Effects of Key Visual on Creativity in the Operating Environment

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Abstract

Numbers of studies forecasted that Artificial Intelligence (AI) technologies might replace 50% of human jobs near future. Meanwhile, the pandemic of COVID-19 has greatly increased the number of people working remotely. Under the threats of AI and the trend of teleworking, it is essential to provide high-level creative environments to enhance human competitiveness in the post-COVID. This study applied key visual, emotional, and creativity theories to operating environment management. Through an experiment of placing emotional images as a key visual object, explore whether people's creativity and emotions are affected. Also, investigate whether different sleeping habits will affect creativity. The results of the experiment demonstrate that people's creativity and emotions are affected by key visual objects. These results yield important implications regarding how to enhance creative performance at work.

Keywords: Operating environment, key visual, creativity, emotion, abbreviated Torrance test for adults (ATTA)

1. Introduction

Under the threats of AI and the potential of teleworking in the post-COVID, it is essential to provide high-level creative environments to enhance human competitiveness. This study explores whether people's creativity and emotions are affected by key visual objects.

1.1 Research Background

Artificial intelligence (AI) technologies assist humans in doing their jobs, such as self-driving cars and applications on diagnosis medical (Dahlin, 2019). Some studies forecasted that 50% of human jobs might be replaced by AI technology by 2035 and cause technological unemployment (Pellegrino et al., 2017). Meanwhile, some studies pointed out that the capabilities of AI may be overestimated (Clifton et al., 2020). For example, there is a long way for AI to replace humans in consciousness, such as creativity (Siau & Wang, 2020). AI may help humans generate and develop new industries and job opportunities (Acemoglu & Restrepo, 2019). Therefore, in the age of AI, creativity has become more critical to increase human job opportunities. It is essential to provide high-level creativity environments, to enhance human competitiveness.

International Labor Organization (ILO) estimated teleworkers represented 7.9% of global employment before the COVID-19 pandemic (International Labour Organization, 2021). According to World Economic Forum, 44% of employees could work remotely during the COVID-19 crisis (World Economic Forum, 2020). These figures tell us the potential of teleworking in the post-COVID.

The ILO's research states that teleworking has negative consequences, including isolation by long hours working alone without social interaction (International Labour Organization, 2021), such as face-to-face creative meetings. Therefore, when teleworking becomes a trend, how to improve employees' creative performance when work alone becomes a challenging task.

1.2 Research Purpose

Different operating environment conditions may affect creativity. For example, an unusual workplace setting can effectively enhance creative performance (Fong, 2006). Key visual is one of the physical environment factors that can attract attention become the first sight object in a place. Key visual design is designed for people's first visual impression, influencing their emotions and behaviors (Bell, 2019).

This study aims to enhance people's creativity in different operating environments, such as work at home. This experiment designs for placing emotional images in a place as a key visual object to explores the influence of the key visual on creativity and emotion. Furthermore, to investigate whether different sleeping habits will affect creativity.

2. Literature Review

This study applied key visual, emotional, and creativity theories to operating environment management. This chapter discusses the relevant theoretical basis and related literature.

2.1 Operating Environment

As mentioned above, due to COVID-19, teleworking and distance learning may become a trend.

Therefore, this study assumes the Operating Environment as any place suitable for work and studying, such as office, factory, home, school, coffee shop, etc.

The operating environment affects productivity; it includes psychosocial and physical factors. Psychosocial factors include management style, motivation, internal communication, etc. Physical factors include the location, layout, temperature, lighting, noise, air quality, etc. The physical factors influence work efficiency, attention, creativity, job satisfaction, etc. (Sarode & Shirsath, 2014). Therefore, applying modifications to the work environment can be a benefit to working performance.

Unusual operating environment and emotional ambivalence affect work performance. An unusual work environment prompts emotional ambivalence, and it increases the sensitivity of thoughts and benefits creativity. Some studies demonstrate employees' creative thinking abilities increased by working in an unusual environment, such as hanging a bicycle from the ceiling in a product design firm - IDEO. It helps employees sharpen their ability to come up with innovative ideas (Fong, 2006).

2.2 Key Visuals

Key visual is one of the physical environment factors that can attract attention become the first sight object in a place. Key visual design is a design for people's first visual impression, influencing people's emotions and behaviors (Bell, 2019), for example, hanging a painting indoors as a key visual to attract attention influence people's moods and behaviours.

