) and this is attributed to the colour's strong associations with nature (Hutchings, 2004; Wierzbicka, 1990). Aside from the study by Lichenfeld et al., there exists little research into the relationship between the colour green and enhanced creative thinking, but based on the earlier research on the positive impact of colour blue on creativity because of its association with tranquillity, it can be predicted that the colour green also enhances creativity.

The research reported in this paper seeks to extend upon previous studies relating the effects of exposure to live plants and the colour green on creative thinking. To date, research into these areas has been sparse and has not been applied to educational settings. This study will investigate the effects of exposure to live plants and the colour green on visual and verbal classifications of creativity in educational settings.

3. Research aims and objectives

The purpose of this research is to investigate whether exposure to live plants and the colour green has a positive impact upon visual and verbal creative thinking in classroom settings. The hypotheses to be investigated through this study are as follows:

3.1. Hypotheses

(H1) Students who are exposed to live plants and views to nature in the classroom will demonstrate a higher level of creativity on given tasks than those who are not.

(H2) Students who complete given tasks on green paper will demonstrate a higher level of creativity than those completing tasks on generic white paper.

4. Methods

4.1. Participants and procedure

108 business students from a British University participated in the study. Each participant was randomly assigned to one of the control or experimental groups. Participants within the control group were seated in a classroom with no plants present and blinds drawn to block views to natural settings. Participants allocated to experimental group one were placed in a classroom surrounded by live plants and blinds were opened providing a view to a green area. Participants allocated to experimental group two were placed in a classroom with no plants present and blinds drawn to block views to nature, but were provided with the creativity tasks on green paper. These groupings and participant numbers are summarised in Table 1.

Table 1
Control and experimental groups.

Group	No. of participants	Setting
Control group	36	No plants. Views to nature blocked. Creativity task on white paper.
Experimental group one	34	Exposure to live plants. Views to nature provided. Creativity task on white paper.
Experimental group two	34	No plants. Views to nature blocked. Creativity task on green paper.

The participants were used to blinds being closed and opened regularly for adjusting room temperatures and preventing sun from creating reflections on computer screens; only few of the rooms in the old Victorian building have air-conditioning.

A visual and a verbal creativity task was completed uniformly by participants across conditions. The tasks used are explained below.

4.2. Data collection protocols

4.2.1. Verbal creativity test

Verbal creativity was measured using the Alternative Uses Task (GAUT) proposed by Guildford as a method of measuring various criteria of creativity, such as fluency, flexibility, and originality (Guildford, 1967). GUAT is a standard test which is used to measure divergent thinking in verbal creativity. The test requires participants to list uncommon uses for everyday objects and is widely used in the area of creativity research (i.e. Chermahini, Hickendorff, & Hommel, 2012; Lewis & Lovatt, 2013; Pretz & Link, 2008). GUAT measures the fluency of participants in idea generation, across both speed and number of ideas. In other words, participants who could generate a greater number of ideas in a given period of time would have an advantage in creative efforts.

Participants were instructed to "Name all of the uses you can think of for a *brick*". It is noteworthy to state that this task is not a measure of performance as such, but of specific problem-solving ability. Simonton (1998) believed that the greater the rate of idea generation, the larger the pool of items to work with and the greater production of originality. There is, however, a positive relationship between the amount of time individuals spend on idea generation and originality (Christensen, Guilford, & Wilson, 1957; Getzels & Csikszentmihalyi, 1976). Participants were given two minutes to complete this task.

4.2.2. Visual creativity test

After completing the verbal task, visual creativity was measured by asking the participants to complete the '30 Circles Test' devised by McKim (1980). Participants were provided with a sheet of paper containing 30 circles and instructed to incorporate the circles into a drawing and to use as many of the circles as possible in three minutes. Participants in the control and experimental groups followed this process uniformly.

5. Results analysis

5.1. Verbal creativity results

Results from the verbal creativity task were evaluated using a modified scoring method of Guilford's standard criteria developed by Silvia et al. (2008). Three criteria were used to assess verbal creativity; uncommon, remote and clever. The scoring of participant's responses was conducted by three independent evaluators. The scoring was performed on a scale of 1 to 5, where the value of 5 represented the highest level of creativity. An intra-class correlation analysis was used to assess the consistency of creativity scorings across the three evaluators. The co-efficient of 0.089 (single measures) and .226 (average measures) ($p = .02$) signalled from slight to fair agreement across the evaluators, which is acceptable for evaluating subjective topics such as creativity outputs (Landis & Koch, 1977). The consistency of evaluations based on the three criteria (uncommon, remote, clever) was also acceptable with Cronbach's alpha of 0.81. Further analysis based on a between-items ANOVA test showed that there was a significant effect when the three criteria were used to analyse the creativity outputs ($F = 109.74$, $p < 0.00$).

