Next Step in Electronic Brainstorming: Collaborative Creativity with the Web

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Abstract

Brainstorming is an essential technique in creative group work. Research literature indicates the strengths of electronic brainstorming over face-to-face work. Despite this evidence, the old practice dominates. We believe that this is due to the inadequate integration of new tools to existing practices and the tendency to focus on idea production alone. This paper explores how to augment traditional, collocated Brainstorming and make electronic brainstorming feasible and accessible with web-based technology. We introduce an electronic brainstorming application prototype and justify its design principles. Our system aimed at facilitating conceptual design and we present design insights from a pilot study with the prototype used by 27 design students. The paper argues that by structuring the generative group process with a low-cost tool, users can sprint through a creative process, from problem definition to defining a solution.

Keywords

Creativity, Brainstorming, creativity support tools

ACM Classification Keywords

H.5.3 Information interfaces and presentation (e.g.,HCI): Group and Organizational Interfaces.

General Terms

CSCW, Group support systems

Introduction

Little did Alex Osborn know when he coined Brainstorming as *a* group work technique, claiming it to double the productivity of a group [10]. Over fifty years later, brainstorming has become *the* creative team work verb. Simultaneously the Brainstorming method has inflated because only few enthusiasts [8] acknowledge the original Brainstorming rules and put effort into learning it even if would be beneficial [1]. For academics, the charm of Brainstorming has been difficult to capture. A line of studies in social sciences has repeatedly shown that group brainstorming loses in productivity to a group of matching number of people working independently. As the number of people around the table goes above three, the more people distract each other (block production), provide chances for free riding, and create pressure for social conformity [16]. Luckily, the awareness of these problems has inspired the development of creativity support tools in the category of *electronic brainstorming.* Studies [3, 4] have confirmed that these group support systems solve many of the identified issues and improve performance.
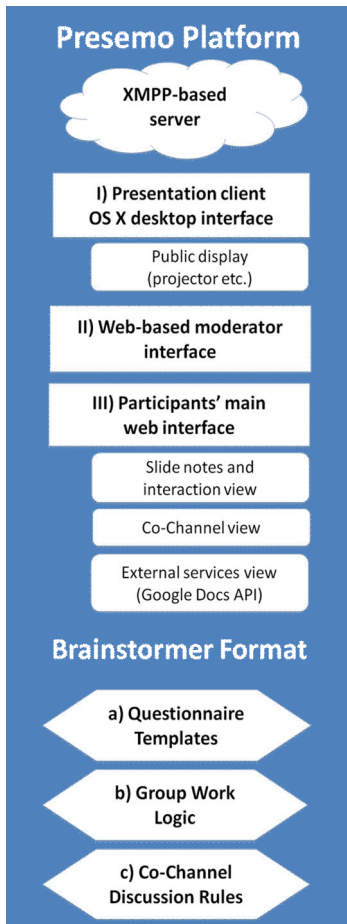
Here we document a novel electronic brainstorming prototype inspired by the needs of concept design. It bridges the properties of traditional and digitally mediated brainstorming in a way that makes it more feasible and useful than the previous systems. Presemo Brainstormer, as it is called, gives an example how to facilitate ideation process over a simple web-based interface. As a proof-of-concept we present results from a pilot study, a brainstorming workshop organized using the system. In the pilot, 27 people sprinted from design briefing to idea presentation with the help of the system. We gained numerous design insights and witnessed many exciting ideas from collocated ideation.

Background and Previous Work

Brainstorming is an important creative practice widely applied in creative enterprise. Brainstorming is best known for applications in conceptual design. For instance IDEO is famous for extensive utilization of Brainstorming in the front-end of their design process [17]. The belief is that the techniques, such as Brainstorming, which allow quick exploration of numerous alternatives, help to discover the right solutions more quickly [18]. This motivates the development and study of Brainstorming support tools, prominently electronic brainstorming (EBS henceforth). Among group-support systems and augmented reality applications, there are a lot of applications that can be appropriated for EBS. The implementations include single and multiple display versions and variable interaction modes. Some systems allow sharing of sketches and other visual items; such as digital whiteboards, digital pens and shared desktops. They support informal EBS but are not particularly designed for it (see [7, 14]).

Previous EBS-specific systems are mostly non-commercial and have been developed by academics. We distinguish   two flavors: commonly participants contribute simultaneously but interaction is modulated or ideation happens asynchronously over an extended period of time [5]. Systems can be designed for collocated meetings or physically remote interaction. The EBS systems operate dominantly in textual mode, with the exception of concept mapping or mindmapping, which has been recently transformed into the domain of EBS applications [12, 14].

