THE EFFECTS OF COMMUNICATION SUPPORT LEVEL ON GROUP CREATIVITY IN DIFFERENT TIME/PLACE SETTINGS: AN EXPLORATORY STUDY

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INTRODUCTION

In today's fast-changing business world, organizations have to come up with new ideas for their products and services in order to compete and stay ahead of their competitors. Individuals and groups in organizations often get involved with idea generation tasks to generate new and valuable ideas. Brainstorming is the most basic and frequently used idea generation technique that focuses on the ways of increasing the sharing of ideas in groups [23]. Brainstorming is an implementation of the free-thinking technique which was originally proposed by Osborn in 1957. This technique encourages users to think freely and generate a large number of ideas without judging the quality of the ideas [30]. Some published studies [27] [34] [37] [36] have also shown that idea generation is an important part of the creative process in group works. Hender et al. (2002) claim that groups that follow Osborn's rules actually generate more ideas than those that do not. Paulus (2000) also confirms this proclamation in his study and adds that brainstorming is often recommended as a helpful technique in organizations.

Several studies have been done regarding creativity software utilization in idea generation task. A study by Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker (1992) indicates that electronic brainstorming reduces the effects of production blocking and evaluation apprehension on group performance, particularly for large groups. Gallupe and Cooper (1993) describe research showing that electronic brainstorming groups are more productive than groups that use traditional brainstorming, and participants like the process more. MacCrimmon and Wagner (1994) develop a computer program, GENI, to investigate whether computer-based procedures for idea generation can help individuals to develop solution alternatives more creatively. The results show that use of the program leads to the development of significantly more creative alternatives than does a control treatment. Researchers have studied various aspects of electronic brainstorming such as anonymity [8], facilitator effects [1], production blocking [41] [14], group versus individual [32] and group size [15] [4], and information overload in a face-to-face electronic meeting [18]. However, none of these studies has discussed in depth the influence of the manipulation of software characteristics such as level of communication support on different aspects of idea creativity, and the influence of the different time/place settings on which the electronic brainstorming session is held on idea creativity.

This study attempts to examine those factors that influence idea creativity in an electronic brainstorming session. Based on earlier studies on Group Support Systems (GSS), this study addresses three constructs as the factors influencing idea creativity: *level of communication support*, *synchronization*, and *proximity*. Idea creativity contains four aspects: *idea fluency*, *idea flexibility*, *idea elaboration*, and *idea originality*. The major inquiry of this study is to answer questions such as: How does each variable affect idea creativity? What are the key variables that enhance idea creativity? Do the differences in mix-and-match time/place settings of electronic brainstorming session affect any of those variables? If so, how? How do individual and group characteristics such as computer self-efficacy affect idea creativity?

We start with a discussion on electronic tools for idea generation, followed by a review of the level of communication support. Next, we discuss different electronic brainstorming meeting environments based on the time/place framework for IT communication support. Creativity is the only dependent variable in this research; however, a potential moderating variable, computer efficacy, is included in the model. We then develop a theoretical framework linking all three constructs to idea creativity. Finally, we state associated propositions and discuss the study's methodology.

LITERATURE REVIEW

Researchers have shown that idea generation is an important part of the creative process in group works, and brainstorming is the most basic and frequently used approach that focuses on increasing the sharing of ideas in groups. Idea generation software can be useful in electronic brainstorming and other creativity tasks, and some published studies have examined several aspects of electronic brainstorming such as anonymity, production blocking, and group size. We discuss idea generation software in the following section.

Idea Generation Software

Idea generation software is designed to help stimulate a single user or a group to come up with new ideas, options, and choices [39]. Also known as electronic brainstorming, idea generation software uses the principle of synergy (association) and assists users in creating a free flow of creative thinking such as ideas, words, pictures, and concepts set loose with fearless enthusiasm [40]. The software will act like a personal trainer and a catalyst to encourage the users to generate alternative solutions, and the key feature in idea generation software is providing the users with many ideas. This is crucial because it keeps the users away from analyzing the ideas so they can concentrate on generating creative ideas instead [40].

