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EVALUATION OF THE EFFECT OF AN IDEATION SPACE ON DESIGN BRAINSTORMING SESSIONS

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1. Introduction

As illustrated by some innovative companies, working spaces of creative professionals are changing. They don't look like "usual" offices any more, as they tend to integrate entertainment tools or relaxing spaces. This evolution is exemplified by Google, which proposes some offices that provides comfortable seating spaces and entertainment objects and games to its office workers (figure 1). Several companies and universities, e.g. [Kress et al. 2012], [Tiensuu and Lammi 2012], strive to design environments that are expected to enhance creative performances but the fact that these new working spaces actually improve collaboration and creativity in design innovation activities has never been demonstrated though scientific experimentation.

Figure 1. Facebook office

Figure 2. Google office

Figure 3. Stanford Imaginarium [Kress et al. 2012]

Figure 4. Creativelab, in [Tiensuu and Lammi 2012]

In this context, we aim at evaluating the effect of the physical environment on people conducting creative activities. This study aims at answering the following question: Is creativity in design innovation activities actually enhanced by working in a “creativity space? We formulate the hypothesis that when conducting design innovation activities, people might have a better perception of

a creativity space than usual meeting room and the perception of the workspace might influence creativity. Our paper reports a research conducted within an engineering and architecture university in Asia, which aims at evaluating the impact of a "creativity space" onto students' subjective perception and creative performances during a brainstorming task. Our experimental approach consisted in designing a creativity space within an university and evaluating its effect on students' subjective perception and creative performances. In the first section of this paper, we introduce related studies about the effects of working spaces on creativity. Then we describe the design of our creativity space and finally we report the experimental assessment of the creativity space, with a focus on subjective perception and creative performances by the participants.

2. Influence of workspace on creativity

2.1 "Place" in 4Ps model of creativity

Because creativity is often described by the 4Ps, Person, Process, Product and Place [Davis 2004], 'Place', from both physical and social points of view, is supposed to have a significant role in the cognitive processes of creativity.

However, although studies acknowledge 'place' to be an essential ingredient to creativity [Shalley et al. 2004], the empirical support is weak. In a state-of-the-art paper, Martens [2011] shows that so far most studies on the effects of working spaces focused productivity, while the focus recently shifted to creativity. These studies attempted to identify various approaches to support creativity, such as supporting:

- - creative interactions
- - flow [Csikszentmihalyi 1996]
- - creative thinking and insight
- - personal qualities [Amabile 1998]
- - a creative environment

2.2 Workspace and situated cognitive activity

With a similar approach and based on the idea that much cognitive work, including design activity, is "situated", Kristensen [2004] claimed that the plan must be acted out so that all kinds of situational adaptations occur. In other words, the physical environment where creators are physically located should support the cognitive processes of creativity. As a consequence, he proposed an embodied creative process (Table 1), based on Wallas model of creativity, and described the layout of a large innovative company as a support of the design process. Indeed, each room and area of the company building was dedicated to different stages in the innovation process and was designed to specifically support these cognitive stages.

Table 1. Embodied Creative Processes [Kristensen 2004]

	Preparation	***Incubation***	***Insight***	***Elaboration and evaluation***
Value creation	Guiding principle	Guiding principle	Guiding principle	Guiding principle and benchmark
Scaffolding	Physical organization of process	Subject to altering and manipulation	No particular role	No particular role
Imagination	Perceptual rehearsal accumulates information	Perceptual rehearsal accumulates information	The moment of novelty	No particular role
Materialization	Preparation includes tools for materialization	No particular role	A new concept, solution or artefact is material and sensory	The material object or artefact is subject of elaboration and evaluation

2.3 Workspace and potential effect on creativity

Using images of spaces, McCoy and Evans [2002] investigated the potential for creativity of various types of environments and attempted to depict the objective qualities of a workplace for creativity. In a similar study, Chung and Danko [2012] specifically studied the perception of "Net generation" participants. The experimental approach mainly consisted in subjective evaluation of pictures. Analyses identified five parameters 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,
(e) less use of manufactured or composite surface materials.

In the same manner, Moghadampour et al. [2012] listed the elements of a virtual creative space which could foster creativity. Again, colors play an important role, as well as natural materials or environments.

In the final step, McCoy and Evans conducted an actual test of creative performance, consisting in the Torrance Test of Creative Thinking (TTCT) [Torrance 1966] and in making collages [Amabile 1989], in two types of spaces defined by the previous study: a "low creative setting" and a "high creative setting". The participants actually perform better in the high creative setting when making collages, but not in the TTCT.

