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The Impact of Communication Technology: The Influence of Task Type on Group Performance

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THE IMPACT OF COMMUNICATION
TECHNOLOGY: THE INFLUENCE OF TASK
TYPE ON GROUP PERFORMANCE

BY
ZHI LI

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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ABSTRACT

This thesis focused on how communication technology influences group performance. The purpose of this study is to examine whether there is a difference in group performance across different communication media when groups are working on an idea-generation task. Past research proposed that different communication media contain different degrees of richness of information. It is proposed that there must be a fit between the richness of information transmitted through media and the information richness requirements of that task. Face-to-face (FTF) communication was considered as an information-rich medium.

Computer-mediated (CM) communication was conceived as being limited in information richness. Therefore, the investigator proposed a hypothesis that groups using CM communication will outperform FTF groups when working on a task that requires a low level of richness of information such as an idea-generation task. In addition, it was proposed that the CM groups will have a higher degree of satisfaction with their performance, the process employed to work on the task, and the communication medium, than FTF groups. The participants were asked to finish an idea-generation task in groups with 5 members each and complete a questionnaire regarding their experiences. The results generally didn't support the hypotheses and showed that there was no significant difference between FTF and CM groups in their performance, or satisfaction with performance and process. The CM groups were less satisfied with the communication medium than FTF groups.

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CHAPTER 1

STATEMENT OF THE PROBLEM

Groups are used in every aspect of human activity. Surowiecki (2004) argues that a collective intelligence exists in groups that “act collectively to make decisions or solve problems” (Surowiecki, 2004, p. 7). Groups benefit from members talking to and learning from each other. During the past three decades, in order to support collaboration and improve the performance and effectiveness of group decision making, there has been a proliferation of communication technologies. Technological advances have created new modes of communication available to group members such as instant messaging and video-conferencing. This leads to a question of when, how, and how well these technologies affect our communication and consequently, decision making. Some attention has been devoted to these questions. Especially, scholars have sought to find out how communication technologies affect group performance (e.g., Easton et al., 1989; Hollingshead, McGrath, O’Connor, 1993).

Research that compares the performance of computer-mediated and face-to-face groups indicates that these technologies have varying and complex effects on group performance and user satisfaction. It appears that characteristics of the group, the communication medium and task type may all moderate the effects of communication technologies on group performance and user satisfaction (Hollingshead, McGrath, O’Connor, 1993).

Communication technologies have not been absolutely established to improve group performance such as decision quality. One of the reasons is that users of

communication technologies in these studies may have encountered problems due to their lack of familiarity with the technology (Chun & Park, 1998). This problem may not be an issue today, however, because most users who were born since the late 1990s grew up with, and witnessed the proliferation of some of these technologies. They are familiar with and quick to learn new communication technologies. Therefore, the purpose of this study is to examine whether computer-mediated groups outperform face-to-face groups on a certain task using a social media platform based in, and primarily used by, individuals from China which may not be familiar to most American students.

CHAPTER 2

REVIEW OF LITERATURE

Computer-mediated communication

Computer-mediated communication (CMC) describes communication that takes place through a variety of computer-based media and can provide geographically distributed group members with video, audio, and text-based messaging capabilities (Graetz, Boyle, Kimble, Thompson, & Garloch, 1998). “These platforms include computer and audio and video conferencing systems, blogs, instant messaging, computer chat rooms, electronic mail, bulletin boards, Facebook, Twitter, YouTube and other social networking platforms (Harris & Sherblom, 2005, p. 261). Many of these CMC systems have software, specifically designed to help groups discuss issues, make decisions, and communicate effectively. For example, WeChat, a powerful instant messaging software used primarily in China, can help people form online groups and support group discussion. If you leave a message and you wish a group member to read it, WeChat can be used to send a notification to remind him or her.

