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LEVERAGING CREATIVITY OF DESIGN STUDENTS WITH A MAGIC-BASED INSPIRATION TOOL

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ABSTRACT
In this paper, we propose an unorthodox approach to enhancing creativity and user experience (UX) in product design with a "magic"-based tool. To support the introduction of magic in product interaction design, we created magic-based inspirational cards that show examples of magic effects. The tool was developed in two modalities, a "static" containing card that show illustrations of magic effects, and a "dynamic" containing the same cards plus videos of magic effects. The tools were experimentally tested with 30 novice designers who were asked to use the tools as a source of inspiration and to generate design ideas for a design task. The ideas generated by the participants were assessed in terms of creativity and intended UX. The findings show that the use of magic-based inspiration resulted in significantly more original but less feasible ideas, and that the use of videos led to design ideas that were significantly more "enjoyable" and more "exciting" than the use of cards only. Consequently, we propose guidelines on the use of magic-based inspiration tools for group ideation in order to help design students create original, enjoyable and exciting UX.

Keywords: Creativity, ideation, magic, inspiration, design tool, user experience

1 INTRODUCTION

Magical UX is defined as a combination of the emotions evoked by surprise, exciting, unnatural, and the unordinary [1] that are similar to those experienced by people seeing magic tricks. Magical UX is a way for designers to appeal to users. In numerous studies, however, the focus is mainly on the user side with prototypes having magical features being created and tested with people to define what is magical UX [1] [2] [3]. While Magical UX is a generally accepted and defined concept, there has been no attempt, to the extent of our knowledge, to provide a tool or guidelines for designing Magical UX.
In this context, our general objective is to support the designing of Magical UX by providing designers with magic-based inspirational materials. This paper reports on the creation of these materials—a decks of cards—and assesses their effectiveness in an experimental design session.

2 LITERATURE REVIEW

2.1 Tools for creativity education

Cards are the most popular type of design creativity tool because they allow for a tangible and approachable way to introduce sources of inspiration [4]. In reviewing over a hundred existing tools for creativity, we found that one-third are cards that contain random triggers to guide designers to various distant aspects or provide them with far-fetched analogies that will inspire novel ideas [5]. Another one-fifth of the existing tools contain more specific context-related triggers, two examples being PLEX (Playful Experience) and PEG (Positive Emotional Granularity) cards [6] [7], which support designing for pleasurable UX.

2.2 Effect of visual representation on design inspiration

Numerous studies have investigated inspiration in the idea generation phase of the design process by manipulating variables relating to the stimuli that are presented to designers and looking at the effect on the design outcomes [8]. It has been shown that designers' creativity is enhanced by visual stimuli [9] and textual stimuli [10], and combining the two has yielded greater results [11]. Also, providing unusual examples increases originality of ideas to a greater extent than familiar examples [12] [13].

3 HYPOTHESIS AND METHODOLOGY

3.1 Research question and hypothesis

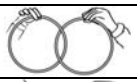
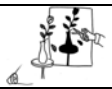
Our goal is to support designers' creativity in designing for Magical UX, through the creation of magic-based inspirational materials. Our first option to present magic effects as sketches and descriptions as they are shown to be effective for creativity. Our second option is to provide a direct magical experience for designers by showing them magic trick videos instead of requiring them to imagine the magical experience as magic does not occur in everyday lives and the sense of wonder from witnessing a magical event that is apparently impossible will cause a person to question reality if only for a split second [14]. This is supported by fMRI scans of the brain that show viewing magic trick videos stimulates a part of the brain called the dorso-lateral prefrontal cortex to a greater extent than surprising events or control videos [15].

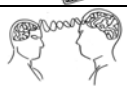
Our main hypothesis is that providing magic trick videos (magical experiences) will have a more positive impact on design outcomes than only static content since the tools not only support analogical thinking, but also stimulate a sense of wonder in the designers.

3.2 Selection and preparation of magic-based external stimuli

We aim at providing designers with a variety of magic effects. Through a review of literature about magic tricks we found there are, to the best of our knowledge, seven different taxonomies of magic effects created by professional magicians [16] [17] [18] [19] [20] [21] [22]. We compared the different taxonomies by the definitions of their magic effects, combined similar categories and removed categories which do not relate to magic tricks (e.g. hypnosis and gag shows). This resulted in 15 magic effects, explained by text descriptions and sketches (Table 1). For each magic effect, we also filmed 10 to 60 seconds of magic trick performances by the same magician (face not shown) in the laboratory in order to keep the video quality and content consistent.