The many design constraints for group support system incorporating ideation have been laid out a time ago [6,

Presemo Platform

XMPP-based server

I) Presentation client OS X desktop interface

Public display (projector etc.)

II) Web-based moderator interface

III) Participants' main web interface

Slide notes and interaction view

Co-Channel view

External services view (Google Docs API)

Brainstormer Format

a) Questionnaire Templates

b) Group Work Logic

c) Co-Channel Discussion Rules

Presemo Participation Platform structure, three interfaces (I-III) connected to XMPP-based cloud server. Brainstormer format is based on configurations a-c

15]. Still there are no signs of EBS gaining popularity. This is hardly a technical challenge because an EBS system is easy to implement. There must be other reasons. The biggest issue is probably the narrow focus on ideas alone that may become stranded within an EBS system and not travel downstream in the group process. A regular brainstorming session is expected to generate common understanding of a problem and best ways to tackle it, but EBS might not provide this output for the upstream process.

It may also be that the previous EBS designs have not tapped on the right constraints that relate to the creative group process. The emphasis in EBS has been on social interaction. Cognitive stimulation and fixation effects within individuals that influence the produced ideas in predictable ways [9, 11], have not been addressed to the same extent. One reason lies in the slow transformation of practices. Electronic systems can be met with resistance because the fear of losing traditional communication channels. In Brainstorming, direct face-to-face contact provides a way for immediate persuasion and decisions making as the ideas emerge. The fit of new electrical tool among existing systems and ways of working can also be a challenge. EBS has usually required special software. However, in the present day world, group collaboration is still mostly carried out by generic software like email, Skype, Dropbox, Google Docs, and wikis.

We believe that the concept of EBS has unutilized potential, but the question is how to leverage it. The system must make a bigger contribution to the process, deliver not just a block of ideas. To us, this is a problem of providing a tool that blends in with the present ways of creative group work.

Presemo Platform

Our EBS prototype is built on Presemo. Presemo Platform is a work-in-progress framework for creating interactive presentations that encourage active participation. The system is implemented using a cloud-based real-time web framework (XMPP) and Javascript as an interface language allowing access from any browser-equipped, networked device. It serves three interfaces. The main interface for the participants is a web service with multiple views. These views can be manipulated from the presentation controller client and are usually synchronized with slide changes. Each time slide changes on the presentation desktop, a note web page for participant is rendered with a view that consists of either a thumbnail of the slide, extra content related to the slide, or interaction. Co-channel is based on chat components, but additionally has annotation, transparency, and anonymity features that can be activated from the desktop client. The system currently works best with laptop browsers.

The platform provides numerous interactive components that can be used to create different participation formats. The formats can consist of several interfaces. An XMPP-based server framework links together different interfaces. The main operating interface is an OSX-native desktop client responsible for rendering the public display images and controlling interaction timing and analysis. The desktop client is build on top of Conduit (live video processor) and is capable of performing real-time image compositing and manipulation. Presemo interfaces Google extensively; Docs API is present and supports Google Presentation session initiation, group assignments, and exporting slides. Google Spreadsheet is utilized for survey composition, group definitions and a system log.

Presemo Brainstormer Process

Presemo Brainstormer

The goal of the Presemo Brainstormer participation format was to provide a structured facilitation for collocated ideation. This meets the needs of early conceptual design combining efforts of tens of people at a time on a single problem, and distil the collective wisdom in a democratic, collaborative manner. This structured process gives a tool that tries to teach inexperienced participants how to navigate through the ideation process effectively to achieve *skill* in brainstorming [1]. Presemo Brainstormer prototype facilitates the ideation by incorporating multiple process-related rules and guidelines [2].

The crucial difference between our Brainstormer and the previous EBS systems is a wider perspective on what "idea generation" involves. We see that the ideation tool must bear more fruit than a list of overlapping ideas. For us, the stages of idea generation in conceptual design are problem definition, idea generation, group decision making, and presentation. Brainstormer carries the participants through all these phases, but most of the best-practice principles are implemented in the idea generation phase. For instance, we kept the contributions anonymous to reduce social apprehension and productivity matching.

Brainstormer was designed to be used with small, three to six person groups. It incorporates clear steps on how to proceed from the design assignment to a presentation of the final concept. In the Brainstormer format, the interface includes three views: *slide notes and interaction* view for task briefing, *co-channel* view for ideation, and a *link* to the Google presentation for group development and presentation.

Pilot Workshop

28 participants representing 14 different nationalities tested our prototype in a pilot session. All were taking part in an international product development course organized by the University of Helsinki (Finland). A full-day workshop on idea-generation techniques was organized involving lectures and tasks about ideation. The trial use of the Presemo prototype was a part of this workshop's agenda. The people were divided into teams A to E each having five to six members who had been at least introduced to each other earlier on. Each team was required to complete two challenges on Presemo using a personal or shared web browser. The participants received a design brief from the public screen, but followed to use their own terminals.