CMC moves communication a step beyond space and time, allowing it to be “instantaneously asynchronous” or “nearly synchronous” and geographically prolific by co-occurring in multiple geographic locations at once. From a human communication perspective, CMC is also a social and psychological phenomenon, not just a technological one (Shedletsky & Aitken, 2004).

For example, more and more corporations are using communication technology

to connect geographically dispersed group members to stay competitive in today's electronically connected economy (Cummings & Worley, 2005). Corporate workers use technologies such as email to share documents as attachments, they use websites to post company information, computer messaging software to carry on group discussions, YouTube for digital video presentations, Facetime and Skype for synchronous spoken conversations, Facebook and other social networking sites to build social relationships with colleagues (Harris & Sherblom, 2005). The wide use of these technologies leads to a question: how do these technologies influence the communication of groups that use them and, consequently, group performance? Many researchers have examined the performance of computer-mediated (CM) groups versus no computer (face-to-face) groups.

Group members who use CMC tend to focus more on the task and instrumental aspects of the process than on the personal and social aspects of the group. Thus, they tend to be more content oriented and less social-emotional in their communication style than face-to-face groups (Walther, 1996). That is to say, they pay less attention to the group's climate and working relationships. Consistent with this finding, Metzger and Flanagan (2002) also report that CMC tends to be more goal directed and intentional. CMC is used to purposely seek out specific types of information and entertainment rather than to casually browse the web just to pass the time.

The equalization of team members' participation is another characteristic of CMC. Research shows that CMC creates less inhibition and thus leads to greater expression of personal opinions, including the use of personal insults and profanity

(Weisband, 1992). Several studies have found that members of CM groups participate more equally than members of face-to-face groups (Weisband, 1992). But Hollingshead's (1996) findings suggest that the apparent equalization effect is due to the information suppression effect because all members participate less in CM than face-to-face settings. The lower frequency of communication in CM groups has been referred to as information suppression (Hollingshead, 1996).

In terms of decision making outcomes, researchers have examined a number of variables including ability to reach consensus, riskiness of decisions, degree to which team decisions differ from the initial opinions of the members who make up the group (choice shift), and the quality or accuracy of decisions (Hedlund, Ilgen & Hollenbeck, 1998). CM groups often have more difficulty reaching consensus than FTF groups. The difficulty may be attributable, in part, to the diversity of opinions generated in CMC. This difficulty is also reflected in the time it takes to make decisions. CM groups have been found to take four to ten times longer to reach a decision than FTF groups (Warkentin, Sayeed, & Hightower, 1997). This may be because group members need more time to exchange information to find a solution which is agreed to by all. In other words, CM groups are less likely to reach consensus than FTF groups in a short amount of time, but given time, can perform well as FTF groups, such as those working on tasks that require them to generate more unique ideas (McGrath & Hollingshead, 1994).

CM groups also tend to make riskier decisions and exhibit more choice shift than FTF groups (Weisband, 1992). However, CMC appears to reduce group members'

criticisms and informal pressures of one another to conform to a particular idea or way of thinking during the group discussion (McGrath & Hollingshead, 1994).

Group Decision Support Systems (GDSS)

Another computer-based communication technology that also influences group performance is a Group Decision Support System (GDSS). A GDSS is any computer-based system which combines “communications, computer, and decision technologies to support problem formulation and solution in group meetings” (DeSanctis & Gallupe, 1987, p. 589). Groups using a GDSS may be configured in many different ways, ranging from having group members meet in one room at the same time or to having members interact from dispersed sites asynchronously. When meeting in the same room, group members have available the traditional verbal and non-verbal channels such as face-to-face communication, in addition to the electronic channel the computers and network provide. GDSS are designed to provide communication and collaborative work support for groups, even face-to-face ones. Some researchers have found that face-to-face groups often do not exceed or even equal the performance of the best individual in the group (Shaw, 1978). This inability of the group to live up to its potential reflects problems associated with the group process, a phenomenon which Steiner has called process losses (Steiner, 1966). For example, too large a group may reduce the motivation of each member and render coordination more difficult. Therefore, GDSS are designed to improve the group meeting process through reducing or eliminating process losses (George, Easton, Nunamaker, Northcraft, 1990).

