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The Effects of Criticism on Creative Ideation

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Abstract

In a typical brainstorming method, criticism must be withheld for creative ideation. We envisage a web-based system that is designed to avoid possible negative influences of, and make good use of, critical thinking to generate creative ideas. To investigate its plausibility, we developed a system in which people participate collectively in a sequence of processes including generating, criticizing, modifying, and evaluating creative ideas. Here we report the results from conducting an experiment with 238 participants to compare the critical thinking (CT) design with a criticizing phase against the brainstorming (BS) design without it. The main finding was that the CT design resulted in the generation of higher quality ideas than the BS design without sacrificing fluency with respect to response time and the number of characters.

Keywords: critical thinking; creativity; idea generation; computer-mediated communication (CMC).

Introduction

Creative thinking has been sometimes contrasted to critical thinking. The former is expansive, innovative, and unconstrained, while the latter is focused, logical, and constrained.

Osborn (1953), who proposed the famous rules of brainstorming to generate creative ideas, included the rule to prohibit making critical comments during a brainstorming session. As for the reason why he adopted this rule, he mentions, "*if you try to criticize and create at the same time, you can't turn on either cold enough criticism or hot enough ideas.*" That is, the two processes interfere with each other.

On the other hand, some approaches to creativity consider critical thinking as playing an important role in creativity (De Bono, 1985; Runco & Chand, 1995; Treffinger, 1995). For example, De Bono (1985)'s *Six Thinking Hat* includes both *Green Hat* for creative thinking and *Black Hat* for critical thinking. Similarly, Isaksen, Dorval, & Treffinger (2011) emphasize the use of both creative and critical thinking to solve a problem.

These previous studies imply both negative and positive influences of critical thinking on creativity. On the one hand,

critical thinking can negatively influence performance because it interferes with creative thinking and it facilitates negative evaluation, which can cause productivity loss (Diehl & Stroebe, 1987). On the other hand, critical thinking can positively influence output because it involves analysis and evaluation processes. However, little is known about how to make good use of critical thinking while avoiding its negative influences.

The work reported in the current paper examined how critical thinking influences creative ideation in an environment designed to curb its negative influences. To avoid the negative influences of and capitalize on critical thinking, we developed a web-based system for creative ideation with two main features: crowdsourcing and anonymity.

Crowdsourcing is a coined word, which combines "crowd" and "outsourcing" (Howe, 2006). It is a mechanism where a large number of people collectively collaborate through information communication technologies. Since crowdsourcing makes people take a small part of task to accomplish a large task collectively, each individual does not have to think both creatively and critically. Thus, the interference problem, which Osborn worried about, would not occur. In a crowdsourcing environment, some people carry out critical thinking, while other people carry out creative thinking. In this way, we can avoid the negative influence he suggested.

In addition, crowdsourcing is expected to increase the chance to have diverse participants. Diversity is an important factor for creative ideation (Fleming, 2004; Nijstad, Stroebe, & Lodewijkx, 2002). Crowdsourcing has been applied as a tool to collect creative ideas (Kittur et al., 2013; Sakamoto & Bao, 2011).

The other feature we adopted is anonymity. In a typical brainstorming procedure, participants are instructed not to hesitate to generate unusual ideas and any ideas are welcomed (Osborn, 1953). However, past studies showed that some participants experienced the fear of negative evaluation from other group members (Camacho & Paulus, 1995; Collaros & Anderson, 1969; Shepperd, 1993). This is

called evaluation apprehension. For example, Collaros & Anderson (1969) demonstrated that perceived expertise of other members discouraged participants from generating ideas.

One solution to mitigate the negative effect of evaluation apprehension is to adopt anonymity. An anonymous environment can reduce the threat of being negatively evaluated by others (Michinov & Primois, 2005) and lead to a greater ease in sharing one's opinion and critical feedback, relative to an non-anonymous environment (Jessup, Connolly, & Galegher, 1990).

Considering crowdsourcing and anonymity, we conducted a pilot experiment in a laboratory using an offline computer and some designed excel spreadsheets as a substitute tool of a system (Tanaka, Sakamoto, & Kusumi, 2011). The results showed that the design in which critical thinking and creative thinking were carried out collectively with anonymity had a potential for creative ideation.

