Modeling Group Brainstorming

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ABSTRACT
Both academic and practitioner endeavors aim to improve idea generation for individuals and groups. However, administering studies to study group brainstorming is difficult due to measurement, task choice, and logistics. A big question concerning group brainstorming is, What factors affect efficiency? To answer this question, we built a multi-agent model. The results of this inquiry point to interesting emergent phenomenon particularly concerning the group size and writing duration independent variables.

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Brainstorm, innovation, complex adaptive systems, model, emergent behavior, NetLogo.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION AND BACKGROUND

Nations around the world want their education systems to prepare students for competing in the modern, connected information economy. To this end, improving student *innovation*, rather than only standardized test scores, has become a point of emphasis. However, no clear classroom pedagogy is available to help instructors engender high idea generation.

Brainstorming is a common way of exploring domains and helping students generate ideas, collaborate with others, and broaden one's perspective on the domain in question. Proposed rules have emerged to improve efficiency and effectiveness of group brainstorming such as those from IDEO [3]. Moreover, some tools have been designed to help the brainstorming process, primarily aimed at corporate customers. However, the study of idea generation remains somewhat a mystery.

Researchers, educators, and business people want to answer a multitude of questions. What environmental factors contribute to high idea flow rates? Are there individual differences to idea generation? What is the link between volume and quality? How can we organize groups of people for optimal idea generation?

This paper presents an approach our team took to understanding the environmental factors that affect the quality of multi-person brainstorming. In the process of creating the model, we attempted to formalize and make explicit some of the underlying assumptions of brainstorming.

Group, as opposed to individual, brainstorming seems at once powerful and dubious. It holds impression potential because of the potential for individuals to build off of one another, generating higher quality ideas. It holds potential drawbacks in that it can pigeonhole people and ideas, capping the potential of individuals or ideas.

Advantages of group brainstorming

- Build off of others' ideas
- Motivation of social pressure
- Colleagues help group stay focused
- Dedicated scribe leaves room to participants to focus on having ideas

Disadvantages of group brainstorming

- Groupthink [1] and tunnel vision
- Social pressure may not be conducive
- Two people cannot speak simultaneously, can stifle verbalization of ideas
- Social protocol can lead to self-censoring

THE GROUP BRAINSTORM MODEL

I built a computer simulation that models group brainstorming in order to learn how the factors interact to create 'good' and 'bad' group brainstorming environments. The overall vision for the model is to observe differences between different group sizes while adjusting other