Table 1. Description of 15 selected magic effects

Sketch	Title and Description	Video content
	Production Something appears out of nowhere or multiplies by itself.	A bottle of wine produced from an empty paper bag.
	Vanishing Something disappears.	A coin placed in a hand vanishes.
	Transposition An object suddenly changes location.	Four coins hidden under four playing cards disappear and reappear under one card.
	Transformation Changes of colour, size, shape, etc.	A 7 of clubs' card transforms into two 3½ clubs cards.
	Penetration A solid object penetrates another solid object.	Two metal rings penetrated each other.
	Restoration An object is destroyed and then restored back to original condition.	A corner is torn from a card and then restored.
	Animation An inanimate object moves by itself.	A deck of cards cut themselves into half and a selected card moves itself out of the deck.
	Anti-Gravity Something reacts contrary to the law of gravity.	A ring floats in mid-air.
	Invulnerability Resistance or proof against injury.	A coin placed inside a piece of silk is pierced by two needles. Later the coin is revealed to be undamaged.
	Physical Anomaly Phenomenon contradicts normal physical rules.	Four aces are slapped onto a table. Then the pips are revealed to be shattered.
	Sympathetic Reaction An object is influenced by and imitates another object.	A spectator and the magician both select the same card from two different shuffled decks.

	Identification Identification of something hidden or unknown.	A card is selected, and the identity of the card is revealed.
	Telepathy The ability to read minds or transmit information to another mind.	The magician reads a spectator's mind to reveal a randomly selected word in a book.
	Extra-Sensory Perception The ability to perceive information without using physical senses.	A spectator randomly selects a card, and then a piece of paper is turned over to show the selected card.
	Telekinesis The mind controls the movement or deformation of an object.	A pair of glasses placed on a table is moved without being touched.

Through this experiment, we aim to evaluate and compare the impact of the magic-based inspirational tools (sketches only and sketches and videos) that we have created on design outcomes.
"Sketch cards" bear a name, a description and a sketch of the magic effect (Table 1). "Video cards" consist of the same card with a video of associated magic tricks. The cards look the same as the static cards and contain a RFID tag that can be read through a Smartphone application developed for our purpose. After touching a card with the Smartphone, a video associated with the card (Table 1) will play automatically on the Smartphone. There is no audio.

3.3 Participants

30 Japanese subjects aged between 20-33 years (M=23.87, SD=3.22), 26 men / 4 women, joined the experiment. The participants were design/engineering students with various academic backgrounds. The experiment was approved by the Ethics Committee of [*authors' institution*].
In order to assign participants into the three groups of control, sketch cards, and video cards, participants were asked to complete an online 3-minute time restricted design task with the instruction, "Design a chair that responds to user's actions and provides an enjoyable experience". The groups were assigned according to their background, level of design experience, and creative ability.

3.4 Procedure

Individual 30-minute design sessions were conducted in a laboratory. First, the participants were asked to study the content of the cards for 5 minutes (sketch group), or 10 minutes (video group), or skipped in case of the control group. Then, the participants were asked to generate as many ideas as possible in 20 minutes for the following design task: "Design a mug cup that responds to a user's actions and provides an enjoyable experience". They were instructed to put down each idea on separate pieces of paper. After 20 minutes, they were asked to select one idea. Finally, the participants, except for those in the control group, were asked to write their comments about their perceptions of their experience with the cards during ideation.

3.5 Evaluation and analysis

3.5.1 Design creativity evaluations

Design creativity was evaluated based on criteria commonly used in creativity studies: fluency (number of ideas), flexibility (number of categories of ideas), originality and feasibility [10]. For originality and feasibility evaluation, only the 30 best ideas selected by participants were evaluated by two independent judges (one is the first author) using the criteria in Table 2. The order of evaluation was random, and the experimental groups were hidden. Inter-rater agreement (quadratic weighted Cohen's Kappa) was .775 (originality) and .904 (feasibility).

Table 2. Originality and feasibility evaluation criteria

Originality		***Feasibility***	
Points	***Definition***	***Points***	***Definition***
1	Cup that already exists	1	Violates the laws of physics
2	Direct mapping from another existing product	2	Further technology research needed
3	Combination of existing products	3	Technology exists but needs development
4	Combination of existing products with new elaborated purposes	4	Possible to manufacture but cost is too high
5	Completely new	5	Possible to manufacture and sell

3.5.2 Intended UX evaluations

Enjoyable, Inviting (attractive), Exciting and Valuable were selected as the UX criteria based on attractiveness and stimulation attributes extracted from Rauschenberger [23], with an addition of Wonder UX. 30 selected ideas from each participant were evaluated by eight design engineering students aged 21-25 (M=23.63, SD=1.60, 5 men 3 women). They did not know about the experiment.

4 RESULTS

4.1 Creative ability assessment for grouping participants

One-way analysis of variance between groups confirmed that participants in the three groups exhibited no significant differences in their baseline creative abilities (fluidity p = .113, flexibility p = .507, originality p = .804, feasibility p = .199).

4.2 Effect on design creativity

A total of 207 ideas were collected (cf. Figure 1).

Figure 1. Examples of collected ideas

One-way analysis of variance between groups showed no significant difference in Fluency and Flexibility. There was a statistically significant difference in Originality: F (2, 27) = 3.88, p = .033 with large effect size (eta squared = .22). Post-hoc comparisons (Tukey HSD) indicated that originality from both the sketch and video groups was significantly higher than the control group. For Feasibility, there was a statistically significant difference: F (2, 19.16) = 1.85, p = .001. Post-hoc tests indicated that Feasibility for the control group was significantly higher than both the sketch and video groups.