Table 2. Elements of a virtual creative space that may foster creativity [Moghadampour et al. 2012]

Element	Description
Plants / Flower	Natural Plants or flower that are placed in the virtual space.
Television and piano	
Window	View to nature Visual access to see the trees, plants, rivers and other natural elements.
Furniture	Chairs, tables, etc. in the virtual space.
Quantity of light	The amount of light
Any window view	Visual access to any outer environment.
Sound (positive sound)	Good music or sounds of nature.
Privacy	The possibility of being secluded from the presence or view of others.
Calming colors	Colors that provide a relaxing experience (green, blue or blue violet).
Inspiring color	Colors that provide a stimulating experience.
Artworks	Creative art can be found in different parts of the building.
Game equipment	Chess.
Chopper	Play and fun.
Fridge	To preserve fruits and other items.
Fireplaces	To warm the room.
Aquarium, spiral staircase	To stimulate the senses.
Projector screen	Streaming multimedia.

2.4 Research question and hypothesis

The aforementioned study shows that some characteristics in the workspace can enhance the creative performances measured with a specific type of test (i.e. collages). Would this result be similar in the case of design activity? Based on aforementioned references, we formulated the following research question: As for design innovation activity, is creativity actually enhanced by working in a "creativity

space"? Our research hypothesis is the following: When conducting design innovation activities, people might have a better perception of a creativity space than usual meeting room and the perception of the workspace might influence creativity.

3. Design and evaluation of a creativity space within a university

3.1 Design of a creativity space

Based on the findings by [McCoy and Evans 2002] and [Moghadampour et al. 2012], we aimed at a complexity of visual details, easy access to visual information and a sensory stimulation at the same time, by showing a large amount of pictures on the wall and allowing the users to use a video-projector to show pictures or websites on the walls. The design is also aimed at providing "sensory stimulation", trough various sitting options and a soft carpet, and "surprise", trough a variety of colors and the option to sit on the floor. Another key point of the Idea Studio is its playground-like design. It is aimed at providing fun to the users who can manipulate various objects and interact with other people around (e.g. yoga ball).

Figure 5. Overview of the creativity workspace ("Idea Studio")

Figure 6. Students in the Idea Studio for a brainstorming

Figure 7. Students can play with various objects

Figure 8. Grass-like carpet provides sensory stimulation

A floor-to-ceiling whiteboard allows the users to express their ideas in a smooth and collaborative way. The use of the projector on the whiteboards also provides a visual stimulation that was shown by many researchers (e.g. [Goldschmidt 2004]) as being essential to designers for enhancing creativity.

3.2 Evaluation of a creativity space

We experimentally compared the creative performances and subjective perception in two conditions: in the creativity space and in the meeting room that is usually used by the students (control condition).

Method: Participants (N = 24) were students belonging to three different universities in Japan, from various backgrounds (e.g. engineering, architecture, marketing…) and various nationalities from Asia and Europe. The groups were composed in a balanced way in term of backgrounds, genders and nationalities. Each group of four participants had to conduct two brainstorming sessions on different topics, one in the creativity space and one in the control condition (meeting room). The brainstorming topics were: "transportation" and "communication". The order of conditions and of brainstorming topics were counterbalanced across the whole sample of participants, as described in the following table. After the brainstorming session, the participants had to complete a questionnaire related to the their perception of the brainstorming activity in both the Idea Studio and the control condition, using 7-point Likert scale.

Table 3. Experimental design

Group	First session		Second session	
1	Idea Studio	Transportation	Control	Communication
2	Idea Studio	Communication	Control	Transportation
3	Idea Studio	Transportation	Control	Communication
4	Control	Communication	Idea Studio	Transportation
5	Control	Transportation	Idea Studio	Communication
6	Control	Communication	Idea Studio	Transportation

Results: The data were analyzed by ANOVAs with SPSS software, with a special focus on the creative performances and the subjective perception. First, the evaluation of the creative performances is conducted with metrics which are well-established in creative thinking studies (see for example [Torrance and Safter 1999]. The metrics are described in the following table.

Table 4. Metrics for the evaluation of creative performances

Metrics	***Description***	***Assessed value***
Fluency	Ability to produce and consider many alternatives	Number of ideas that were produced
Fluidity/flexibility	Ability to move from one conceptual field to another	Number of categories of ideas
Originality	Ability to get away from the obvious and common place (original ideas are statistically infrequent)	Number of unusual responses, as compared to other groups

The evaluation of the creative performances show a significant difference in the originality metrics (control condition: 1.6, idea studio: 3.5, p=.012) and no significant difference for the fluency and fluidity metrics.

Then, the subjective perception was evaluated with questionnaires which focused the perceived usability of the Idea Studio, as compared to the control condition, i.e. usefulness, efficiency, easiness and pleasantness. Other questions related to the feelings of the users were also added (e.g. comfortable, relaxing, stimulating, surprising…).