However, this study was conducted in a laboratory setting with a limited sample of students from a university. The task assignment process was not automated by computers but instead was manual by the experimenter, inconsistently with the spirit of crowdsourcing. In addition, there was a problem with the reliability of the evaluation method that required participants to evaluate a large number of ideas, which also went against the norm of crowdsourcing.

To overcome these problems, we developed a web-based system, in which people generated creative ideas and criticized them collectively with anonymity. We also changed the load of the evaluation task to be smaller than in the pilot study, keeping in line with typical crowdsourcing. We also measured the response time each participant spent on producing an output as an indication of the fluency of creative ideation.

In the current study, we used this system to examine how critical thinking might influence creative ideation. The hypothesis of this study is that critical thinking does not give negative effects on creative ideation in an environment that adopts crowdsourcing and anonymity. We measure the effects of critical thinking in terms of the fluency of creative ideation, defined by response time and the number of characters, and the quality of idea, defined by novelty and practicality.

Method

Participants

In total, 238 people (141 men, 97 women) participated in this experiment through the Internet from different locations across Japan, with the mean age of 23.7 (SD = 6.94). Each participant received a gift card in the amount of 500 Japanese yen (about five USD).

System design

Based on the design of the pilot study that was conducted in a laboratory (Tanaka et al., 2011), we developed a web-based system called CONSIDER: Crowdsourced ONline

System for IDEa Radiation. It consists of four different subtasks; idea generation, critical thinking, idea improvement, and idea evaluation. Through all the phases, the system considers creative solutions for an ill-defined social problem. As an example, in this experiment, the following social problem was considered: *"There is diverse information on the Internet, including wrong information, deceptive information, and information that has no evidence. What can we do to avoid or reduce the negative influences of misinformation on Internet users?"*

All participants tried to complete their own task referring to this social problem. This problem was always shown in text on computer screen. Each participant was assigned to one of the following crowds (phases).

Crowd 1 (Idea generation)
Crowd 1 took part in a phase to collect original seed ideas. For each idea, a participant filled in the following three blanks; *"One way to avoid or reduce the negative influences of misinformation on Internet users is to [blank 1]. An example is to [blank 2]. The advantage of this is that [blank 3]"*. Each participant was asked to generate three different ideas. In total, 21 people participated in Crowd 1, resulting in 63 seed ideas.

Crowd 2 (Critical thinking)
Crowd 2 participated in a phase to point out problem of idea logically. Each participant was shown three different ideas generated in Crowd 1, one by one, and asked to criticize each idea by filling the following blank; *"The problem of this idea is that [blank]. Therefore, it is difficult to avoid or reduce the negative influences of misinformation"*. It was important for this structure to emphasize, first, that participants were not urged to criticize the person who generated this idea, but to point out problem of the idea itself. Second, participants were supposed to do so logically because the blank was followed by "therefore". This structure was designed with the aim that participants refrain from unessential criticisms such as nitpicking.

Crowd 3 (Idea improvement)
Crowd 3 completed a phase to modify and improve the original seed ideas of Crowd 1 with the help of critical thinking of Crowd 2. In this phase, each seed idea was paired with its corresponding criticism. Three pairs of these two ideas were shown, one at a time, to participants in this phase. Each participant was asked to generate a new idea from each pair by filling the identical blanks to those of Crowd 1 and to repeat the same procedure three times with three different pairs.

Crowd 4 (Idea evaluation)
One of the main differences of this system from the design in the previous laboratory study (Tanaka et al., 2011) is the evaluation phase. The previous study asked participants to evaluate 179 ideas. This design likely made participants tired, and, consequently, made the evaluation less reliable. In the new system, as people take part in this phase through the Internet from their convenient location at their convenient time, unlike in a laboratory experiment, participants could easily discontinue their task. With this

risk in mind, we reduced the number of ideas to give each participant from 179 in the previous study to 15.

Fifteen ideas were randomly selected from all the ideas generated in Crowd 3, and shown to each participant one by one. Each idea was evaluated in terms of novelty and practicality by using 7-point scales ranging from 1 (Not at all) to 7 (Highly). Novelty and practicality are common measures for evaluating creativity (Gallupe & Dennis, 1992; Sternberg, 2006; Thagard & Stewart, 2011; Ward, 2004).