Idea generation has been recognized as a group process that produces a list of ideas, and a study by Jackson and Poole (2003) signifies that group 'give themselves over' to the idea generation process, to the activity's fundamental logic, and to the productivity's assumed value. Participants in a group create idea simultaneously, and the ideas are shown to other participants, stimulating electronic discussion or generation of more ideas. A large number of ideas are usually generated in a short time, and these ideas are then electronically organized, debated, and

prioritized by the group [39, p. 556]. The benefits of creativity enhancement afforded by idea-generating software are numerous [39, p. 556].

Like other GSS-supported tasks, an electronic brainstorming task depends on the GSS technology facilitating the activities in the task. Zigurs and Buckland (1998) develop theory of task/technology fit (TTTF) in GSS environments based on attributes of task complexity and their relationship to relevant dimensions of GSS technology. We discuss TTTF in the next section.

Theory of Task/Technology Fit

Task/technology fit can be defined as ideal profiles composed of an internally consistent set of task contingencies and GSS elements that affect group performance [42]. Idea generation task is considered a *simple task* because it has a single desired outcome of generating the greatest number of ideas, a single solution scheme (possible course of action to attain a goal), and no conflicting interdependence or solution scheme/outcome uncertainty.

TTTF classifies GSS technology environment into three dimensions: *communication support* is any aspect of the technology that supports, enhances, or defines the capability of group members to communicate with each other; *process structuring* is any aspect that supports, enhances, or defines the process by which group interact; *information processing* is the capability to gather, share, aggregate, structure, or evaluate information [42]. In idea generation task, GSS-supported groups performed better on a variety of measures than non-GSS groups because the GSS emphasizes communication support via providing simultaneous input, anonymous input, input feedback, and group display of ideas. Therefore, a GSS should provide primarily communication support so that group members can communicate their ideas about the solution to one another [42].

The issue of task/technology fit has been recognized in the past few years as an important factor in understanding the effects of technology use, and technology usage can generate different outcome depending on its fit with the needs of the task and the way in which groups choose to use it [9]. Accordingly, GSS have been employed to assist organizations in the idea generation process. While technology such as GSS has been widely employed among organizations, the most used component of GSS is a brainstorming tool since it provides information which is then used with other GSS tools such as alternative ranking [27]. Both the quantity and quality of ideas generated can be increased with the use of GSS for idea generation [36]. The GSS tool provides a structure to the group's work, enables group members to cooperate with one another at the same time, provides a complete written record of all work, allows group members to interact with one another anonymously, and helps groups carry out more complicated learning tasks by enabling a number of people to interact more easily and efficiently [27].

In accordance with the theory of task/technology fit, the focus of this study is on one critical feature of idea generation software: communication support dimension. The features of the technology can be critical in determining how people exchange ideas with one another and thus technology can significantly influence group-based idea generation outcome [28]. Communication support is discussed in the following section.

Level of Communication Support

Communication support is defined as any aspect of the technology that supports, enhances, or defines the capability of group members to communicate with each other [42]. Some examples of elements in communication support dimension in a GSS are simultaneous input (also known as parallelism), anonymous input, input feedback, and a group display. Individual and group messaging can be considered part of input and display. In addition, the communication support dimension also includes the physical configuration of communication channels because that configuration defines how group members can communicate.

High communication support involves features such as anonymity, parallelism, input feedback, and a group display, whereas low communication support environment lacks one or more of these features. Individual and group messaging can be considered part of input and display.

Dennis, Wixom, and Vandenburg (2001) explain two aspects of GSS communication support: parallelism and anonymity. As stated in their study, parallelism is the ability of group members to simultaneously enter information and thus no participant has to wait for others to finish before contributing information. The need to wait to speak is called *production blocking* and is identified as a major cause of poor performance in brainstorming groups. The use of parallelism can reduce production blocking and result in process gain.

Anonymity enables group members to contribute comments without being identified, which may increase the motivation to participate. Anonymity reduces group members' reluctance to contribute information because it shields the contributor from group reaction and deindividualizes the interaction. Without anonymity, group members may feel pressured to conform to the group majority's view or may withhold ideas because of negative evaluation apprehension [10].

Most idea generation software has the communication support elements. Therefore, the researcher can manipulate the experimental design setting in such a way that high communication support is presented when a group is provided with all communication support elements, and low communication support is presented when one or more of these elements are not provided in the experiment.

