Providing Timely Examples Improves the Quantity and Quality of Generated Ideas

Submission # 1877

ABSTRACT

Emerging online ideation platforms with thousands of example ideas can provide an important resource for creative production. But how best to leverage these examples to support other ideators? Recent work has demonstrated that not just the choice of examples, but also the timing of their delivery can impact creative outcomes. According to a theory of idea generation called SIAM, people are particularly likely to benefit from examples when they ran out of ideas. We explore two mechanisms that leverage this insight: 1) a system automatically infers—from their behavior—when people run out of ideas and provides examples at that moment and 2) a system that provides examples when a user explicitly requests them. We conducted an experiment to explore these two example delivery mechanisms and compared against two baselines: providing no examples and showing examples at a regular interval. Our results show that people who decided when to request examples themselves generated the most novel ideas and while people who were provided ideas automatically when they appeared to be stuck produced the most ideas. These results can inform the design of future ideation support systems that aim to help people generate a lot of high quality ideas.

Author Keywords

creativity, ideation

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Idea platforms—such as Quirky.com, Innocentive.com, 99designs.com—with thousands of example ideas can provide an important resource for creative production [1]. Ideas generated by others can help innovators spur new concepts, by broadening their notion of the design space [4, 7, 14] and allowing for reinterpretation and recombination of ideas [4, 16, 9]. When viewing ideas for inspiration, innovators should pay attention to how to select examples [7, 15, 6, 14], how to judge their quality [4], and how to view them for maximum benefit. Kulkarni et al. examined the question of *when* to deliver examples, and concluded that early or repeated—rather than late—exposure to examples improves the creativity of generated ideas [5].

Building on this finding, this paper explores different delivery mechanisms for exposing example ideas. Kulkarni et al. delivered examples at a fixed regular interval, however this may not be optimal in the context of an ideation system that provides examples from a corpus with a lot of available examples. According to a theory of idea generation called SIAM and the subsequent empirical results, ideas generated by others can have both positive effects (cognitive stimulation) and negative effects (cognitive interference) based on when an example is shown [11, 10]. On the one hand, seeing ideas of others generally helps activate ideas that would not have been accessible otherwise. On the other hand, ill-timed examples can prematurely terminate a person's train of thought causing a loss of potentially creative ideas that usually come later in the session [11, 12]. According to these findings, we would expect that examples should benefit idea generation when people run out of ideas. At that point, ideas of others can act as external stimuli and steer the retrieval of mental images away from the current set.

One solution to identifying the right example timing might be a machine-driven approach that automatically infers when people run out of ideas and presents examples at that time. There are different possible approaches for detecting when a person is stuck in a mental rut. One possible approach is to leverage a user's activities to infer whether he or she is stuck. Previous work has shown that it is possible to predict cognitive outcomes from event logs [2]. Another approach is to look at users' submitted ideas. The system might infer that a user needs examples if it detects that the user has submitted several similar ideas in a row. However, such an approach would require a system that can dynamically reason about the semantics of ideas — a daunting task for a computer especially if ideas are not in text format. In this paper, we chose to study a simple time-based mechanism that infers that a user is stuck if he or she remains inactive for a fixed time period.

A more straightforward solution is a user-driven approach that presents people with examples when they explicitly request them. This approach guarantees that the examples will be provided when people are receptive to new ideas [3]. It also does not require any work from the system. However, people might not realize that they are stuck or might take sometime before the realization.

To study these different delivery mechanisms, we implemented an ideation support system to compare two approaches: a machine-driven approach that automatically delivers examples when users are stuck and a user-driven ap-

proach that lets users determine when to see examples. To automatically detect when people were stuck, we used a simple time out mechanism: when no activity was detected in the interface for 30 seconds, the system automatically provided a new set of examples of ideas generated by others.

In a between-subjects experiment, we compare these two approaches to each other and to two baselines: a condition where no examples were provided and a condition where the examples were provided at a regular interval (replicating Kulkarni et al. [5]). The latter baseline condition lets us distinguish between the effect of access to examples and the effect of timing of the delivery of examples.

Our results show that people who received examples on demand produced ideas that were deemed significantly more novel by evaluators compared to people who did not receive any examples and to people who received examples automatically when the system thought that they were stuck. While people who received examples at a regular interval did not produce less novel ideas than people who received examples on demand, they ended up producing fewer ideas. Meanwhile, participants who received examples automatically whenever they were idle produced a larger quantity of ideas than participants in other conditions.