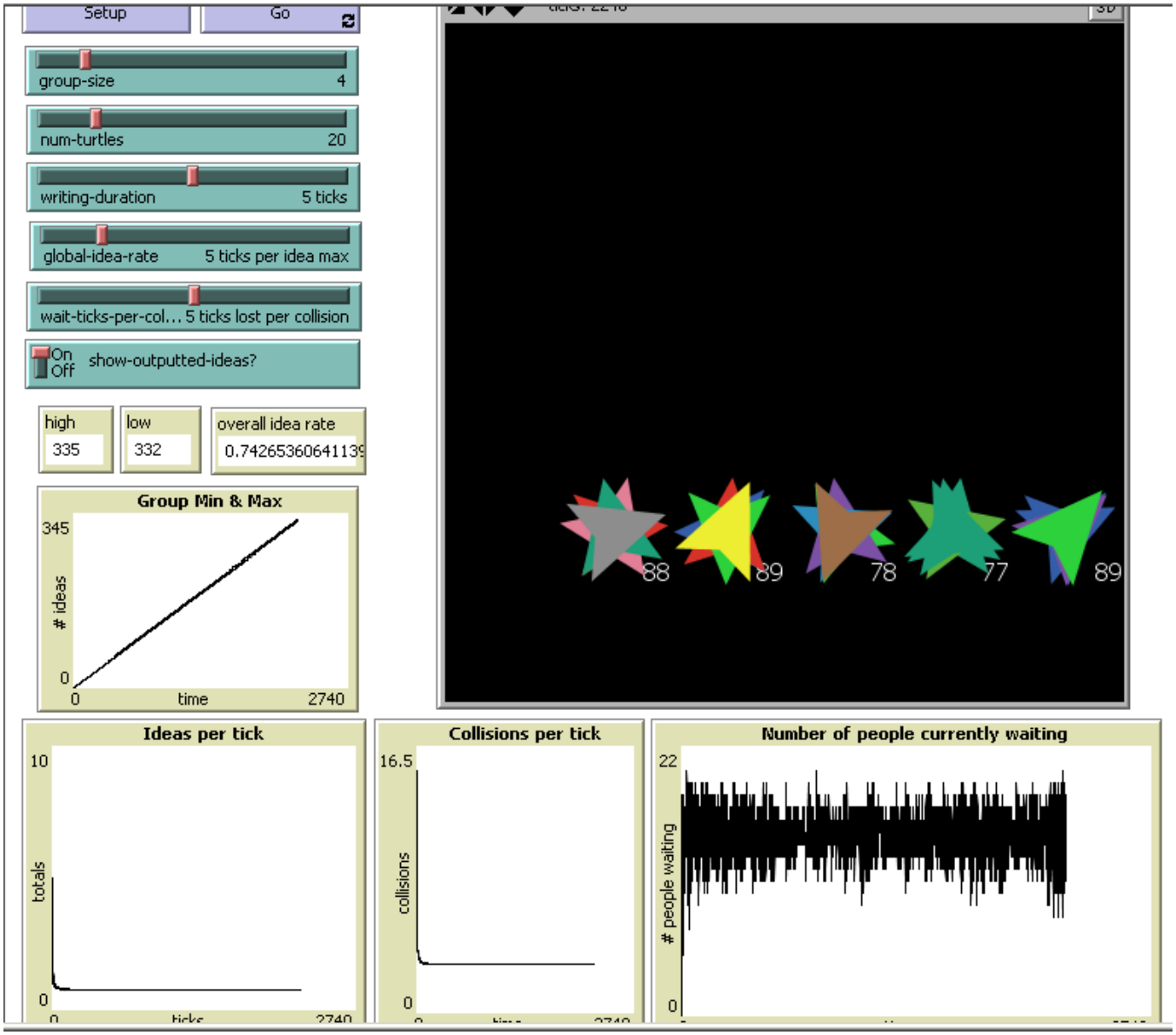

Figure 1. The group brainstorming model I built using NetLogo. In this example, 5 groups of 4 students each are visible and the number of ideas outputted by each group is displayed. You can see the range of ideas is from 77 to 89.

variables. The goal of the model is to identify bottlenecks, potential avenues for process improvement, and idiosyncrasies of group brainstorming.

Modeling environment

I used Uri Willensky's NetLogo 4.0.3 as our modeling environment on a Windows Vista machine with 4 GB RAM. Each person was represented as a turtle and patches with turtles on them represented writing spaces (e.g. pad of paper).

Model design

The model is displayed in Figure 1. In designing the model for the group brainstorming scenario, I decided upon the following agents, set in the NetLogo environment:

- Students: Each student was represented by a turtle. There was no 'scribe' role or similar. Each student had an equal chance of generating ideas.
- Writing pads: Each patch with turtles on them was a piece of virtual paper where the number of ideas was output on to.

The independent variables were:

- Total number of brainstormers
- Group size: The user can determine how large each group should be. Any leftover brainstormers will form their own, smaller group.
- Writing speed: The speed it takes to write an idea down.

- Possible idea rate: Each brainstormer will use a random number of ticks to have an idea, with this as the maximum.
- Wait time after collision: If a student attempts to verbalize an idea at the same time another's idea is being written down, the brainstormer will get 'frustrated' and have to wait this many ticks before attempting to verbalize again. The brainstormer cannot have any other ideas until the current idea is verbalized.

The dependent variables were:

- Group idea rate: The number of ideas outputted over the time passed.
- Actual wait time: The number of ticks that students have been waiting presently.

In this model, individuals cannot build up a queue of ideas. An individual is 'stuck' on an idea until they can output it.

Limitations

This model does not account for many of the nuances of group brainstorming. Specifically, the model does not account for inspiration that you might get from other people. It doesn't account for peaks and valleys of the rate of idea flow. So, if a person is alone, they are at a large advantage in this system – they can just continue coming up with ideas indefinitely. The model has no notion of good or bad ideas – only the number of ideas.

Findings

We found that writing speed was a big bottleneck for groups. This has implications for the design of brainstorming environments – e.g. that writing in parallel is probably best and that using keywords rather than writing the entire idea down may be desirable.

The interaction between group size and the other variables is not yet apparent to me. In general, it does seem that small groups are more effective than larger groups, due purely to the 'traffic' that arises in a large group. However, I can adjust the variables enough to make a 10-person group generate ideas quite yet.

NEXT STEPS

I want to model the writing of ideas in parallel. I also want to make the model complex enough to handle building off of others' ideas so that we can determine exactly when Groupthink occurs.

Building in a notion of good and bad ideas may be beyond this model. It's difficult enough for humans to discern between good and bad ideas.

CONCLUSION

What I've created is the beginning of an interesting platform for inquiry into group idea generation. I want to work on improving the system because, as it stands, it's not nuanced enough to really capture the essence of group brainstorming. I've made one interesting insight about writing down ideas but this is only the beginning of what this model will be useful for.

ACKNOWLEDGMENTS

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