For example, *GroupSystems*, software developed by the University of Arizona can help groups to achieve effective electronic brainstorming. During a brainstorming session, after an idea for discussion has been posted on *GroupSystems*, it is displayed on each group member's computer. As group members simultaneously type their comments on separate computers, those comments are anonymously pooled and made available to all group members for evaluation and further elaboration (George, Easton, Nunamaker & Northcraft, 1990). Compared to face-to-face brainstorming, electronic brainstorming supported by *GroupSystems* can reduce several psychological constraints associated with face-to-face meetings identified by Gallupe and colleagues (1992) such as production blocking (reduced idea generation due to turn-taking and forgetting ideas in face-to-face brainstorming) and evaluation apprehension (a general concern experienced by individuals for how others in their presence are evaluating them).

However, GDSS appears to have varying and complex effects on group process, performance, and user satisfaction. Research in this area has failed to provide a convergence of findings and the results are mixed. Ki Jeong Chun and Hung Kook Park (1998) systematically reviewed existing GDSS studies and explored the probable reasons for inconsistent findings regarding the effect of GDSS on group performance. In terms of decision quality, seven studies have shown that use of a GDSS improves decision quality compared to a no-support-at-all treatment (Easton et al., 1989; Gallupe, 1986; George et al., 1990; Lewis, 1982; Jarvenpaa et al., 1988; Jessup et al., 1988;). While two studies (Easton, 1988; Sharda et al., 1988) have shown the use of a

GDSS has no effect on decision quality, one study (Watson, 1987) reports that the decision quality of GDSS groups was lower than the no-support-at-all groups because users suffered from problems due to their lack of familiarity with the technology. In addition to decision quality, other variables that have been assessed pertain to user attitudes, including users' perception of their performance, their satisfaction with the decision process and outcome, and their intrinsic interest in the system. But the results of the effects of GDSS on user attitudes are also divergent. (Chun & Park, 1998).

It appears different factors, including task type, the communication medium, and the characteristics of the group may all moderate the effects of electronic technologies on group process, performance, and user satisfaction. A model proposed by Reder and Conklin (1987) demonstrates how influential group and task characteristics are on decision and process outcomes, and it also demonstrates how the communication medium affects these outcomes.

According to the model, "the impacts of group and task characteristics are filtered through the communication medium, directly affecting the outcomes and the message features, which in turn affect the outcomes. Although the direct influences of group and task characteristics are strong, the intervening influence of the communication medium may overpower them" (George, Easton, Nunamaker & Northcraft, 1990, p. 395).

Task typology

The task has been an important factor in the study of groups. Most small group researchers would agree that one cannot fully understand group process or

performance without taking into account the nature of the task on which groups work (Goodman, 1986). Numerous scholars have proposed theoretical frameworks that classify tasks on the basis of critical features. For example, Hackman and his colleagues (Hackman, 1968; Hackman, Jones, & McGrath, 1967) proposed three types of tasks: production (i.e., idea generation), discussion (requires an evaluation of issues), and problem-solving tasks (i.e., planning). Steiner (1972) classified tasks as unitary (tasks that yield a single outcome and that must be performed by the group as a whole) or divisible (tasks that can be achieved through a division of labor). He further classified unitary tasks based on determinants of group productivity, such as disjunctive (choosing the most productive member's input as the group's sole product), conjunctive (the group's product is limited to the contribution of the least proficient member), additive (the group's product is an equally weighted sum of the member's contributions), or discretionary (the group can choose how to weight the contributions of its members in determining the group's product). These categories reflect how members' efforts are combined to yield the group product. Laughlin and his colleagues (Davis, Laughlin, & Komorita, 1976; Laughlin, 1980) classified tasks into cooperative and competitive. Cooperative tasks include intellectual and decision-making tasks; competitive tasks include two-person, two-choice (e.g., prisoner's dilemma), bargaining and negotiation, and coalition formation tasks.