As can be seen in Table 2, the results of a one-way ANOVA analysis suggest that there was a significant effect when the control group was compared to the green paper condition. The overall value for creativity was lower in the green paper condition (1.59) than in the control group (1.73) ($F = 4.387$, $p = .04$). Creativity was therefore judged to be lower in the green paper group than in the control group. There was no significant effect when the control group was compared to the plant group. The results of the ANOVA analysis were consistent across the three criteria used to measure verbal creativity, except for 'cleverness' which varied little across the different conditions. The results suggest, in contrast to our hypothesis, that exposure to plants and the colour green do not increase creativity for verbal tasks. In fact, verbal creativity can be higher in normal conditions.

Table 2
Verbal creativity results.

Criteria	Mean	*F*	*p*
Control/plant			
Creativity overall	1.73/1.73	.001	.97
Uncommon	2.03/1.97	.195	.66
Remote	1.74/1.73	.008	.93
Clever	1.41/1.48	1.162	.29
Control/green paper			
Creativity overall	1.73/1.59	4.387	.04
Uncommon	2.03/1.77	6.049	.02
Remote	1.74/1.59	3.908	.05
Clever	1.41/1.40	.110	.74
Plant/green paper			
Creativity overall	1.73/1.59	3.362	.07
Uncommon	1.97/1.77	3.294	.07
Remote	1.73/1.59	2.472	.12
Clever	1.48/1.40	1.875	.18

5.2. Visual creativity results

Results from the visual creativity task were assessed using a modified version of the consensual assessment technique established by Amabile (1982). This involved the three evaluators independently rating the drawings according to eight dimensions. This technique was selected, due to its focus on evaluating creative products. In using the technique we followed the four procedural requirements outlined by Hennessey et al. (2011). These requirements are as follows; evaluators should be experienced in using the technique. Secondly, evaluators must make their evaluations independently. They must not be trained to agree with each another; and are not to be given criteria for judging creativity; and must not confer in their assessments. Thirdly, evaluators should be instructed to rate products relative to one another. Finally, each judge should view the products in a different random order. The evaluators who participated in the evaluations had previously used the consensual assessment technique (where all evaluations were made independently), following instructions to rate the drawings as relative to one another, whilst given the drawings in a different random order. An important aspect of this technique is that evaluators should make their assessment independently using their own subjective definition of creativity (Amabile, 1982; Baer & McKool, 2009; Kaufman, Lee, Baer & Lee; Hickey, 2001).

In this technique, interjudge reliability is regarded as an equivalent to construct validity, i.e. if evaluators independently agree that a product is creative, it is accepted as such. The technique is reported to offer a more authentic method towards assessing creative products than factoral approaches and is a widely accepted method for assessing creativity (Sternberg & Lubart, 1991; Hennessey, 1994). In our study, the rating between the three evaluators was consistent with an intra-class correlation co-efficient of 0.425 (single measures) and 0.689 (average measures) (Landis & Koch, 1977).

As expected, levels of creativity differed between the control and experimental groups. Evaluations were made on a scale of 1 to 5 where the value of 5 represented the highest level of creativity. Creativity scores were higher in the plants condition than in the control group. In the plants condition, creativity was evaluated on average at the level of 2.13 points against 1.78 points in the control group where plants were not present ($p = 0.01$). As expected, exposure to the colour green increased creativity and was evaluated at 2.05 points ($p = 0.05$). There was no statistically relevant difference between the plants and green paper conditions ($p = 0.57$). The scores for visual creativity are summarized in Table 3. The results are presented for each judge separately as well as across judges.

Table 3
Visual creativity results.