Time/Place Framework for IT Communication Support

Developed by DeSanctis and Gallupe (1985, 1987), the time/place framework for IT communication support presents four different settings for a meeting: same time/same place (ST/SP), same time/different place (ST/DP), different time/same place (DT/SP), and different time/different place (DT/DP). Figure 1 illustrates this time/place typology.

Based on 200 GSS experiments conducted during 1970-1998, a study by Fjermistad and Hiltz (1998) reports that 66% of GSS studies are conducted in the same time, same place "decision room" environment. Similarly, Anson and Munkvold (2004) point out that very little field-based research on electronic meeting systems (EMS) use has been conducted in non-same time/same place meeting environments. Referring to these different forms of time and place interactions as

"modes," Anson and Munkvold (2004) indicate that they were unable to find any published field studies that emphasize multimode meetings and/or combined use of different forms of technology support. In addition, no field studies have included all four modes in a comparable manner [2]. This present study focuses on both *synchronization / asynchronization* and *proximity*, and all four settings (or "modes") of these two variables. We discuss synchronization/asynchronization and proximity in the following section.

		Time	
		Same	Different
Place	Same	Decision room (computer-mediated communication, face-to-face interaction)	Interspersed, co-located interaction
	Different	Synchronous, dispersed interaction	Asynchronous, distributed interaction

Figure 1. The time/place framework for IT communication support

Synchronization / Asynchronization

A large amount of GSS research has been conducted in the same-time environment (synchronization); however, little research has touched upon the different-time setting (asynchronization). According to Fjermistad and Hiltz (1998), synchronous studies account for 91.5% of all the hypotheses examined and produced 16.7 % positive effects, while asynchronous hypotheses only account for 7.4% of the total and resulted in 20.3% of the positive effects. Fjermistad and Hiltz (1998) indicate that the probability of positive outcomes is slightly better for the asynchronous technologies.

Computer-mediated communication (CMC) can provide three components that may significantly change information exchanges: parallelism, anonymity, and group memory [36]. Studies have found that GSS group using parallel brainstorming techniques produce more ideas, experience increased equality of participation, and report a higher level of satisfaction [36]. Synchronization can be beneficial to group members since it supports parallelism; that is, a group cannot achieve parallelism if the group members are not meeting at the same time.

Proximity

The different place setting may be referred to as distributed meetings or virtual meetings [2]. According to the aforementioned study by Fjermistad and Hiltz (1998), same-place (decision room) settings account for 64% of the hypotheses that have been tested. Decision room settings have produced 18.2 % positive results compared with 16.6% for all proximity modes combined, and a positive ratio of 1.3 compared with an overall ratio of 1.0. Different-place (distributed)

settings, on the other hand, account for 35.9% of the hypotheses and yield only 14.1% positive results. Distributed settings also have almost twice as many negative effects as positive effects, with the ratio positive/negative effects = 0.6. The results are relatively more favorable for decision room conditions than for the various types of distributed conditions [12].

It appears that a group may gain several advantages when a meeting is held at the same place. For example, group members will be able to get information through body language, eye contact, gaze awareness, etc. Research has shown that quality has improved, more comments are generated, and more and higher-quality ideas have been generated by distributed groups [12].

Apparently, more research is needed in the asynchronous and distributed areas. Since technology can significantly influence group-based idea generation outcome [28], our study attempts to examine the electronic brainstorming activity conducted on all four possible environments, under different levels of communication support and different modes of idea generation software. These factors can be critical in determining how people exchange ideas, and hence can significantly impact group performance. We assess group performance in terms of idea creativity, which is discussed next.

Idea Creativity

A purpose of idea generation is the identification of good or interesting ideas with a view to implementing one or some of them. *Idea quality* is, therefore, considered a goal of brainstorming [3]. Researchers [15] [3], have evaluated idea quality in terms of *originality* (the extent to which the idea is novel, out of the ordinary) and *feasibility* (the extent to which the idea is precise and easy to implement). However, *creativity* is an important aspect of idea quality. *Creativity* is defined as the quality of creating rather than imitating, and *creative ideas* are original rather than regular, newly created rather than "picked off the shelf" [17]. Sosik et al. (1998) define *group creativity* as a group's divergent production of ideas and claim that researchers have paid much attention to group creativity when examining groups interacting in face-to-face meetings.