The Brainstormer guided the subjects through six steps of idea generation. The first step is to find the right problem. We asked the participants to redefine the challenge in their own terms. For this activity, they used the co-channel feature in a transparent (all contributions visible) and anonymous mode once problem was set. In the following idea generation phase, everyone worked in their own co-channel window and were asked to generate one idea per line. This attempts to reduce production blocking. After people have had their initial burst of ideas, the next phase exposes participants to other group members' ideas (transparency is activated) to harness group synergy [3] (cognitive stimulation). After seeing those ideas, participants could review and build upon them. In the fourth step, brainstorming continued transparently in a shared co-channel view. Users could immediately see what others contributed. Finally the session converged into an interactive, collocated group work. Here the groups reviewed the ideas and defined

Photo displaying some groups using Presemo

Feedback from pilot testers (N=27) about the Brainstormer session

the idea for group presentation. The final part took place collectively in Google Presentation but was coordinated face-to-face.

Design Insights
Each group succeeded in producing the requested ideas, some of which were genuinely surprising and novel. Being able to present a concept after working on it for half an hour is a notable achievement.

The prototype was also effective in evoking ideas for further development. The first insight comes from the analyses of logs. We tried to keep the Presemo environment relatively anonymous using *ad hoc* groups, but we realized that the participants wanted to resolve others' "anonymous identities" to the people they knew. This again questions the pursuit of anonymity in an EBS [13]. We also gathered qualitative, open-ended feedback from the users. The results were grouped into three categories.

Communication: Many people deemed important to maintain as realistic (face-to-face like) communication channels as possible. This seems reasonable but conflicts original design goals (anonymity and free production). One user suggested inclusion of smileys. Many respondents believed that the system would be generally valuable for people collaborating remotely in global settings although no rationale was provided.

Representation of ideas: In the prototype, the work space consisted of uniform text entries. Contributions varied from virtual hand shaking to idea presentation. This implies that expressing ideas in a textual format does not come effortlessly. Thus ideas tended to be difficult to spot and hard to build upon. This suggests

that we need a communication back channel to separate the stream of ideas from interactions. The ideas themselves might deserve a different format. A few participants requested visual representations to replace or complement text, others desired a way to organize the ideas. This might be achieved by alternative representations such as collaborative, computer-assisted concept mapping (cf. [14])

Process Transparency: Users desired additional transparency for the procedure. Although we had briefed them verbally how the process evolves, this information was not particularly illustrated within the interface. The information about the quantitative goals and the phases of the process could be easily added to keep the participants better aware of the process.

Future work
Our next step is to implement the documented improvement ideas. We intend to create tools that open up the application for wider user groups. The current system requires detailed programming in order to generate Brainstorming sessions, we will produce a tool to facilitate this. This could be achieved using session templates for group sessions designed to handle different types of creative challenges. To enrich the idea generation part, we will consider new input tools and modalities, for instance, to enter the visual domain relevant for design. This would break away from textual, list-based representation to a more spatial mind-mapping type of representation. Another direction is improving process interventions, e.g. inclusion of pre-selected or random stimuli and reinforcement of process rules. Finally we should support other steps of the process, foremost problem definition and group decision making.
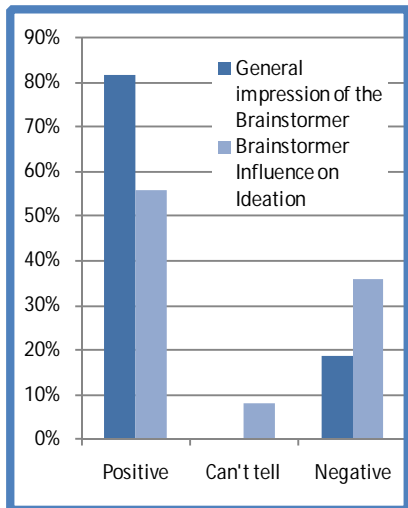
"FOOT LOCKER"

A chip embedded in the shoes matches the identification in the pedal (e.g. via RFID). When the shoe is put on the pedal, a lock inside the pedaling mechanism is opened. Chip can be put in different types of shoes and can be given to different people.
Furthermore, the Foot Locker can be combined with an alarm system and anti-theft-mechanisms, i.e. electric shocks.