McGrath (1984) integrated many of the concepts proposed by Hackman (1968), Steiner (1972), Laughlin (1980), and their colleagues in his typology of tasks.

McGrath (1984) proposes that most group tasks can be classified into categories that

reflect the following four basic processes: “generate,” “choose,” “negotiate,” and “execute.” First, idea generation tasks include creativity tasks (such as brainstorming), and planning tasks (such as agenda setting); these tasks require groups to generate ideas. Second, intellectual tasks require solving problems with a correct answer, and decision-making tasks require deciding issues and then choosing a preferred answer. Third, cognitive conflict tasks require resolving conflicts of viewpoint, and mixed-motive tasks require resolving conflicts of motive-interest. Both of the requirements need to be achieved through negotiation. Fourth, execute tasks are those requiring executing performance and resolving conflicts of power such as contests tasks (i.e., compete for victory).

In this thesis, I wish to discuss group performance based on McGrath’s task circumplex. When comparing CM and FTF group performance across different tasks, outcome has been one of the measures. For example, with generation tasks, the objective is to generate as many solutions as possible; so group performance as an outcome is measured by the quantity of unique or creative ideas generated. Intellectual tasks have a demonstrably correct answer, so the outcome is measured by whether the answer is correct. Decision making tasks have no demonstrably correct answer; group members need to reconcile different information, attitudes, and opinions to reach consensus, so the outcome is measured by whether they reach consensus and choose preferred alternatives. Negotiation tasks are the most difficult on which to reach consensus because group members have mixed-motives. The outcome is measured by whether group members resolve conflicting interests as well

as their attitudes and opinions.

Communication media

In 1986, Daft and Lengel (1986) proposed information richness theory which suggests that different media contain different degrees of richness of information. “Richness of information refers to the amount of emotional, attitudinal, normative, and other meanings that the information carries beyond the literal denotations of symbols” (Hollingshead, McGrath & O’Connor, 1993, p. 310). A rich communication medium can provide multiple simultaneous communication modes with verbal and nonverbal cues, synchronous feedback, a variety of languages and inflection, and a personal focus that conveys feelings and emotion along with the informational content which produces a greater sense of social presence (Trevino, Daft, & Lengel, 1990). Social presence is the perception among group members that the communication medium facilitates the development of their social-emotional-relational communication and shared meaning (Short et al., 1976).

Face to face communication is an information-rich medium and has the greatest opportunity for establishing rich communication and social presence. Group participants could simultaneously exchange more types of information (emotional, attitudinal, relational and contextual) in a face-to-face setting. Video-conferencing, followed by audio-conferencing, and then text-based computer conferencing systems, in contrast, are considered leaner communication media. “Leaner media” refer to media that do not carry all types of information simultaneously (Harris & Sherblom, 2005).

Daft and colleagues (Daft & Lengel, 1986; Trevino, Lengel, & Daft, 1987) argue that there must be a fit between the richness of information and the information richness requirements of that task. The information can be transmitted through that system's technology. McGrath and Hollingshead (1993) have applied Daft and Lengel's (1986) notion of task-media fit to the domain of communication medium. They present a frame work that is a four-by-four matrix. One axis of the matrix is defined in terms of McGrath's (1984) task circumplex (generating ideas or plans, choosing the correct answer, choosing a preferred answer, and negotiating conflicts of interest). The other axis consists of four media forms (computers, audio systems, video systems, and face-to-face communications) that vary in information richness.

The first three types are cooperative tasks, but the last one has both competitive and cooperative features in which group members must reconcile individual competitive goals with group cooperative goals. These four task types also reflect successively increasing degrees of interdependence among members, thus making consensus successively more difficult (Argote & McGrath, 1993). Interdependence is the mutual reliance between two or more group members. For example, generate tasks do not require consensus among group members, because the task objective is to generate as many ideas as possible. Each member can independently contribute ideas in the group setting and each original and unique idea contributes to increased group productivity and interdependence is low. Little coordination is required between members. Thus, with this type of task, there are minimal requirements for member interdependence.