Criteria	Mean	*F*	*p*
Control/plant			
Creativity all judges	1.78/2.13	6.298	.01
Judge 1	1.51/2.01	11.108	.00
Judge 2	1.88/2.15	2.073	.15
Judge 3	1.97/2.24	1.782	.19
Control/green paper			
Creativity all judges	1.78/2.05	4.056	.05
Judge 1	1.51/1.87	6.366	.02
Judge 2	1.88/2.20	2.437	.12
Judge 3	1.97/2.08	.265	.61
Plant/green paper			
Creativity all judges	2.13/2.05	.331	.57
Judge 1	2.01/1.87	.745	.39
Judge 2	2.15/2.20	.070	.79
Judge 3	2.24/2.08	.659	.42

6. Discussion

Previous research has suggested that environmental factors have an impact on creativity (Runco & Johnson, 2002). Scholars have attributed these positive effects to the relaxing connotations of views to nature and plants. However, research into these areas has been sparce and has not been previously applied to educational settings. A number of studies have demonstrated that views to nature and exposure to the colour green have a positive effect on the ability to think creatively (Atchley et al., 2012; Lichtenfeld et al., 2012; Shibata & Suzuki, 2002). The results of our research support the previous findings in that they demonstrate a positive connection between nature and visual creativity. However, our study findings do not support earlier findings on the positive impact of nature on other forms of creativity. Shibata & Suzuki, 2002 reported in their study that indoor plants enhanced creativity measured through a word association task which resembled the alternative uses task used in the present study to measure verbal creativity. Even though Shibata & Suzuki's study applied only to women, it is contradictory to our results and suggests that environmental manipulation needs to be precise in order to produce the targeted effect. The quality of access to nature, the creativity task, the measurement of creativity and other factors can have an effect on the overall impact.

A possible explanation for the differences in results between visual and verbal creativity tasks can be found in the domain of cognitive science. Research in this area suggests that there are significant differences in the cognitive processing of visual and verbal information (Mayer & Masser, 2003), and that individuals may have a preference for visual or verbal processing (Childers, Houston, & Heckler, 1985). Furthermore, research suggests that visual and verbal information is processed in two distinct channels in the brain (Paivio, 1971). Verbal information is processed in the left hemisphere which specialises in rational, analytical and convergent thinking, whereas, the right hemisphere is often associated with creativity and divergent thinking (Runco, 2014; Vartanian & Goel, 2005). Additionally, studies in the area of neuroscience report that the right hemisphere of the brain is concerned with the processing of visual information and the left with verbal (Kramer, Rosenberg, & Thompason-Schill, 2009), and that creative thinking often involves bilateral processing (Aziz-Zadeh, Liew, Dandekar, 2012). This suggests that the verbal task may not have been best matched with creative thinking, although it is noteworthy to state that Guilford's Alternative Uses Task is a widely used measure of creative thinking. Our outcome is congruent with previous studies which have reported dissociation between visual and verbal creativity (i.e. Shaw & DeMers, 1986; Roskos-Ewoldsen et al., 1993).

Another explanation may arise in differences in the evaluator's subjective definitions of creativity in assessing the verbal creativity task. Amabile (1996) acknowledges that in some instances it can be problematic for experts in their fields, to agree on the level of creativity expressed in creative products. Furthermore, this outcome might also be explained by the domain specificity of creativity. Previous research suggests that creativity consists of both domain specific and general skills and talents (i.e. Amabile, 1983; Baer, 2010). For example, an individual might be artistically creative, but not in everyday chores. Our results indicate that access to nature has a positive impact on the domain of visual creativity, but not on verbal creativity as operationalised in the alternative uses task. Our findings are similar to Baer (1996) research which reported that when creativity training is targeted at a specific domain, creativity improves only in this domain, not others. This is substantiated by a number of scholars who also report that creativity is dependent on domain-specific skills (Palmiero et al., 2010; Silvia et al., 2009). More empirical research is needed to establish the domain categories. The tests used in our research come close to two of the seven general thematic areas identified by Kraufman, Cole & Baer, 2009, which are; artistic/visual area and problem solving area, and provide support to the overall argument that creativity is domain specific.

7. Conclusions

In this study, we have extended upon previous research by demonstrating that the influence of environmental factors is not uniform for different forms of creativity. The results have clear practical implications in demonstrating that classroom features can enhance creativity among students. The visual creativity of students can be increased by incorporating plants in classrooms or ensuring that classrooms are designed with views to nature. When access to nature is difficult to arrange, using green coloured paper in classroom tasks can have a similar effect on creativity. It is also possible that these environmental features have a positive impact on other domains of creativity, but this impact needs to be investigated in further studies.

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