To avoid the effect of individual differences in evaluation tendency, and to make the evaluation values given by different participants comparable, we used the following idea as a reference for the evaluation: *"Educate students so that they develop an awareness that wrong information, deceptive information, and information that does not based on the fact exist on the Internet, the ability to check the truth of such information, and the skill to judge and criticize whether the information is useful for solving the problem at hand."* Participants were instructed to evaluate each idea supposing that this reference idea was moderately novel and practical: the ratings of 4 for both novelty and practicality.

System requirements

The system was written in PHP and required every participant to join through the Internet, ideally from a laptop or a desktop computer instead of a mobile phone. The system has been tested in Internet Explorer 10, FireFox, and Chrome on Windows and Mac OS.

Experiment

To examine the effect of the system design that included the critical thinking crowd for creative ideation (CT design), we included a control design into the experiment. The control design did not include the critical thinking crowds in Crowd 2. Instead, the task of Crowd 2 was replaced by idea generation task, which was identical to Crowd 1. Further, the task of Crowd 3 was to combine two randomly selected ideas from Crowd 1 and 2. Since this task followed the procedure of brainstorming, which recommends combining several ideas into another idea (Osborn, 1953), we called this the BS design. The CT design and the BS design share Crowd 1 and Crowd 4. That is, both designs started from the same seed ideas generated in Crowd 1, and ended with evaluation by the same participants in Crowd 4. Figure 1 summarizes the experimental design. In Crowd 4, all the ideas generated in Crowd 3 from both designs were mixed and randomly shown to the participants so that they evaluated each idea without knowing in which design the idea was generated.

The dependent measures were two dimensions of creativity: the fluency of ideation and the quality of idea. Fluency is the productivity with respect to ideas. It is often measured by counting the number of ideas in the previous studies (Almeida, Prieto, Ferrando, Oliveira, & Ferrándiz, 2008). However, since the number of ideas that each participant was asked to generate was fixed at three, we used, instead, response time and the number of characters to measure fluency in the current study. We assumed that the fluency of ideation was high when an idea was generated in a short period of time or in a large number of characters. For quality, we used novelty and practicality values that were evaluated by Crowd 4 as mentioned previously.

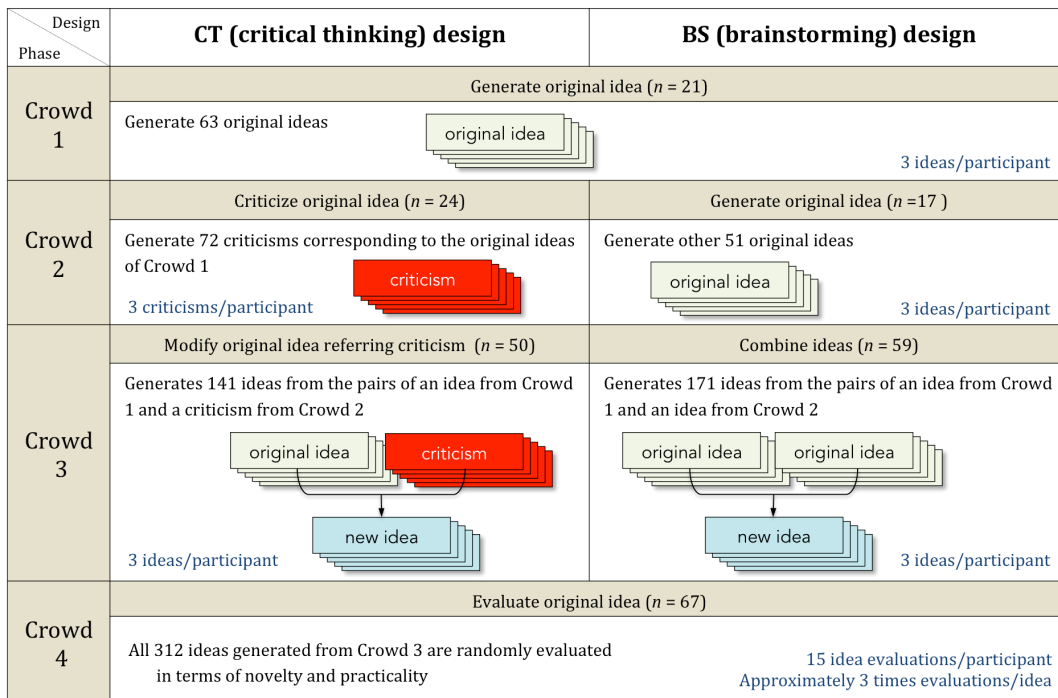| Design \ Phase	CT (critical thinking) design		BS (brainstorming) design
Crowd 1	Generate original idea (*n* = 21)		
	Generate 63 original ideas original idea 3 ideas/participant		
Crowd 2	Criticize original idea (*n* = 24)		Generate original idea (*n* =17)
	Generate 72 criticisms corresponding to the original ideas of Crowd 1 criticism 3 criticisms/participant		Generate other 51 original ideas original idea 3 ideas/participant
Crowd 3	Modify original idea referring criticism (*n* = 50)		Combine ideas (*n* = 59)
	Generates 141 ideas from the pairs of an idea from Crowd 1 and a criticism from Crowd 2 original idea criticism new idea 3 ideas/participant		Generates 171 ideas from the pairs of an idea from Crowd 1 and an idea from Crowd 2 original idea original idea new idea 3 ideas/participant
Crowd 4	Evaluate original idea (*n* = 67)		
	All 312 ideas generated from Crowd 3 are randomly evaluated in terms of novelty and practicality		15 idea evaluations/participant Approximately 3 times evaluations/idea

