Random Display of Hints and Its Effect on Generating Ideas in Brain-Writing Groupware

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Abstract. Reflecting on the results of previous experiments, we proposed methodology for effective visualization in Brain-writing groupware. This present research mainly explains the approaches that highlight the effects of visualization in Brain-writing, and the results of combining and associating idea-labels. We have proposed methodology to combat the problem of overload viewing by analyzing the individual's ability to combine, and associate idea-labels.We conduct a test with five different modes, which are all simple in structure and are very similar in theory. Test results shows that gradual display of hints, rather than package display generates better quality ideas by maintaining the cognitive stimulation of participants, as well as keep alive the demands of individuals to view and share all ideas within groups.

Keywords: Divergent thinking, Brain-Writing, Visualization of ideas, Idea combination and association.

1 Introduction

There are varieties of approaches and techniques to conduct idea-generation; a few are: Brainstorming, Brain-writing, and Mind mapping. But we focused on the concept of Brain-writing, as several research studies show that the process of Brain-writing is effective to generate ideas in collaboration [1]. The main aim of developing a Brain-writing support system is to enhance divergent production both in quality and quantity, by dramatically increasing the creativity of the group. And, this dramatic increase can be achieved by balancing the quantity of inputs and outputs. Previous results shows that people were happy using the system and we got some good data in Brain-writing groupware, but lack of observation regarding the numbers of visible ideas actually degenerated the overall outcome [2].

Our previous results show that synergy is not always an advantage to generate ideas in groups; at times it has negative effects, as participants will be absorbed only in reading other people's ideas, and not input new ideas of their own [2]. On the other hand, results also show that participants want to view all idea sheets

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over the course of the meeting, and they acknowledged the system that supports this desire as one of the best and appropriate systems to generate ideas [2]. The comparison study of Pool Writing and Gallery Writing (these approaches are comparatively close to Brain-writing) in which the author (s) summarized the studies conducted on ‘Group Support Systems,’ shows that, “meeting participants want to be able to view all comments written by group members at any given time or over the course of the meetings [3].” However, no single studies were conducted to verify the flexible numbers of idea-labels that should be displayed on the individual monitor, in accordance with appropriate time, without hampering the input process of individuals. Therefore, to clarify the numbers of ideas that should be made available for viewing; so that participants will still have time to generate newer ideas, it is necessary to study the minimum capacity of the human brain to make associations by combining idea-labels. This paper generally reflects the approach that we are going to undertake to overcome the drawbacks of information overload in idea-generation in Brain-writing groupware. Concatenate two aspects: input and sharing of ideas thus helps to design a fascinating Brain-writing support system.

2 Brain-Writing Groupware and Previous Insights

Brain-writing, a creative technique aimed to address the potential deficiencies of “Brainstorming,” was a term coined in Germany, and “Holiger” invented the procedure of Brain-writing in 1968 [4]. The Brain-writing process can be split into two categories: traditional and automated. Compared to the traditional process of Brain-writing, the automated process is usually considered to be more versatile, as it is capable of accommodating many users and serving many functions. In face-to-face meetings some participants might be reluctant to express his/her ideas within a group, but the online distributed environment has the potential to defuse such tension, and allows groups to speak about sensitive issues in an open and candid way without the fear of judgment or shyness that characterize face-to-face groups [5] Another, potential advantage of automated meetings is that the participants gain benefits from simultaneous input/output. Moreover, the fundamental procedures of Brain-writing, in which participants input their ideas on pieces of paper and exchange ideas with others, do not need oral communication, and hence it is easy to implement in a distributed environment.

In Brain-writing, ideas generated by individuals are written down on paper, and then exchanged and combined with those of other individuals in the group. Written ideas are circulated and read by every other participant in the group, who in turn add newer ideas. In general six participants in a group generate and write three ideas in five minutes. After five minutes, in the second round, each participant passes the paper to the person on their right, who adds three more ideas [4]. This process continues until a fixed time has passed, or until each participant gets their original paper back. The paper-based traditional Brain-writing process has restrictions on input of ideas, and participants were also restricted from viewing other ideas. However, the restrictions on input of ideas and the restrictions on viewing other ideas can be suppressed technically by designing the system more specifically. Moreover, the characteristics of traditional Brain-writing make it easier to tame it in a distributed environment. Therefore, in an effort to overcome the drawbacks of traditional Brain-writing, and to improve the efficiency and effectiveness of the whole Brain-writing process, we have proposed and developed a prototype system with subsumed architecture of three different modes: [1Sheet-3+ideas] (1s-3+i), [6sheets-3+ideas] (6s-3+i), and [1Sheet-3ideas] (1s-3i); each with different functions and characteristics. The main window of the prototype is presented in Figure 1.