As mentioned above 2.1, product design firm IDEO hangs bicycles from the ceiling to attract people's first visual impression and stimulate the creativity of employees (Fong, 2006), which is a key visual example.

Therefore, this research explores placing emotional images as a key visual object to stimulate people's emotions and work performance, including creativity and emotion.

2.3 Emotions

Emotions include positive, negative, and Emotional Ambivalence. Positive emotions include joy, interest, contentment, love, etc. (Cohn & Fredrickson, 2009). Negative emotions such as depression, fear, anger, frustration, sadness, etc. (Kaya & Epps 2004). Humans are rarely pure happiness or pure sadness and tend to be a combination of positive and negative emotions; it's called Emotional Ambivalence (Fong, 2006).

Emotions help make judgments and guide appropriate behaviors (LeDoux, 2000). The "fear-arousing bridge experiment" proved that psychology reflects might be caused by environmental factors that attribute to wrong psychology and emotional reasons (Dutton & Aron, 1974). It proved that environmental factors could manipulate emotions.

2.3.1 The influence of images on emotions

Images are stimuli by the conditioned sensory response; they may elicit emotional responses. Therefore, positive images may cause positive emotions and cause avoidance responses under negative images (Staats & Lohr, 1979). Some studies pointed out that the same text description plus different images can arouse readers' varying emotions and impressions of the news (Strivers, 1994).

2.3.2 The influence of emotions on creativity

Numbers of research have convincingly demonstrated that emotions do influence creative performance (Fong, 2006). Meanwhile, there is conflict and debate regarding the relationship between emotion and creativity. Some research demonstrates positive emotions cause creativity (Isen et al., 1987), and negative emotions reduce attention and are not conducive to creativity (Fredrickson, 2001).

Some research demonstrates that negative emotions cause creativity (George & Zhou, 2002). Meanwhile, some studies state that creativity is affected by motivation intensity, not emotions (George & Zhou, 2002). For example, joy is a positive emotion. However, it has low motivation intensity, and reduced attention comes up with low-level creativity. On the other side, same as joy, desire is a positive emotion, but with high motivation intensity and increased attention, it comes up with high-level creativity. (Harmon-Jones et al., 2013).

2.4 Creativity

Creativity is the ability to use skills and imagination to create new things or art (Stevenson, 2010). Creativity is a mental and cognitive process (Perlovsky & Levine, 2012). Innovation requires creative ideas, which are both original and useful. Usefulness is crucial for ideas to be implemented and turn into an innovation. Valuable ideas must be useful; otherwise, they are not creative (Ostermaier & Uhl, 2020). People with high-level creativity can find out more possibilities and choices when making decisions and solving problems (Keeney, 1994).

Many factors affect creativity, such as operating environment, education, culture, emotions, etc. (Runco, 2007). For example, unusual office layouts can effectively enhance employees' creativity (Fong, 2006).

2.5 Creativity Measurement Tools

Many researchers used the concept of Divergent Thinking, which is under the Structure of Intellect, to study creativity. Divergent thinking is a process and method to generate creative thinking by exploring many possible solutions. Divergent thinking might apply as an assessment method of creative abilities. It measures creativity by scoring

into four dimensions: Fluency, Flexibility, Originality, and Elaboration (Guilford, 1970).

Torrance Tests of Creative Thinking (TTCT) is a test that measures figural creativity. It applies Guilford's theory to measure cognitive competencies. It measures scores on a few dimensions, including fluency, originality, elaboration, the abstractness of titles, resistance to premature closure, and 13 creative strengths (Torrance, 1966).

2.6 Sleeping Habits

Numbers of studies pointed out that poor sleep is detrimental to thinking flexibly (Harrison & Horne, 1999). Sleep quality significantly of variance in work performance outcomes (Budnick & Barber, 2015). Rapid eye movement (REM) is the final stage of the sleep cycle. Many studies demonstrate that REM catalyzes the creative process (Prince & Abel, 2013). One sleep cycle consists of one non-REM and one REM period. A complete sleep cycle takes about 90 to 110 minutes (Steiger, 2010) and three to five sleep cycles per night (Blumberg et al., 2020). American Academy of Sleep Medicine recommends sleeping at least 7 hours per night (American Academy of Sleep Medicine, 2021). Therefore, this study investigates whether different sleeping habits – average sleep more or less than 7 hours per night affect creativity.

3. Methodology

Based on the purpose of the study and the literature review. This chapter discusses the research structure, hypothesis, experiment arrangement, and procedure.