Table 3. Creativity evaluation results

	Control (N=10)		Sketch (N=10)		Video (N=10)		
	M	*SD*	*M*	*SD*	*M*	*SD*	Sig.
Fluency	8.10	3.07	5.90	1.79	6.70	1.77	.120
Flexibility	5.90	1.52	4.70	1.42	5.80	1.48	.149
Originality	1.85	0.58	2.65	0.97	2.80	0.86	.033*
Feasibility	4.90	0.32	3.70	1.11	2.95	1.21	.001*

4.3 Effect on the intended UX of the design outcomes

One-way analysis of variance between groups showed no significant difference in Wonder, Inviting, and Valuable UX, while there was a significant difference at the p<.10 level in Enjoyable: F (2, 27) = 2.73, p = .083 (eta squared = .17) and Exciting, F (2, 27) = 3.07, p = .063 (eta squared = .19). The effect size was large. Post-hoc tests indicated that the video group was significantly higher than the sketch group for both Enjoyable and Exciting UX evaluations.

Table 4. Intended UX evaluation results

	Control (N=10)		Sketch (N=10)		Video (N=10)		
	M	SD	M	SD	M	SD	Sig.
Wonder	2.66	0.48	2.84	0.99	3.30	0.74	.181
Enjoyable	3.16	0.44	2.98	0.55	3.51	0.57	.083*
Exciting	3.02	0.38	2.73	0.57	3.26	0.49	.063*
Inviting	2.96	0.57	2.68	0.58	3.14	0.39	.152
Valuable	2.86	0.47	2.94	0.86	3.30	0.54	.287

4.4 Designers' perception of the inspiration tools

Comments were collected from the participants in the sketch and video groups. 15 participants (75%) commented that the cards were useful for idea generation (8: sketch, 7: video). Around half of participants added that they found the cards inspirational for unexpected ideas that would not usually occur or might be difficult to come up with. On the other hand, 7 participants (35%: 3: sketch, 4: video) were concerned that the cards might have limited their ideas. 15 participants (75%) said they would like to use the magic framework in their future projects (9: sketch, 6: video). 3 participants from the video group commented that the videos were not necessary and that just the cards were enough.

5 DISCUSSION

5.1 Impact of magic-based inspiration on ideation

While the exposure to the magic contents did not significantly impact the number or the diversity of generated ideas, it helped to lead to more original ideas. Analogical thinking has a significant impact on ideations, and analogies made between the most distant domains are usually the most creative analogies [24]. The participants were invited to map magical effects into their ideas and thus to explore an unusual ideation space. We also found that the exposure to magic-based stimuli led to ideas that were relatively less feasible; in many cases, the mapping of a magic effect into an idea was straightforward, with little consideration for feasibility. Also, our results showed that the video cards were better than the sketch cards in terms of intended enjoyable and exciting UX. Comments by the participants suggested that their own direct response to magical experiences motivated them to design enjoyable and exciting products. This was more than just direct mapping of magic effects to the design, even though they might not be aware of that.

Lastly, one-third of the participants felt that their ideas were restricted to magic. This is expected since the purpose of the tools was to force analogical thinking between the design problem and magic effects. We did not allow them any time to think about the design task without being exposed to magic effects since we had to control the variables in the experiment. For the application of the magic-based tools to real-world problems, we expect the tools to be used in group ideation with additional time to think without being exposed to the cards. An instruction guideline for group ideation will be discussed in the next section.

5.2 Implications for design education

We propose an instruction guideline for using magic-based inspiration tools in group ideation as follows. Before using the cards, the group should discuss the design problem freely within a period of about 10 minutes. Then each person should randomly take an equal number of cards from the deck until there are no cards left. Next, they should individually study the content of each card (reading the text, watching the videos), and select one card. One member then initiates discussion with the other members of the group on ideas based on their selected card. All the ideas should be written down so that they can be recalled for ideation later. This procedure is followed with each member of the group. After the first round, the discussion continues with their second selections. This is repeated until all 15 cards have been discussed. The next step is to eliminate the cards that seem inapplicable to their design problem. Once only a few magic effects remain, the group should start thinking about possible combinations of the ideas from multiple cards. After this stage, they can enter into free group discussion and ideation.

Figure 2. Group ideation workshop with the magic-based cards

This guideline is inspired by the use of similar card-based tools [6] [7]. The differences are the free discussion without the cards at the beginning, which has been introduced based on the comments from the participants in our experiment, and the requirement that all the cards are discussed in an order that will allow designers some choice over which magic effect they think can be most closely related to the design task. This gives the designers a chance to use analogical thinking to link each magic effect to the design task, from the most related effect (easy card) to the least related effect (hard card).

6 CONCLUSION

We compared the effects of providing magic-based inspiration using only sketches and using both sketches and magic trick videos. Our main finding shows that both versions of the tools led to more original ideas. Specifically, when exposed to videos, ideas were rated as more enjoyable and more exciting than when exposed to only sketches. We hope that the 'magic' perspective we propose will be helpful in design and engineering education and in addressing real-product design problems.

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