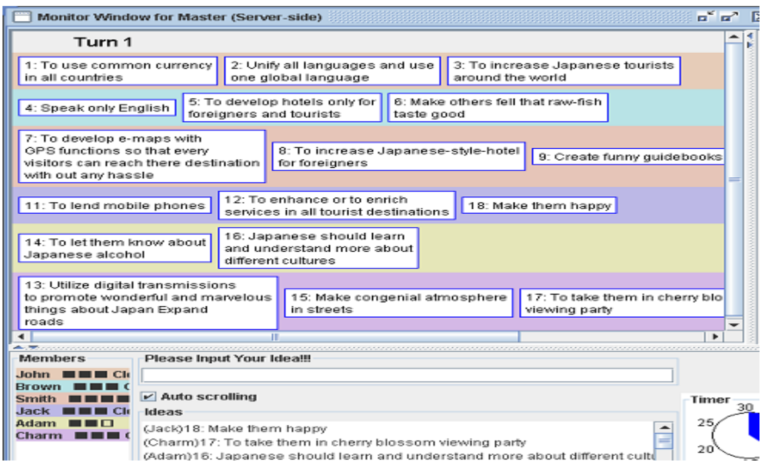

Fig. 1. Ongoing process of Brain-writing in Prototype system

In (1s-3+i) mode, in their "first turn" participants were restricted from viewing other ideas. After all the participants input at list three ideas (minimum), they can then proceed to the "second turn", where they can view one sheet of ideas. Hereafter, in every new "turn", according to login order, the system automatically passes one new idea sheet to individuals in a round robin process. In the case of inputting ideas, in every "turn" each participant is able to input as many ideas as they can.

In (6s-3+i) mode, from the very beginning participants can view all input ideas without any restrictions. The idea which one participant inputs at his/her keyboard is immediately transmitted to the group as a whole. Participants can also input ideas without any restrictions.

(1s-3i) mode is completely based on the traditional concept of Brain-writing, where participants were restricted from viewing others' ideas at the beginning. Moreover, each participant is restricted from inputting more than three ideas in each "turn." If any participant finished inputting three ideas in a "turn", system automatically sent a message to his/her monitor to wait until all participants had input the minimum number of ideas. They have to wait for other participants to input their three ideas, and when all participants have input three ideas, they can proceed to the next "turn".

Adhering, the three modes of the prototype system we conducted test. Our past results showed that participants wanted to view all idea sheets over the course of the meeting, and they acknowledged that the system that supports this desire is one of the best and appropriate systems to generate ideas. However, the mode (6s-3+i) which permits full visibility of ideas shows negative impact as well, because participants were absorbed only to read other ideas, and not input newer ideas of their own. Without diminution or exception we received positive outcomes. However, lack of observation in regard to the components of visibility of ideas in (6s-3+i) actually degenerated the overall outcome.

3 Proposed Methodology and User Study

The prime objective in sharing others' ideas is that when they themselves are deadlocked in progress, they can find other ideas from which they can refine, harvest and produce new grains of ideas; literally newer ideas are the consequence of sharing others' ideas. Research shows that effective decisions or creative solution meetings, whether face-to-face or computer networked, require a full exchange of ideas by all group members [6]. But, when people have lots of ideas on the display in front of them, as they have while using (6s-3+i), they may take time to sort out ideas which they should select and associate, or which they should combine. And in this process they lose their creative momentum and therefore, could not generate large number of ideas. The ability of the human mind to combine and associate idea-labels and variations on displaying idea-labels in Brain-writing groupware will overcome the barriers, as well as production blockage. Thus, the whole process of Brain-writing can be brought to a successful end.

No work has been done regarding idea-sharing in groups, and no researchers have proposed the number of flexible ideas that should be shared in groups in accordance with appropriate timing. However, two conditions, attention (group members may not be very attentive to the ideas expressed in the group) and incubation (members may take some time to reflect on the shared information and to integrate this with their own ideas) had been proposed in which idea-sharing in groups can be productive [7]. This kind of hypothesis generally suits the traditional brainstorming paradigm, but does not match the real-time Brain-writing paradigm. According to the "cognitive stimulation theory," as long as group members pay careful attention to the shared ideas there is much potential for cognitive stimulation [8]. Although there is much potential in stimulation, participants in real time meetings were required to generate a large number of ideas within an allocated time. Therefore, they were unable to get much creative stimulation, as large number of ideas appeared instantly on their monitor, and participants finished up by only reading them. To preserve the cognitive stimulation impact, as well as the demand of individuals to view and share all ideas, we had decided to examine the minimum ability and minimum time taken by individuals to combine and associate idea-labels.