There are four basic categories of divergent thinking: fluency, flexibility, elaboration, and originality [37]. *Idea fluency* is the number of ideas generated by groups, *idea flexibility* is the number of approaches used to produce solution units, *idea elaboration* is the number of comments that add detail of new features to a solution, and *idea originality* is the number of original solutions [37]. In this study, we will assess idea creativity using all four aspects of divergent thinking.

Even though the notion that there is a positive correlation between idea quantity and idea quality has not yet been theoretically supported or empirically examined, researchers have observed this correlation. For example, Potter and Balthazard (2004) propose an exploratory hypothesis anticipating the correlation, while Barki and Pinsonneault (2001) find evidence of the correlation. Potter and Balthazard (2004) argue that the common purpose for brainstorming is to produce one or more high quality ideas, and the notion of a constant proportion of high quality ideas to all ideas generated has yet been refuted. Therefore, we believe it is acceptable to include idea fluency as a dimension of idea creativity.

In our study, we also consider computer self-efficacy to be related to the way individuals use idea generation software. Social cognitive theory has been applied to the study of computer self-efficacy in earlier research; therefore, we discuss social cognitive theory and computer self-efficacy in the following section.

Social Cognitive Theory

Social Cognitive Theory was introduced by Albert Bandura during 1977-1986. SCT explains the triadic reciprocality of environmental influences, individual differences, and behavior. That is, individuals choose the environments in which they exist and thus affect the environments. These environments in turn affect the individuals as well as their behaviors, while the behaviors also affect the environments. Lastly, individuals' cognitive and personal factors affect their behaviors, which in turn affect those factors [6].

According to SCT, two sets of expectations are critical cognitive factors guiding individual behavior: outcome expectations and self-efficacy. Outcome expectation indicates that individuals are more likely to undertake behaviors they believe will result in valued outcomes. Self-efficacy is concerned with judgments of what one can do with the skills he/she has. It has an effect on the choice about which behaviors to undertake, the effort and persistence put forth in spite of obstacles to the performance of those behaviors, and the mastery of the behaviors. SCT states that individual's perception of self-efficacy influence his/her outcome expectations, and self-efficacy expectations influence individuals' ability to perform the behavior [5] [6].

Computer Self-Efficacy

Based on SCT, computer self-efficacy can be defined as a judgment of one's capability to use a computer to accomplish a task, and one's ability to apply his/her skills to broader tasks [5] [6]. Previous SCT-based research [5] [6] [7] has investigated the influence of computer self-efficacy and reported that self-efficacy plays a significant role in shaping individuals' feelings and behaviors. Individuals who had confidence in their ability to use computer had higher expectations of their outcomes and scored higher on measures of performance than those lacked this confidence. Additionally, in their longitudinal study, Compeau et al. (1999) revealed that those with high computer self-efficacy used computers more, had higher outcome expectation—both performance-related and personal, gained more pleasure from their use, liked using computer more, and experienced less computer anxiety. Therefore, it can be seen that self-efficacy represents a unique and important contribution to the development of computing skills even over a long period of time, and it will continue to be a determining factor when people decide what technologies to adopt, their extent of use, and how much to persist when there are obstacles to successful utilization of such technologies.

The term "self-efficacy" may have different meanings in different contexts [16], and other more general terms have been employed in previous research. For example, Hargittai (2008) uses the term "skill" and defines it as the ability to complete a task, how much time individuals spent on the task, and the level of efficiency and effectiveness with which individuals locate information online, while Marcolin, Compeau, Munro, and Huff (2000) make use of the term "user

competence," defined as "the user's potential to apply technology to its fullest possible extent so as to maximize performance of specific job task," in their conceptual model [33, p. 38].

Previous research [20] [21] [22] [24] [25] [29] [31] [38] has examined factors similar to computer self-efficacy; for example, self-efficacy, computer literacy, online fluency, online expertise, online skill, and experience with the Internet. This previous research points out that the amount of time users spent on computer is related to the users' level of skill, and the frequency of use as well as the length of experience with computer are the most important predictors of how the users use computer. That is, experienced users with greater skills and self-efficacy take up more activities more often than those with lower level of experience. These users also report higher level of know-how about computer, while those who have used computer for fewer years and spend less time on computer are less knowledgeable about it. Consequently, a lack of skills (such as not knowing how to use computer) is an important reason for low- and non-use of computer: individuals who have just gained access to computer recently, and who lack confidence in their skills, use computer more conservatively, stay with the more popular uses, and participate in fewer activities.