BikeDetectives.com

Your bike is stolen

You register your bike on the social networking site Bike Detectives

The community looks for it together, giving tips

Bike is found, rewards, fame, unfriendly atmosphere for thieves

Virtual and real gym for physical and psychological fitness:
-> **wrist bands** that record health information
-> use **cell phones** for constant communication and updates on nutrition, training plan, meetings and routes for running etc.
-> progress monitoring through an **avatar** that changes according to your progress (combine with **social networks** if wanted)
-> in the gym there a fitness and psychological trainers as well as lifestyle and nutrition coaches that optimize not only your health, but also your **social and motivational situation**

AVATAR FITNESS

SMALL WORLD
anytime   anywhere with anyone

ride the world and compete with other people

Four out of ten concept presentations produced in 35 min

Conclusion

This paper documented a prototype of a groupware created for conceptual design. We are trying to develop a tool that can contribute positively to group creativity. In this process we must consider what could make it acceptable for wider audiences. In the presented system, we focused on generating a productive work flow by incorporating several principles from literature on creative group work in a web-based application. We also delivered the output in re-usable, common file formats. We believe that mastering brainstorming as a creative practice [1] is an important asset for any R&D professional. Specially crafted creativity-support tools can possibly educate users in ideation practices. This requires step by diffusion of new group-support systems, such as the Brainstormer, in organizations.

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References

[1]   Baruah, J. and Paulus, P. B. Effects of training on idea generation in groups. *Small Group Res.*, 39, 5 (2008).

[2]   Carroll, E. A., Latulipe, C., Fung, R. and Terry, M. Creativity factor evaluation. In *Proc. C&C'09*, ACM Press (2009), 127-136.

[3]   Dennis, A., Pinsonneault, A., Hilmer, K. M. N., Huber, M. and Bellavance, F. Patterns in Electronic Brainstorming. In N. Kock (ed.) *Emerging e-collaboration concepts and applications*, (2007), 193.

[4]   Dennis, A. R., Valacich, J. S., Connolly, T. and Wynne, B. E. Process structuring in electronic brainstorming. *Information Systems Research*, 7, 2 (1996), 268-277.

[5]   Dornburg, C. C., Stevens, S. M., Hendrickson, S. M. L. and Davidson, G. S. Improving Extreme-Scale Problem Solving: Assessing Electronic Brainstorming Effectiveness in an Industrial Setting. *Human Factors*, 51, 4 (2009).

[6]   Gallupe, R. B., Dennis, A. R., Cooper, W. H., Valacich, J. S., Bastianutti, L. M. and Nunamaker, J. F., Jr. Electronic Brainstorming and Group Size. *The Academy of Management Journal*, 35, 2 (1992), 350-369.

[7]   Ivanov, A. and Cyr, D. The Concept Plot: a concept mapping visualization tool for asynchronous web-based brainstorming. *Inf. Vis.*, 5, 3 (2006), 185-191.

[8]   Kelley, T. and Littman, J. *The Art of Innovation*. Doubleday, New York, 2001.

[9]   Nijstad, B. A. and Stroebe, W. How the group affects the mind: A cognitive model of idea generation in groups. *Pers. Soc. Psychol. Rev.*, 10, 3 (2006), 186-213.

[10] Osborn, A. F. *Applied imagination. Revised edition*. Scribner, New York, 1957.

[11] Pinsonneault, A., Barki, H., Gallupe, R. B. and Hoppen, N. Electronic brainstorming: The illusion of productivity. *Information Systems Research*, 10, 2 (1999), 110-133.

[12] Prante, T., Magerkurth, C. and Streitz, N. Developing CSCW tools for idea finding. In Proc. *CSCW 2002*, ACM press (2002), 106-115.

[13] Shepherd, M. M., Briggs, R. O., Reinig, B. A., Yen, J. and Nunamaker, J. F. Invoking social comparison to improve electronic brainstorming: beyond anonymity. *J. Manage. Inf. Syst.*, 12, 3 (1995), 155-170.

[14] Shih, P. C., Nguyen, D. H., Hirano, S. H., Redmiles, D. F. and Hayes, G. R. GroupMind. In Proc. of *GROUP'09*, ACM (2009), 139-148.

[15] Stenmark, D. The Mindpool Hybrid. In Proc. *HICSS-34*, IEEE (2001), 1037-1047.

[16] Stroebe, W., Diehl, M. and Abakoumkin, G. The Illusion of Group Effectivity. *Pers. Soc. Psychol. Bull.*, 18, 5 (1992), 643-650.

[17] Sutton, R. I. and Hargadon, A. Brainstorming groups in context: Effectiveness in a product design firm. *Administrative Science Quarterly*, 41, 4 (1996), 685-718.

[18] Yang, M. C. Observations on concept generation and sketching in engineering design. Res. in Eng. Des., 20, 1 (2009), 1-11.