3.1 Research Structure

This research focuses on the relevance between key visual images and work performance. The key visual images will stimulate experiment participants. Experimentally records the influence on emotion and creativity by different key visual images. Also, investigate different key visual effects on samples with varying sleeping habits (Sleep less than 7 hours or more than 7 hours) as a moderating variable. The preliminary analysis framework proposed in this study is shown in Figure 3-1-1.

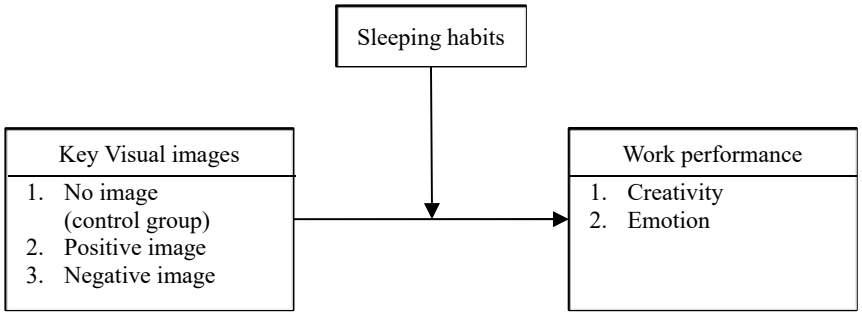

Figure 3-1-1: Research Structure

3.2 Hypothesis

H1: Key visual has a significant impact on creativity in operating environments.

H2: Key visual has a significant impact on positive emotion in operating environments.

H3: Key visual has a significant impact on negative emotion in operating environments.

H4: Key visual has a significant impact on creativity in operating environments for sleeping habits.

3.3 Participants

In this study, all experiment participants were current students of the Fu Jen Catholic University. There was a total of 96 participants (48 females and 48 males).

3.4 Key Visual Images

In this study, use emotional images as key visual objects for the experiment. Select one strongly positive and one strongly negative picture as key visual images. Also, there is one group without any image as a control group. The key visual and participants' experimental arrangement is shown in Table 3-4-1.

Table 3-4-1: Experiment Arrangement

Key Visuals	Participants
No image (control group)	32
Positive images	32
Negative images	32

In order to select the strongest positive and negative images, a pre-test questionnaire had to be conducted. The questions of the pre-test questionnaire were 30 images from online without copyright. Respondents were asked to evaluate the emotions expressed by each image with seven scales. The scales were "Strongly positive"; "Positive"; "Somewhat Positive"; "Neither Positive nor Negative"; "Somewhat Negative"; "Negative" and "Strongly Negative". The scoring of the questionnaire is shown in Table 3-4-2.

Table 3-4-2: Scoring of the Pre-test Questionnaire

Scales	Scores
Strongly positive	3
Positive	2

Scales	Scores
Somewhat Positive	1
Neither Positive nor Negative	0
Somewhat Negative	-1
Negative	-2
Strongly Negative	-3

The result of this pre-test questionnaire is the sum of the scores of all valid questionnaires. The highest score would be used as the positive image and the lowest for the negative image.

A total of 240 questionnaire replies were collected, of which 13 were invalid, so the final valid questionnaire was 227. As a result, the positive emotion picture is the "Guests and balloons" with a total score of 572; the negative emotion picture is the "Full of blood", which has a total score of negative 559, as shown in Figure 3-4-1.

Figure 3-4-1: The Selected Positive and Negative Key Visual Image

3.5 Creativity Test Evaluation Tool

This study uses the Abbreviated Torrance Test for Adults (ATTA) as a creativity measurement tool to measure experiment participants' creative ability. ATTA simplified the Torrance Test of Creativity (TTCT) into an adult version. The test yields result for four dimensions, including Fluency, Originality, Elaboration, and Flexibility. It measures participants' creative index (CI) based on their test performance, shown in Table 3-4-3.

Table 3-4-3: Creative Index of the ATTA

Creative Index (CI)	1-49	50-56	57-61	62-66	67-70	71-75	76+
Levels of creativity	1	2	3	4	5	6	7
Description of levels	Lowest	Low	Lower than average	Average	Higher than average	High	Highest

As the agreement between this study and the ATTA Chinese copyright owner – Psychological Publishing Co., Ltd. This study is not allowed to disclose any ATTA questions on papers.