It can be seen that individuals' degree of computer self-efficacy is an important factor affecting the way these individuals use idea generation software. Hence, computer self-efficacy is likely to influence users' beliefs about the software, and these beliefs can have an effect on the users' perceived capability to use idea generation software to accomplish tasks.

RESEARCH MODEL AND HYPOTHESES

The research model for this study is shown in Figure 2 below.

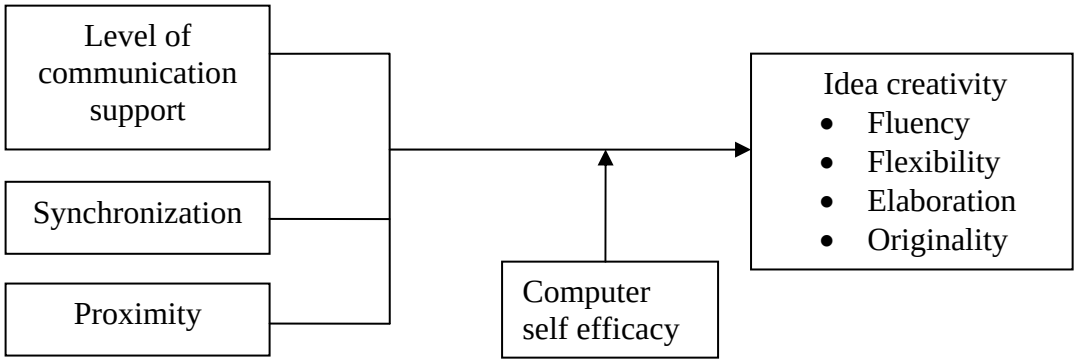

Figure 2. Research Model

This model suggests that level of communication support, synchronization, and proximity can significantly influence idea creativity in electronic brainstorming—assessed by idea fluency, idea flexibility, idea elaboration, and idea originality. Additionally, computer self-efficacy may play a moderating role in an electronic brainstorming session.

According to the model, we propose the following propositions:

Proposition 1: Groups provided with high level of communication support will have higher level of creativity than groups provided with low communication support.

Proposition 2: Groups meeting in an asynchronous environment will have higher level of creativity than groups meeting in a synchronous environment.

Proposition 3: Groups meeting in a decision room environment will have higher level of creativity than groups meeting in a distributed environment.

Proposition 4: A group's level of computer self-efficacy will affect the group's idea creativity.

METHODOLOGY

We plan to validate the model through a laboratory experiment involving human subjects engaged in a suitable idea generation task. The level of communication support (high/low), synchronization (same time/different time), and proximity (same place/different place) will be manipulated in the experiment. The four aspects of idea creativity will be assessed through content analysis of the group discussion.

All four independent variables have two levels, which will result in a 2x2x2 factorial design (8 cells). The manipulative nature of the independent variables will make Multivariate Analysis of Variance (MANOVA) an appropriate analysis for this study. A recommended minimum cell size for MANOVA is 20 observations [19], and we believe that the appropriate group size is three since this size enables one to be able to obtain the largest number of groups with the smallest number of subjects [12]. Therefore, this experiment will include 160 groups of three, resulting in 480 subjects.

Statistical analysis will be conducted to test the proposed model. First, confirmatory factor analysis will be employed to determine whether the number of factors and loadings of items involved in the perceived strategic value conform to the model. Then MANOVA analysis will be utilized since we manipulate the level of communication support as well as time/place settings of the electronic brainstorming sessions.

DISCUSSION AND CONCLUSION

This research focuses on the effects of creativity software on electronic brainstorming in different time/place settings. The results can be used as a guideline for future research that aims to examine GSS-support activities as well as IT communication support, and this stream of research can create knowledge about factors and group setting that enhance idea creativity, about individual and organization characteristics that affect idea creativity, and about user satisfaction resulted from idea creativity.

As indicated earlier, very little GSS research has been conducted on the non-ST/SP environment. This study will be one of the first few studies that provide the research background and the

empirical findings on different time/place environments. Thus, we believe that the electronic brainstorming model being used in this study will have both managerial implication for practitioners employing creativity software in different business settings (face-to-face, virtual team, etc.), and academic implication for researchers who are interested in electronic brainstorming or other GSS-based tasks in different time/place settings.

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