These results confirm that the example timing can influence the creative output. From a system designer's perspective, our results suggest that, instead of giving people examples in an ad hoc way, the examples should be presented at the right moment when the user is ready to make use of those examples. We learned that a simple machine-driven mechanism can help boost people productivity without sacrificing the creativity of ideas. On the other hand, while the user-driven mechanism does not share the same benefit of productivity gain, it can help improve the creativity of generated ideas.

EXPERIMENT

Task and Procedure

Each participant did two idea generation tasks. In the first task, they had 3 minutes to generate ideas for alternative uses for rubber bands. In the second task, they had 15 minutes to generate product ideas for an imaginary technology—a touch-sensitive "fabric display" that could render high resolution images and videos on any fabric through a penny-sized connector. The alternative uses task was a warm-up task designed to familiarize participants with the system and with the example delivery mechanism (if any). We did not include the data from the first task in our analysis.

At the beginning of the experiment, each participant was randomly assigned to one of the four conditions:

- *None*: Participants saw no examples while generating ideas.
- *On-demand*: Participants could request a new set of three examples whenever they wanted until they saw all available examples.
- *On-idle*: Participants were automatically presented with a new set of three examples when they stopped typing for 30 seconds.
- *On-interval*: Participants saw a new set of three examples at the beginning of the task and on every fixed intervals afterward (1 minute for the alternative uses task and 3 minutes for the product ideas task).

There were 9 examples available for the alternative uses task and 15 examples for the product ideas task. The examples were divided into sets of three. These examples were chosen from the ideas generated by earlier participants in a pilot study. We made sure that the ideas in each set of examples were of high quality and diverse, as example quality and diversity impact ideation performance [13, 8, 11, 15]. When new examples appeared, they were shown prominently at the top of the example grid until another set of examples came. Older examples were available throughout the idea generation session, but they were less prominent (Figure 1).

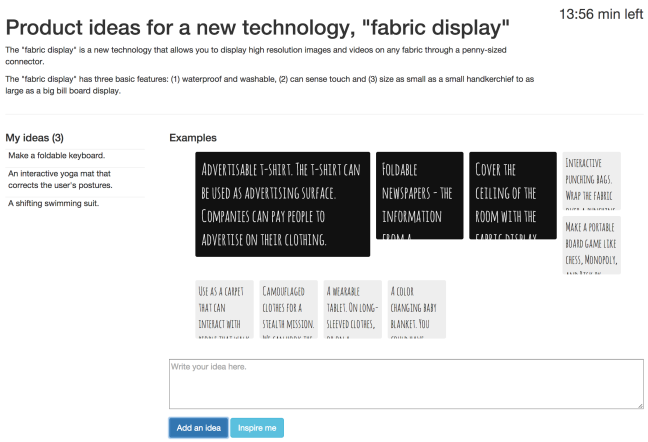

Figure 1. Participants typed their ideas in the text box. After they submitted an idea, it appeared on the pane on the left. For those in the *On-demand*, *On-idle* and *On-interval* condition, examples were shown in the example grid above the idea entry box. Latest examples were shown more prominently than others. The "Inspire me" button at the bottom was visible only to participants in the *On-demand* condition.

Before each idea generation session, all participants were informed about how and when they would have an access to a new set of examples.

Design And Analysis

We conducted a between subjects study with Timing of example delivery (*None*, *On-demand*, *On-idle* and *On-interval*) as the sole factor.

We collected two performance measures:

- *Number of generated ideas*
- *Creativity of ideas generated measured by novelty and value of generated ideas* as assessed by other MTurk workers. We randomly sampled 28 participants from the *On-idle* condition, 25 participants from the *On-interval* condition and included all participants from the *None* and the *On-demand* conditions. We asked MTurk workers to evaluate

the novelty and value of all 1,149 ideas generated by these participants. Each idea was evaluated by at least two workers.

Each evaluator rated randomly sampled 25–30 ideas. We normalized the score of each evaluator before taking the average for each idea. Then, we computed the average of the novelty and the value scores for each participant.

We also recorded the timestamps when ideas got submitted and when participants saw a new set of examples. Using these timestamps, we looked at how much time passed after the latest idea submission before participants requested new examples.

Participants

We recruited 120 MTurk workers to do the idea generation tasks. Three participants did not complete the experiment and were excluded from our analysis.

There were 25 participants in the *None* condition, 26 participants in the *On-demand* condition, 31 participants in the *On-idle* condition and 35 participants in the *On-interval* condition.