The reliability of ATTA is adopted from test-retest reliability and inter-rater reliability. The test-retest reliability of each creativity index is between .340 and .682 ($p<.01$); the inter-rater reliability is between .311 and .975 ($p<.01$), indicating that the test has good stability. In terms of validity, the correlation with the "Problem Solving Creativity Test" is .368 and .457 ($p<.05$), showing that this test has good validity (Goff & Torrance, 2006).

3.6 International Positive and Negative Emotion Scale

This study uses the International Positive and Negative Affect Schedule (PANAS) to measure the emotional state of the experiment participants. The content included ten positive and ten negative words (Watson et al., 1988). Experiment participants need to select the intensity according to their feelings during the experiment.

3.7 Questionnaire

This study collected information on the participants' sleeping habits in a questionnaire for research and analysis.

3.8 Statistical Tools

After the experiments were completed, used SPSS as the statistical analysis software. Analyze whether the key visual has a significant impact on creativity and emotion in workplaces.

3.9 Experimental Procedure

Each participant experiments for approximately 20 minutes in the designated classroom, as shown in Figure 3-9-1. In the first part, the participants focus on the emotional image for two minutes and feel the emotion conveyed by the image. In the second part, the participants fill out the ATTA test. In the third part, the participants recall their feelings when working on the ATTA, then fill in the PANAS accordingly. At last, the participants fill in the questionnaire to finish the experiments.

Figure 3-9-1: The Setting of Experiments in the Designated Classroom

4. Results

This chapter analyzes the data collected from the experiment and uses SPSS as the statistical analysis software.

4.1 Effects of Key Visual on Creativity

This study used ANOVA to investigate different key visuals (No image, positive image, and negative image) on creativity. The results are shown in Table 4-1-1.

According to the analysis for all 96 samples, the highest mean of creativity index (CI) was 71.97, which appeared at the negative key visual image. The next was 68.38 at the positive key visual image. The lowest creative index was 60.97, which appeared at no key visual image.

For the significance analysis, the key visual on the creative index (CI) had a significance of <0.001, which is less than 0.01, which means that the key visual has a significant impact on creativity.

Table 4-1-1: Effects of Key Visual on Creativity Index

Key Visual	N	Mean	Standard deviation	F	Significance
Negative image	32	71.97	8.046	20.383	<.001***
Positive image	32	68.38	6.228		
No image (Control group)	32	60.97	6.684		

Significance: *p<0.1; **p<0.05; ***p<0.01

4.2 Effects of Key Visual on Positive Emotion

This study used ANOVA to investigate the influence of different key visuals (No image, positive image, and negative image) on positive emotion. The results are shown in Table 4-2-1.

According to the analysis for all 96 samples, PANAS's highest mean of positive emotion was 32.25, which appeared at the positive key visual image. The next was 24.06 at the no key visual image. The lowest was 23.31, which appeared at the negative key visual image.

For the significance analysis, the key visual on the positive emotion scored had a significance of <0.001, which is less than 0.01, which means that the key visual has a significant impact on positive emotion.

Table 4-2-1: Effects of Key Visual on Positive Emotion

Key Visual	N	Mean	Standard deviation	F	Significance
Positive image	32	32.25	4.088	18.256	<.001***
No image (Control group)	32	24.06	8.598		
Negative image	32	23.31	6.214		

Significance: *p<0.1; **p<0.05; ***p<0.01

4.3 Effects of Key Visual on Negative Emotion

This study used ANOVA to investigate the influence of different key visuals (No image, positive image, and negative image) on negative emotion. Results are shown in Table 4-3-1.

According to the analysis for all 96 samples, PANAS's highest mean of negative emotion was 29.72, which appeared at the negative key visual image. The next was 14.16 at the no key visual image. The lowest was 13.84, which appeared at the positive key visual image.

For the significance analysis, the key visual on the negative emotion scored had a significance of <0.001, which is less than 0.01, which means that the key visual has a significant impact on negative emotion.

Table 4-3-1: Effects of Key Visual on Negative Emotion

Key Visual	N	Mean	Standard deviation	F	Significance
Negative image	32	29.72	10.091	45.905	<.001***
No image (Control group)	32	14.16	6.570		
Positive image	32	13.84	5.225		

Significance: *p<0.05; **p<0.01; ***p<0.001

4.4 Effects of Key Visual on Sleeping Habit

This study used ANOVA to investigate the influence of different key visuals (No image, positive image, and negative image) on varying sleeping habits (Sleep less than 7 hours or more than 7 hours). The results are shown in Table 4-4-1.