Intellective tasks require group members to find a demonstrably correct answer (Laughlin & Ellis, 1986). If one group member has the correct answer either during or prior to group discussion, then it's not difficult for him or her to convince other members to adopt the correct solution (Hollingshead, McGrath & O'Connor, 1993) and so this type of task requires a low level of interdependence between group members. Decision-making tasks present more difficulty for groups to reach consensus, because there are no demonstrably correct answers. Group members must reconcile their different information, attitudes, and opinions to reach consensus. Negotiation tasks are the most difficult on which to reach consensus for group members, because they are mixed-motive tasks. Group members have to reconcile their conflicts of interest and their different information, attitudes, and opinions. This task requires the highest level of interdependence between group members (Straus, 1999).

“At each successive level of interdependence, the group's need for richness of information increases” (Hollingshead, McGrath & O'Connor, 1993, p, 313).

Generation tasks require the lowest level of richness of information because group members may require only the transmission of specific ideas. Negotiation tasks require the highest level of richness of information. This task type requires that group members reach consensus. Group members need to exchange a lot of information to resolve conflicts of views or interests such as different values, attitudes, emotion, expectations, commitments, and so on, on negotiation tasks. Intellective tasks lie between the two extremes noted, being above but nearer the low-richness end (Straus,

1992). Group members who know the right answer convince other members to adopt their idea, so this task does not require very much information exchange between group members. Decision making tasks lie between the two extremes but nearer the high richness end because this task has no correct answer. Group members need to exchange different ideas to arrive at a preferred answer and so this kind of task requires a higher level of richness of information to successfully complete (Straus, 1992).

However, that does not mean that media which have a high capability to transmit that richness of information are suitable for all kinds of tasks. The group may be less efficient if the technology provides more information richness than the task requires, because it may detract from efficient performance of the task. For example, Gallupe, Bastianutti and Cooper (1991) proposed that CM groups outperform FTF groups on generation tasks. Group members may be prevented from generating new ideas during discussion because they are distracted by hearing contributions of other members while waiting for their turn to participate. Therefore, on the basis of the literature reviewed, I predict that:

H1: On generation tasks, computer-mediated groups will outperform (generate more unique ideas) face-to-face groups when using a medium that has a low level of richness of information.

H2: On generation tasks, computer-mediated groups will report more satisfaction than face-to-face groups with their task performance, process, and communication medium.

CHAPTER 3

METHODOLOGY

Study population and sampling procedure

Participants in this study were 239 undergraduate students from several academic majors enrolled in undergraduate communication courses at the University of Rhode Island. The students were given extra credit for participating in the study. An alternative means of obtaining extra credit was available to those not wishing to participate. The participants were asked to work in groups of five members each. Participants were recruited, and the investigation took place, in their classrooms. The investigator told participants of the purpose of the study, asked if the participants had any questions, and then asked the participants to form groups with the person sitting closest to them. One of the group members (chosen randomly) in each group was charged with recording ideas but did not participate in the discussion. Approximately half of the groups met as computer-mediated groups, the other half met as face-to-face groups. Each group was labeled with an identification number.

These 239 students formed a total of 49 groups. Five groups were eliminated from further analysis because of an insufficient number of group members (group members did not reach five in member). Therefore, the final sample consisted of 44 groups. The breakdown of the number of groups per communication medium condition is as follows: 21 CM groups and 23 FTF groups. The recorder in each group wasn't required to complete the questionnaire which was administered upon conclusion of the group discussion. As a consequence, demographic information was

gathered from 176 students. The study comprised 76 men and 96 women (gender information was missing for four individuals). The mean age of the participants was 20.18, and 97.5% were between ages 18 and 23.

