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Directed Brainstorming: A GSS Technique for Collaborative Crisis Response

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Introduction

An expert decision maker working under time pressure often perceives the pattern of available information, matches the present situation with remembered experience, and jump immediately to a single solution rather than using the rational decision making process of sense-making, alternative generation, alternative evaluation, and selection [1]. However, there are many problems so large and so complex that a single expert cannot have all the experience, the information, or the cognitive resources to solve the problem alone. In such cases a team of decision makers must combine their knowledge and effort to solve the problem using a methodical approach. However, teamwork itself places heavy demands on cognitive resources.

Teams working on complex problems under time pressure may benefit from a Group Support System (GSS) to address cognitive and communication limitations that would otherwise arise. This paper introduces a new GSS-supported idea generation process called Directed Brainstorming, which shows promise as an effective technique for generating and evaluating alternative solutions to complex problems under time pressure.

Theory

Team Theory posits that in order to become productive, teams must divide limited attention resources among three processes: communication, deliberation, and information access. It further posits that team members will only become productive to the degree that the goals of the individuals are congruent with the team goal [2].

A GSS is collaborative technology a team can use to improve productivity by enhancing communication, by structuring and focusing problem solving efforts, and by establishing and maintaining an alignment between personal and group goals. A Directed Brainstorming intervention, founded on GSS technology, may reduce the cognitive load of idea generation, an important component of the deliberation process. It may keep the team more focused on their goal than would standard electronic brainstorming methods.

A GSS is an interactive computer-based environment which supports a team making concerted and coordinated cognitive effort towards a goal. A GSS consists of a suite of collaborative software tools running on a network of personal computers. Participants communicate in parallel, and, when appropriate, anonymously, by typing ideas into the system, which then passes the contributions to other participants in the session. Each tool in a GSS can be used to focus group deliberation in some unique way. For example, an

electronic brainstorming (EBS) tool, like the one used for the technique described here, encourages a group to *diverge* from accustomed thinking patterns, seeking a broad set of new ideas. A categorizer tool, on the other hand, encourages a team to *converge* quickly on key issues.

A GSS can support collaborative list building, synchronous discussion, and polling, team writing and drawing, and other group processes. It supports solution generation, evaluation, selection, planning, and documentation.

Combinations of software tools and process structures have led repeatedly to demonstrated gains in group productivity [3]. For example, Post [4] found GSS enhanced techniques reduced project times to one tenth the previously experienced duration in concurrent engineering activities at Boeing. Dean and his colleagues [5] undertook extensive process re-engineering tasks with the Department of Defense and found that their GSS-based process reduced project times to one quarter of what they previously were while increasing perceived quality in the results.

The specific effect a GSS has on a particular group depends heavily on the way the team elects to use it. This paper describes a new process for using an existing technology. The new process appears to lead to substantially faster and better results than does the old process using the same technology.

Time pressure is a negatively valenced affective response to the perception that there may not be sufficient time to achieve some important goal. Research shows that, under time pressure, decision makers are much better at comparisons than at judgments [6]. They can compare the relative merits of several alternatives much more reliably than they can judge whether a single alternative is a good one. We reasoned that if we could develop an idea generation process based on comparison, we might be able to improve the overall quality of the ideas generated as a part of solving problems under time pressure.

People engaged in free-form electronic brainstorming can produce hundreds of ideas in less than an hour. In free-form brainstorming people are often encouraged to diverge far afield in search of inspiration. Even bad ideas are considered useful because they may stimulate better understanding of the problem space, or inspire a completely different solution. However, it can take twice as long to organize ideas as it takes to generate them. When a team works under time pressure, a host of poor ideas becomes a cognitive burden that may outweigh the benefits of inspiration. We reasoned that if a brainstorming technique based on comparison could improve the ratio of good ideas to bad ideas, it might also reduce the amount of time required to organize those ideas.

Directed Brainstorming

Directed Brainstorming requires the use of GSS brainstorming software based on the brainwriting technique. Such a tool starts each participant on a different electronic page. The participant may contribute only a single idea before sending the page back to the group. The system randomly returns a different page containing somebody else's ideas. In

free-form brainstorming, this can encourage participants to broaden their thinking because each new page offers them ideas generated by other minds. However, there is no built-in structure to explicitly push the participants to think in new ways; this is usually left to chance. Nor does free-form use of such a tool push thinking in any particular direction.

Figure 1.

The Directed Brainsorming Process

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1. Develop criteria for idea quality
2. Develop Directive Prompts for idea generation
3. Elicit one idea from each participant
4. Ask participnats to trade ideas
5. Generate new idea based on a directive prompt
6. Repeat Steps 4 and 5 until prompts are exhausted.