All participants and evaluators we recruited were limited to workers who reside in the U.S. who had completed at least 1,000 HITs with greater than 95% approval rate. Participants were paid $2.50 for their participation.

Adjustments of Data

In our analysis on performance measures, we only included the participants in the *On-demand* condition who requested examples more than once to ensure that all included participants understood the example request features and made use of it.

RESULTS

Providing examples at idle time led to more ideas

We observed a significant main effect of timing of example delivery on the number of ideas generated by participants ($F(3,93)=2.87$, $p = 0.0405$). On Average, participants in the *On-idle* condition generated most ideas (M=13.6) followed by participants in the *None* condition (M=10.84), the *On-demand* condition (M=10.74) and the *On-interval* condition (M=8.80) (Figure 2).

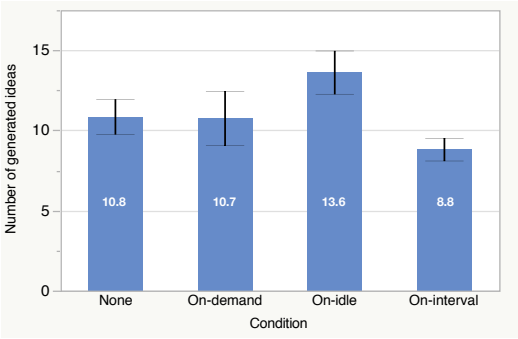

Figure 2. Participants in the *On-idle* condition generated significantly more ideas than participants in the *On-interval* condition.

On-demand example requests led to more novel ideas

We observed a significant main effect of timing of example delivery on the average novelty of ideas ($F(3,93)=4.89$, $p = 0.0034$). The pairwise Student's T comparisons show that participants in the *On-demand* condition (M=0.18) generated ideas that were deemed more novel than those in the *None* condition (M=-0.18) and those in the *On-idle* condition (M=-0.01). There was no difference between the *On-demand* condition and the *On-interval* condition (M=0.05) (Figure 3).

We did not observe any statistically significant difference across condition for the value scores of ideas ($F(3,93)=1.18$, n.s.).

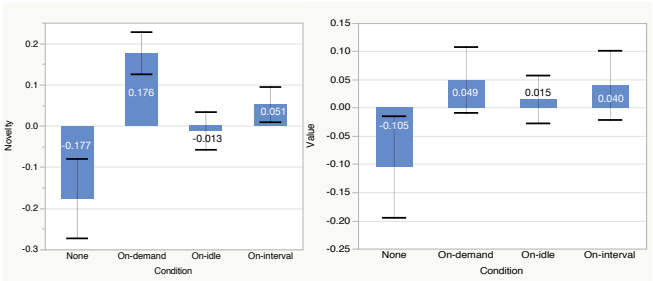

Figure 3. The mean novelty score for participants in the *On-demand* condition is significantly higher than for those in the *None* and *On-idle* condition. There is no statistically significant difference across conditions for the value scores.

Participant wait time before requesting a new example varies

By examining the timestamps of users' activities, we found that the means of waiting time before example request per participant range from 1s to 100.3s with the standard deviations range from 1.5s to 93.3s.

DISCUSSION

Our study provides further evidence that seeing examples generally helps with the creativity of generated ideas [5, 9, 15]. Participants who saw no examples produced significantly less novel ideas. More importantly, our results show that timing of example delivery and example delivery mechanism affect the creative output in idea generation. Letting participants access the examples on demand had the largest impact.

In terms of productivity, participants who were automatically presented with examples whenever they were idle produced the most ideas, while participants who received examples at regular intervals produced the fewest (even fewer than participants who saw no examples at all).

One might wonder why there were differences in the novelty of generated ideas between the *On-demand* and the *On-idle* conditions given that both interventions aimed to offer examples to people when they were stuck in a mental rut. One possible explanation is that when people requested ideas themselves, they were more prepared to accept new stimuli than when the system automatically provided them with examples.

Another possible explanation may be related to our specific mechanism for automatically inferring when the person was stuck. Delivering examples when a person is idle for 30 seconds might be too naive or we might not have picked the right threshold time to infer the stuck moment. The timing data from the On-demand condition indicate that the waiting time before example request varied substantially from one person to another. In order to understand how to predict when people are stuck from their activities, further studies need to be conducted and we leave that to future work.