According to the analysis for 63 samples with average sleep less than 7 hours, the highest mean of the creative index (CI) was 72.29, which appeared at the negative key visual image. The next was 68.75 at the positive key visual image. The lowest was 60.32, which appeared at no key visual image.

For the 33 samples which average sleep more than 7 hours, the highest mean of the creative index (CI) was 71.36, which appeared at the negative key visual image. The next was 67.75 at the positive key visual image. The lowest was 62.40, which appeared at the no key visual image.

Table 4-4-1: Effects of Key Visual on Different Sleeping Habit

Sleeping habits	Key Visual	N	Mean	Standard deviation	F	Significance
Less than 7 hours	Negative image	21	72.29	7.753	17.337	<.001***
	Positive image	20	68.75	6.206		
	No image (Control group)	22	60.32	6.498		
More than 7 hours	Negative image	11	71.36	8.936	3.679	.037**
	Positive image	12	67.75	6.482		
	No image (Control group)	10	62.40	7.214		

Significance: *p<0.05; **p<0.01; ***p<0.001

5. Conclusions and Suggestions

This chapter will summarize the results from the experiments and suggest how to apply the experimental results to different operating environments.

5.1 Conclusions

This study through experimentation with ATTA, PANAS, and questionnaire to measure key visual impacts on creativity and emotion. The summary of the study results of the hypothesis are shown in Table 5-1-1.

Table 5-1-1: Hypothesis Results

Hypothesis	Results
H_1: Key visual has a significant impact on creativity in operating environments.	Accept
H_2: Key visual has a significant impact on positive emotion in operating environments.	Accept
H_3: Key visual has a significant impact on negative emotion in operating environments.	Accept
H_4: Key visual has a significant impact on creativity in operating environments for sleeping habits.	Accept

5.1.1 Creativity

The experimental results show that key visual has significance on creativity. The creative performances with both positive and negative images are significantly better than the no images control group. The creativity performance with negative images ranked first, and the control group with the worst performance. Therefore, this study suggests applying negative images in operating environments would be the best choice to enhance creativity.

Furthermore, the samples either average sleep more or less than 7 hours, their creative performances with both key visual images are significantly better than the control group. Therefore, sleeping habit is not an influential factor of creativity.

5.1.2 Emotion

The experimental results show that the key visual image significantly impacts both positive and negative emotions. Table 4-2-1 & 4-3-1 shows that the positive image positively influences positive emotions; the negative image positively influences negative emotions. The samples in the control group do not have any significant emotional tendency. Therefore, this study suggests that applying positive images in operating environments would be the best choice to enhance positive emotions.

5.2 Suggestions

This study suggests companies and individuals may consider applying emotional images in different operating environments.

5.2.1 General indoor operating environment

General indoor operating environments, such as schools, offices, factories, stores, etc. This study found that different key visual images have slightly different effects on creativity. The negative image with the highest Creative Index (CI), the positive image is the next, and the no image group is the worst. It should enhance the team's maximum creativity if applying negative emotion image as a key visual. However, general indoor operating environments are collaboration environments; organizations are concerned about employees' creative performances but also the overall working atmosphere and teamwork spirit. As this study found that negative images increase negative emotions, that affect employees' emotions which is not conducive to teamwork spirit.

Therefore, this study suggests that when teamwork is involved, positive images should be the best choice. Although it is not the best for creativity, its creative performance is better than no image environments. Plus, positive emotion images effectively enhance positive emotions, which is conducive to teamwork spirit.

In addition, this study recommended updating the key visual images regularly to maintain a high level of stimulation.

5.2.2 Work-From-Home environment

Work-From-Home environment refers to general living and residential environments, including apartments, studio flats, houses, etc. Due to the COVID-19, the feasibility of teleworking is greatly increased. Employees working alone, social interactions such as creative meeting activities reduced. People should apply key visual images to stimulate creativity at home.

This study found that the negative image with the highest Creative Index (CI), the positive image is the next, and the no image group is the worst. Therefore, when working at home, people can choose negative or positive images as key visuals depending on their needs. It should enhance individuals' maximum creativity if applying negative emotion image as a key visual. But working at home alone reduces social interaction and may cause feeling lonely. If people concern creativity more than emotions, recommended using negative images to get the highest level of creativity. On the other hand, if people are more concerned about emotion than creativity, they are recommended to use positive images to enhance creativity and conducive to their positive emotions.

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