Figure 1. Experimental design

Participants were assigned to one of the four crowds in the order received their application, and then randomly assigned to one of the two designs. We instructed all participants to complete all the assigned tasks in 30 minutes. In addition, the participants whose tasks were to generate ideas were instructed to generate ideas that were as creative as possible and that creativity would be evaluated with respect to novelty and practicality.

Results

In Crowd 3, the CT design resulted in 141 ideas by 50 participants, and the BS design resulted in 171 ideas by 59 participants. The number of ideas differed because of the assignment of participants. In both designs, each participant was asked to generate three ideas, and, thus, the number of ideas does not reflect fluency.

Considering the procedure in which participants were asked to generate three ideas in 30 minutes, we excluded an idea from analysis when its response time was over 30 minutes. We also excluded an idea whose response time was less than one minute. After removal, 138 ideas in the CT design and 159 ideas in the BS design remained for further analyses.

Fluency of ideation

We measured the fluency of ideation in terms of response time and the number of characters, and examined the differences between the CT design and the BS design. Response time was calculated by taking the difference in the timestamps recorded by the system when participant was shown a task to generate an idea and he/she submitted the idea. In the case that a participant once submitted an idea, came back later, and modified the idea, we used total response time.

As an overall tendency, participants spent 9.21 (SD = 5.65) minutes to generate an idea. It was a reasonable duration for completing the task to generate three ideas in the given time limitation of 30 minutes. To examine the difference between the two designs, we conducted a one-way analysis of variance (ANOVA) on response time. The result showed no significant difference between the two designs (Table 1).

To measure fluency, we also counted the number of characters per idea in Japanese. The average number of characters per idea was 174 (SD = 80.42). The result of a one-way ANOVA showed no significant difference between the two designs (Table 1).

Quality of idea

To examine the difference in the quality of idea generated in Crowd 3 between the CT design and BS design, we calculated novelty and practicality for each idea based on the evaluation values in Crowd 4. As each idea was evaluated by three or four participants, we used the average rating as a representative value. Each idea had two quality scores, novelty and practicality. We used these scores as dependent measures to examine the difference in the quality of idea between the CT design and BS design. Table 1 shows the means and standard deviations for novelty and practicality as well as the response time and the number of characters in each design.

We conducted a one-way ANOVA on novelty and practicality. As for novelty, the result showed no significant difference between the two designs. On the other hand, a one-way ANOVA on practicality, $F(1, 312) = 7.47$, $p < .01$, $\eta^2 = .02$, demonstrated statistically significant difference between the two groups. The practicality of ideas generated in the CT design ($M = 4.39$, $SD = 0.92$) was higher than that of the BS design ($M = 4.04$, $SD = 1.23$).

Discussion

The current study investigated whether or not criticism interferes with creative ideation. We compared two designs; the CT design, in which the seed ideas were criticized and then a separate set of participants used the criticisms to improve the seed ideas, allowing participants to be free from the risk of being directly criticized, against the BS design, which did not include the criticism phase. We measured fluency of ideation and the quality of idea as dependent variables. We expected that if criticism disturbed creative ideation, both the fluency of ideation and the quality of ideas would be lower in the CT design than the BS design.