Although participants in the *On-idle* condition produced slightly less creative ideas than participants who received examples on demand, they were the most productive. This result suggests that a mechanism that shows people examples automatically when they probably stuck can increase productivity with no loss in creativity of generated ideas. This productivity gain might be explained either by the fact that new examples were presented to them before they realized that they were stuck—allowing them to pursue a new train of thought sooner instead of wasting waiting for new ideas—or that the appearance of a new set of examples signaled to people that their performance was being monitored and thus nudged them to keep on working.

Our results also provide some evidence that poor timing of example delivery can harm productivity. Although participants in the *On-interval* condition generated ideas that were no less novel than those in the *On-demand* condition, they were the least productive (even less productive than people who saw no examples at all). While this effect might be caused by our choice of time interval, this result does demonstrate that it is possible to harm productivity with ill-timed example delivery. More in-depth examination of the effect of different length of fixed time interval would shed some light on how we can vary this variable to induce the desirable creative outcome.

CONCLUSION

Timing of example delivery during an ideation session can affect the creative output. A simple machine-driven mechanism that provided people with examples when they are idle can help boost productivity without sacrificing the creativity of ideas, while a user-driven mechanism where users receive examples on demand can help improve the novelty of generated ideas. In an ideal world, we want people to generate ideas both in high quantity and of high quality. A challenge for researchers and designers of future idea generation support system is finding the right balance between both approaches to help people do their best in generating creative ideas.

REFERENCES

1. Chan, J., Dow, S., and Schunn, C. Conceptual distance matters when building on others' ideas in crowd-collaborative innovation platforms. In *Proceedings of the Companion Publication of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*, CSCW Companion '14, ACM (New York, NY, USA, 2014), 141–144.
2. Fern, X., Komireddy, C., Grigoreanu, V., and Burnett, M. Mining problem-solving strategies from hci data. *ACM Transactions on Computer-Human Interaction (TOCHI) 17*, 1 (2010), 3.
3. Friedman, R. S., Fishbach, A., Förster, J., and Werth, L. Attentional priming effects on creativity. *Creativity Research Journal 15*, 2-3 (2003), 277–286.
4. Herring, S., Chang, C.-C., Krantzler, J., and Bailey, B. Getting inspired!: understanding how and why examples are used in creative design practice. *Proc. CHI '09* (2009).
5. Kulkarni, C., Dow, S. P., and Klemmer, S. R. Early and repeated exposure to examples improves creative work. In *Design Thinking Research*. Springer, 2014, 49–62.
6. Kumar, R., Satyanarayan, A., Torres, C., Lim, M., Ahmad, S., Klemmer, S. R., and Talton, J. O. Webzeitgeist: design mining the web. In *Proc. CHI '13*, (Apr. 2013).
7. Lee, B., Srivastava, S., Kumar, R., Brafman, R., and Klemmer, S. R. Designing with interactive example galleries. In *Proc. CHI '10*, (Apr. 2010).
8. Leggett Dugosh, K., and Paulus, P. B. Cognitive and social comparison processes in brainstorming. *Journal of Experimental Social Psychology 41*, 3 (May 2005), 313–320.
9. Marsh, R. L., Landau, J. D., and Hicks, J. L. How examples may (and may not) constrain creativity. *Memory & Cognition 24*, 5 (1996), 669–680.
10. Nijstad, B. A., and Stroebe, W. How the group affects the mind: A cognitive model of idea generation in groups. *Personality and Social Psychology ...* (2006).
11. Nijstad, B. A., Stroebe, W., and Lodewijkx, H. F. M. Cognitive stimulation and interference in groups: Exposure effects in an idea generation task. *Journal of Experimental Social Psychology 38*, 6 (2002), 535–544.
12. Parnes, S. Effects of extended effort in creative problem solving. *Journal of Educational psychology 52*, 3 (1961), 117–122.
13. Paulus, P. B., and Dzindolet, M. T. Social influence processes in group brainstorming. *Journal of Personality and Social Psychology 64*, 4 (1993), 575.
14. Ritchie, D., Kejriwal, A., and Klemmer, S. d. tour: style-based exploration of design example galleries. In *Proc. UIST'11* (2011).
15. Siangliulue, K. P., Arnold, K. C., Gajos, K. Z., and Dow, S. P. Toward collaborative ideation at scale—leveraging ideas from others to generate more creative and diverse ideas. In *Proc. CSCW'15* (2015). To appear.
16. Yu, L., and Nickerson, J. Cooks or cobblers?: crowd creativity through combination. *Proc. CHI '11* (2011).