In order to clarify the desired numbers of ideas that should be made available for viewing, so that participants will still have time to generate newer ideas, we designed an individual-based idea generating tool. The necessity to verify how an individual reacts when the quantity of information on their display changes, compelled us to design a tool with five different modes: *Mode 1, Mode 2, Mode 3, Mode 4, and Mode 5* respectively. Although, the tool was composed of five different modes, the modes are simple in structure and are very similar in theory. The first mode, *Mode 1*, has a text field where ideas related to the particular theme could be input. *Mode 1* does not provide any other information, such as hints or suggestions, rather it only displays the 'theme' at the top of the display. *Mode 2*, on the other hand, provides three ideas as a hint by displaying them on the monitor. At the interval of every three minutes, the tool uploads three newer ideas by randomly selecting them from the pool of 30 ideas that were collected beforehand, and displays them on the monitor. In *Mode 3*, the initial number of hints that are displayed on the monitor is six. At the interval of every six minutes, the tool uploads six newer ideas, by randomly selecting them from the pool of 30 ideas that were collected beforehand, and displays them on the monitor. In *Mode 4*, the initial number of hints that are displayed on the monitor is 15, and 15 hints will be added in the interval of 15 minutes. On the other hand, 30 hints were displayed instantly in *Mode 5*. There are no updates of hints in *Mode 5*. Participants can view all 30 hints from the initial phase of the idea generating process to the end of the process.

Each hint displayed on the monitor has a checkbox. If subjects combined any number of hints to generate newer ideas, or if subjects associated the hint and generated newer ideas, subjects were told to click that particular hint so that their log of combination and association could be verified at the analysis stage. Subjects were free to use any number of hints at a time, and subjects were allowed to use the same hints multiple times. The system automatically stores the log of the hints clicked, and the new idea that reflects the notion of that particular hint, along with the idea input time. The image of Mode 3, and Mode 5 are presented in Figure 2 and Figure 3 respectively.

Implementing the above described modes, we conduct a comparison experiment to study the individuals' ability to combine and associate ideas, using 25

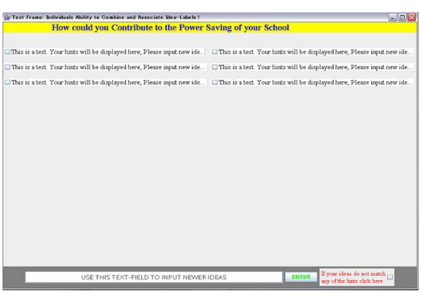

Fig. 2. Display of hints in Mode 3

Fig. 3. Display of hints in Mode 5

subjects. The subjects were randomly divided into five different groups from group one to group five and each subject in the five groups experienced the test individually. The *first group* undergoes the test using *Mode 1*. The *second group* took part in the test using *Mode 2*. The *third, fourth, and fifth group*, took part in the test by using *Mode 3*, *Mode 4*, and *Mode 5* respectively. Due to the differences in the number of visible hints in each mode, the exposure time per hint in each mode was also different. For instance, in *Mode 5*, 30 hints were displayed instantly. Therefore, the volume of exposure is (30 hints $\times$ 30 minutes) 900 hints per subject. On the other hand subjects experiencing *Mode 2* had the exposure rate of (3 hints $\times$ 30 minutes + 3 hints $\times$ 27 minutes + $\cdots$ + 3 hints $\times$ 3 minutes) 495 hints. Ultimately, this makes a big difference in the volume of exposure. To avoid the differences, we decided to standardize the volume of exposure based on the exposure rate of 495 hints while using *Mode 2*. Therefore, for *Mode 1* and *Mode 2*, we allocated 30 minutes. We allocated 27.5 minutes for *Mode 3*, 22 minutes for *Mode 4* and 16.5 minutes for *Mode 5* respectively.

Regardless of mode, to provide similar opportunity for all subjects at the beginning of the test, we allocated five minutes. In the first allocated five minutes all subjects used the same function where they were not provided with any hints. On all of the tests, subjects were told to think about "how they could contribute to power saving at their school."

4 Results

The total number of qualitative ideas and quantitative ideas generated by each subjects is presented in Table 1.