Table 1 Means, standard deviations, and ranges for the quality of idea, response time, and the number of characters

	CT design (n =138[a])			BS design (n = 159[a])				
	M	SD	Range	M	SD	Range	F	p
Fluency								
- Response time (min)	8.75	5.56	1.90-27.65	9.60	5.62	1.23-28.13	1.65	.200
- Number of characters [b]	165.63	79.49	44-456	181.26	80.77	46-545	2.81	.095
Quality of idea								
- Novelty	3.97	0.95	1.67-6.00	4.08	1.14	1.67-6.67	0.87	.353
- Practicality	4.39	0.92	2.00-7.00	4.04	1.23	1.33-7.00	7.47	.007**

Note. ** $p < .01$. a) n = the number of ideas generated in Crowd 3. b) Number of characters was counted in Japanese.

On the other hand, if criticism did not disturb creative ideation, we would find no statistical differences or an opposite pattern of differences between the two designs.

First, we examined the differences in the fluency of ideation. The results did not show any significant differences in neither response time nor the number of characters between the two designs. That is, the criticism phase did not make creative ideation process takes longer or the length of each idea shorter. Consequently, the results showed that criticism had no negative influence on the fluency of creative ideation.

Next, we examined the differences in the quality of idea generated through the two designs. The result showed no significant difference in novelty. This result implies that including criticism phase into creative ideation process does not have a negative influence on the novelty of ideas.

These results may seem contradictory to the Osborn's rule for brainstorming that asks for participants to withhold criticism during sessions (Osborn, 1953). However, in the current system, a single individual did not criticize and create at the same time. These two tasks were completed by separate crowds. Thus, the rule for refraining from criticism did not apply to our system.

Considering the number of original seed ideas, the novelty of ideas in the BS design should be higher because the ideas of crowd 3 in the BS design originated from the ideas generated from Crowd 1 and Crowd 2. That is, the BS design had about twice as many seed ideas than the CT design. Thus, the chance of having novel ideas should be higher in the BS design than the CT design. In this sense, it was unexpected that the CT design, with fewer ideas generated, and resulted in ideas that were as novel as the BS design. Accordingly, if the procedure is well designed for people to think critically and creatively separately, criticism could generate ideas as novel as brainstorming.

Our most noteworthy finding was that more practical ideas were generated in the CT design, not in the BS design. Considering that psychological models of creativity, which assume that the process of finding problems plays an important role in problems solving (Runco & Chand, 1995; Treffinger, 1995; Treffinger, Selby, & Isaksen, 2008), it makes sense why the CT design contributed to producing highly practical ideas. It included the phase, which concentrated on finding and pointing out the problems of generated ideas, while the BS design did not have such a phase. Each participant in Crowd 3 in the CT design was given a seed idea and a corresponding criticism, and asked to produce a new creative idea from them. Naturally, it would be difficult for the participant to ignore the problem that the criticism pointed out, and, thus, he/she was drove to consider how to overcome the problem. This overcoming process presumably made the ideas of Crowd 3 in the CT design more practical.

It is also important to emphasize that the participants in the CT design did not have to worry about being criticized by others; the participants who generated seed ideas completed their task when they submitted their ideas, they did not see their ideas being criticized. Instead, the CT design makes good use of the essence of criticism. Consequently, the presence of the critical crowd resulted in higher quality ideas at least with respect to practicality.

Limitation and future step

The current study is not the one that examines the difference between an electronic method and a face-to-face method. According to previous studies in brainstorming, where some showed that the former would be better (Michinov & Primois, 2005; Michinov, 2012), others cast doubt upon the superiority of electronic brainstorming (Pinsonneault, Barki, Gallupe, & Hoppen, 1999). Thus, it is unclear whether or not the proposed CT design of CONSIDER works better than a face-to-face brainstorming. One possible next step is to compare the outputs between the current system and face-to-face brainstorming.

Concluding remarks

Worried about thinking critically and creatively at the same time, the founder of brainstorming adopted the rule that criticism must be withheld during a brainstorming session (Osborn, 1953). However, more than a half-century later, advances in technologies now allow us to join creative ideation process collectively through a web-based system. Relying on such a system, we proposed a critical thinking design, in which some people take creative part and others take critical part. The results showed that this design resulted in more practical ideas than a brainstorming design, which was in line with Osborn's brainstorming rules. We conclude that, in a well-designed environment, it is promising to capitalize on the critical thinking of crowds for creative ideation.

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