In crisis situations it may be useful to push thinking outward along specific vectors. Free-form brainstorming can produce a very large count of unstructured comments, which the group must then organize and converge into a focused set of key ideas. The convergence process can be difficult and time consuming. Directed Brainstorming overcomes these two limits of free-form idea generation.

The first step in Directed Brainstorming is to create a set of evaluation criteria upon which ideas may be compared as they are generated. For example, we supported a team of military planners working under time pressure in a war game scenario. The enemy was behaving in unexpected ways, and the commander wanted to know what it meant. He therefore tasked eight experts on his staff to generate possible enemy courses-of-action (COAs), and produce a memo detailing the most likely, least likely, and most dangerous enemy COAs. The criteria by which COAs would be compared, then , were "more likely," "more unlikely," and "more dangerous." We also worked with a group of 24 educators who wanted to generate plans for incorporating technology into their curriculum. We started by asking them how they would judge a good way of using technology. Their top four criteria were, "technical feasibility, improved learning, low cost, and engaging-to-students"

The second step of directed brainstorming is to create a set of comparative prompts based on the evaluation criteria developed in Step One. These prompts take the form of an instruction to the team about what kind of idea to generate. In the war-games case we asked the warfighters, we developed prompts like:

"Now give me an idea that would be a much more likely enemy response than the idea before you. Now give me an idea that would be a much more dangerous enemy response than either idea on the page before you. Now give me an idea that is a much more unlikely enemy response than any before you."

We then varied our comparative adjectives by asking for something more surprising, something more reasonable, and something more threatening, etc.

In the case of the educators we created prompts like,

"Now give me something that would be more practical than the ideas you see. Now think of a way to use technology that would lead to more learning than any of the other ideas on your page. Can you think of a less expensive alternative than any of the ideas you see?"

The team actually begins working together in Step Three, where the moderator elicits a single idea from each member of the group. In Step Four the moderator asks the participants to exchange their electronic pages. In step five, the moderator presents the first comparative prompt. The team then repeats steps four and five until there are no more prompts, or until they run out of ideas.

The method proved very effective for both the war fighters and the educators. The eight-member crisis action team took about 15 minutes to generate 56 possible explanations for their enemy's unexpected behavior. The challenge was then to converge quickly on their best ideas. We tried two approaches, both of which turned out to be fast and effective. In the first session we opened an electronic polling ballot on the public display. We then said, *"Each of you has a different page in front of you. Tell me the best ideas on that page.* We built a list, and then said, *"Please swap pages. Now look at the new page and tell me if anything should be added to the list."* On the third swap, nobody added any new items to the ballot. We asked the team to rank the items from most likely to least likely, then again from most dangerous to least dangerous. Following a brief discussion of the results, the team then briefed their commander on the most likely, least likely, and most dangerous options available to the enemy. The entire COA generation and evaluation process took about 40 minutes.

During a later session we tried a different convergence approach. We moved all the COAs from the separate brainstorming pages to a single list, and then set up three electronic "buckets" labeled, "most likely," "least likely" and "most dangerous." The team members worked in parallel to drag-and-drop items off the main list into the buckets. This took under a two minutes. Then they reviewed the contents of each bucket. If they felt an item had been misplaced they moved it to a more appropriate bucket. They then took a poll to rank-order the contents of each bucket, and after discussing and affirming the results, recommended the highest-ranked idea in each category to the commander.

The participants and the expert facilitators involved the meetings asserted that the contents of the Directed Brainstorming sessions were much more focused, and were

much more useful than those produced by free-form electronic brainstorming. Said one, "I'm used to seeing the ideas get worse and worse as the brainstorming session goes on. This time the ideas seemed to get better and better." The warfighter were able to generate and categorize their ideas in the same amount of time typically spent just generating ideas with a free-form approach.

The Directed Brainstorming technique produced similar results for the team of educators. Later, we used the technique for a very different purpose. Eleven of the team were wrestling with whether or not to implement a controversial pedagogical change. We asked them each to enter the strongest argument they could on which ever side of the issue they chose. We then asked them to swap pages and enter as strong an argument as they could against the thesis they found on the new page, regardless of their personal beliefs. Finally we asked them to swap pages again, and then to build an argument that bridged the two mutually exclusive arguments they found on the new page. The educators struggled with the third prompt, but in the end they managed to execute it. They then had eleven arguments and resolutions to draw on when making and defending their final choice. They arrived at a resolution within 20 minutes of completing the exercise.

Directed Brainstorming takes advantage of the team's powers of comparison under time pressure, while reducing the raw number of ideas generated and providing directionality and structure to the team's deliberation. It also incorporates a streamlined process for rapid convergence. The Directed Brainstorming technique may produce more creative ideas along the most useful vectors while reducing time pressure. We hypothesize that these gains will increase as group size increases, because large groups incur larger communication overhead incurred by larger groups. It appears that further investigation of Directed Brainstorming is warranted.

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