For the qualitative evaluation of ideas, we asked three individuals to evaluate the ideas based on a five stage rating system. After the evaluation, the average of each idea was calculated and the ideas with more than three points on average were considered to be good ideas. Based on the log file, we verified the patterns of combined ideas, associated ideas and directly-input ideas. The numbers of combined, associated, and directly input ideas are presented in Table 2.

Table 1. Total number of ideas (Left),Total number of qualitative ideas (Right)

Subject	S:1	S:2	S:3	S:4	S:5	Total	Average
Mode 1	34	25	120	21	37	237	47
Mode 2	17	24	49	60	19	169	34
Mode 3	19	26	21	26	41	133	27
Mode 4	27	23	14	24	29	117	23
Mode 5	11	35	9	7	17	79	16

Subjects		S:1	S:2	S:3	S:4	S:5
Mode 1	First 5 minutes	3	1	2	3	2
	After 5 minutes	15	13	37	3	5
Mode 2	First 5 minutes	5	4	6	5	10
	After 5 minutes	6	11	20	6	0
Mode 3	First 5 minutes	4	2	5	5	8
	After 5 minutes	9	11	9	10	3
Mode 4	First 5 minutes	7	4	4	4	7
	After 5 minutes	2	5	4	10	12
Mode 5	First 5 minutes	2	5	2	3	4
	After 5 minutes	2	10	0	1	5

Table 2. Numbers of Combined, Associated and Direct Ideas

Subjects		S:1	S:2	S:3	S:4	S:5	Total
	Combination	1	12	11	0	2	26
Mode 2	Association	8	7	19	14	5	53
	Direct	3	0	6	32	0	41
Mode 3	Combination	2	3	9	8	2	24
	Association	49	12	5	10	10	41
	Direct	9	5	1	1	19	35
Mode 4	Combination	4	5	1	0	13	23
	Association	14	9	6	13	6	48
	Direct	1	0	2	7	1	11
Mode 5	Combination	2	3	0	1	1	7
	Association	2	15	0	2	13	22
	Direct	2	3	7	0	6	18

We asked subjects their impression of the Modes by conducting a questionnaire session subsequently. The answers of the questionnaire were evaluated by adopting a seven stage rating system. The average values of the answer to the question "Did you read all displayed hints throughout the session?" were different for each mode: six for Mode 2, six for Mode 3, seven for Mode 4 and five for Mode 5 respectively. For the question, "Was the time sufficient to read all hints and generate newer ideas?", the average values of the answer were five for Mode 2, five for Mode 3, four for Mode 4 and three for Mode 5 respectively. We asked them "Could you have generated a large number of ideas if you were provided more hints?". The average values of the answer to the question were, four for Mode 2, three for Mode 3, four for Mode 4, and three for Mode 5 respectively. Furthermore, all participants experiencing Mode 1, where they do not receive any hints replied that they felt it was difficult to generate ideas, and that they would have generated more ideas if hints were provided to them.

5 Conclusions

In this paper we proposed methodology to combat the problem of overload viewing by analyzing the minimum time and minimum number of idea that should be made visible and sharable with participants in a way that still maintains the cognitive stimulation of participants, as well as meet the demands of individuals to view and share all ideas.

In each mode subjects who generated more ideas in the first five minutes also generated more ideas at the later stage. On the other hand, it was observed that subjects who had fewer ideas in the first five minutes generated a larger number of ideas after they were stimulated by hints. The pattern of displaying hints does not matter much to subjects who are good at divergent thinking, as they demonstrate continuous increase in generating ideas. But all patterns of hints display that they support the idea generating process of subjects with fewer ideas by stimulating them to generate a large number of ideas. They tended to combine and associate hints to increase the volume of ideas.

On the qualitative evaluation of ideas, the percentage of good ideas of modes where hints are provided exceeds the results of Mode 1 where subjects do not receive any hints. However, due to fewer samples, the explicit differences among the modes where hints are provided were not observed. Nevertheless, intimate relationship between the qualitative ideas and the patterns of combination and association were observed in all modes. Almost all qualitative ideas were generated by either associating or combining hints. Moreover it was observed that, subjects combine more pairs of hints when hints are provided gradually rather than at times when large numbers of hints were displayed instantly. This may be because, when larger volumes of hints are around, subjects may get mired in confusion, and thus be unable to decide which pairs of ideas could be combined.

Our results shows that gradual pop-up display of hints, rather than package display, generates better quality ideas, as well as meet the demands of individuals to view and share all ideas.

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