Table 5. Perception for creative activity

	Mean score Control condition	Mean score Idea Studio	Paired difference Mean	Sig. (2-tailed)
useful	4.3	5.3	1.0	.00
efficient	4.4	4.7	0.4	.39 (NS)
pleasant	3.4	6.0	2.6	.00
easy to use	5.0	5.0	-0.7	.87 (NS)

Table 6. Perception for communication between people

	Mean score Control condition	Mean score Idea Studio	Paired difference Mean	Sig. (2-tailed)
useful	4.3	5.7	1.4	.00
efficient	4.6	5.5	0.9	.01
pleasant	3.6	6.3	2.7	.00
easy to use	4.6	5.2	-0.6	.12 (NS)

For most evaluation items, the scores are significantly higher for the Idea Studio: it is perceived as more useful and more pleasant when conducting creative activity (table 5), it is also perceived as more useful, more efficient and more pleasant when collaborating with people (table 6). However, regarding perceived efficiency, there is not significant difference between the Idea Studio and the control condition.

Table 7. Global perception

	Mean score Control condition	Mean score Idea Studio	Paired difference Mean	Sig. (2-tailed)
comfortable	4.4	6.3	1.9	.00
relaxing	3.5	6.4	2.9	.00
surprising	1.3	5.8	4.5	.00
stimulating	2.9	5.0	2.1	.00

As for the global perception, the scores are also significantly higher with the Idea Studio. Indeed, the Idea Studio is perceived as being more comfortable ($F(1/24) = 6.3$; $p = .00$), more relaxing ($F(1/24) = 6.4$; $p = .00$), more surprising ($F(1/24) = 5.9$; $p = .00$) and more stimulating ($F(1/24) = 5.0$; $p = .00$) than the control condition. The perception of the Idea Studio is significantly better than the perception of the usual meeting room. The findings suggest that people feel better in the Idea Studio rather than in a usual meeting room, when conducting creative activities as well as when communicating with people.
Our experimental results tend to support the idea that the brainstorming conducted in the idea studio had a better creative performance than in the usual room, especially in the originality criterion. It seems that the participants had a more positive subjective perception of this space, as they expressed the opinion that this space could effectively support creative activities and collaboration between people. Thus we tend to think that a positive subjective perception of a space can lead to better creative performances.

4. Perspectives

Combining ideation space, as described above, and fabrication space could enhance the output of a design process by reducing the time taken to completion. These united spaces would include all the tools required to conduct a human-centered design process. Such an environment would reduce the time between design iterations, encouraging technological exploration, and improving communication.

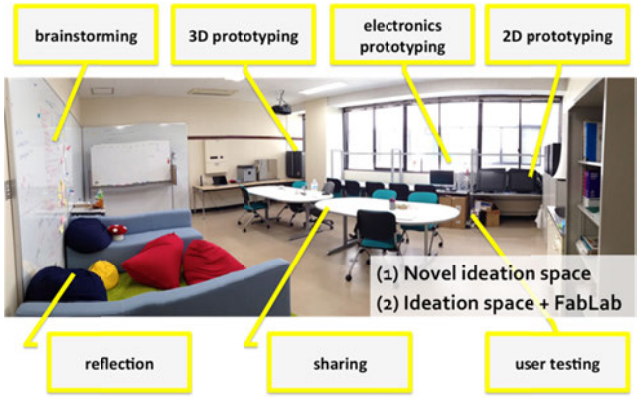

Figure 9. Combining ideation space and prototyping space

It is the hope that generating ideas near fabrication tools will more likely result in disruptive innovations or eccentric creativity. The ensuing creative space should contain the tools for each stage to deal with the particulars, while enabling communal space for intensive exchanges and collaboration [Kristensen 2004]. With such goals in mind, one can start envisioning an environment which would gather all the steps of the design process and provide their tools for its users. Our investigation aims at determining whether gathering the tools for prototype fabrication and ideation in the same physical location leads to a better quality of output in the creative process.

The brainstorming space described earlied has been combined to a fabrication space with an access to fabrication tools such as 3D printing equipment and Arduino electronics prototyping tools. An active method of ideation, achieved by adding fabrication tools, is hoped to accelerate physical and mental activities of the design process through the facilitation of iterations between all stages of the design process and designing tools.

5. Conclusion

Although there is a growing interest in designing spaces that support creativity, there is still weak evidence that such creativity spaces actually enhance users' creativity. Through the design of a creativity space within our university, we experimentally evaluated the effects of the designed environment onto students' creativity, with a specific focus on design innovation creativity. The preliminary results tend to show that our creativity space is perceived as being more pleasant, comfortable, relaxing, stimulating and surprising than a usual meeting room. These hedonistic qualities tend to support better creative performances as shown by the creativity assessment.

Assessing the effect of external parameters on creativity is not an easy task, but this study can at least inspired the design of playful and surprising creativity spaces in similar settings, like architecture and engineering universities.

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