Research design

A brainstorming task called “The Tourist Problem,” used extensively in past studies on group brainstorming (e.g., Jablin, 1981; Lamm & Trommsdorff, 1973) was used. The participants were asked to generate as many ideas as possible to get more tourists to visit the United States (see Appendix A). A description of the task and information for completing it was provided for the FTF and CM conditions on paper. Participants were assigned, within their class, to different groups and media rich condition (CMC or face-to-face). The students were asked whether they had a laptop before the study. The students who did not have a laptop were assigned to face-to-face groups. The computer-mediated groups used Web-based WeChat as the CM platform with which to communicate with each other. I will discuss the characteristics of WeChat in detail later in this thesis. The study took place during regularly scheduled class hours in the classroom and students who were assigned to computer-mediated groups were required to bring their laptop. They were given instructions about how to register in WeChat and how to form online groups. Participants brainstormed the problem for 15 minutes, which was the length of time that has been adopted frequently by earlier research on brainstorming tasks (e.g., Dennis, Minas & Bhagwatwar, 2013; Jablin, 1981; McLeod, Lobel & Cox, 1996). During the discussion, the recorder in the face-to-face groups kept track of all the ideas the group

generated. After finishing group discussion, the recorder gathered all the ideas generated in their group and submitted them to the author. For the computer-mediated groups, the recorder kept track of the discussion record on WeChat, gathered all the ideas generated and submitted them via e-mail to the author. Although the investigator can identify recorders' names through email, the recorder wasn't required to complete the questionnaire. The identifying information from those who emailed the investigator will remain separate from the survey data collection. Therefore, the investigator will not be able to collect identifiable private information from the recorders.

Instruments and tools for collecting data

The computer-mediated groups used Web-based WeChat as the platform to communicate with each other. WeChat is a cross-platform instant messaging service developed by Tencent in China which was first released in January 2011. As of May 2016, WeChat has over a billion created accounts and 700 million active users with more than 70 million outside of China (Tencent 2016 Interim Report). WeChat is a powerful software which provides text messaging, hold-to-talk voice messaging, broadcast (one-to-many) messaging, video conferencing, video games, sharing of photographs and videos, and location sharing. However, in this study, to provide only a low level of richness of information, the participants were allowed only to use the text messaging function. WeChat allows users to form online groups and have a discussion. To register in WeChat, participants will need to provide their email addresses.

A questionnaire used by previous research (Dennis & Valacich, 1993; Dennis, Aronson & Heniger & Walker, 1999) was adopted in this study. This questionnaire is an assessment of a group's satisfaction and other outcomes (see Appendix B). The questionnaire has been slightly modified to fit the purposes of this study, and included four items asking for demographic information and nine items asking for participant's satisfaction with the idea generation process, ideas proposed, communication medium, being a member of the group and experience. In addition, there are two items asking whether participants had sufficient time to work on the task. All items use a seven-point Likert scale, with 1 indicating low and 7 indicating high. I will discuss the measures in detail later in this thesis.

The variation of the satisfaction scale used in this research assessed three types of satisfaction: performance satisfaction, process satisfaction and medium satisfaction. The performance satisfaction scale was composed of questions 3 and 4 on the questionnaire. The process satisfaction scale consisted of questions 1, 2, 8, 9, and 12. The medium satisfaction scale consisted of questions 5, 6, and 7.

Data processing procedures

Performance was measured by counting the number of unique ideas produced by each group. The investigator first identified all unique (i.e., non-redundant) ideas proposed (as identified from the list of ideas submitted by group members who were recorders) in the CM and face-to-face groups. An idea was counted only once for each group even if it appeared multiple times. Similar ideas were counted as one idea (Dennis, Aronson & Heniger & Walker, 1999). A second adjudicator (a graduate

student in Department of Communication Studies) independently identified the number of different ideas of 22 (11 computed-mediated groups and 11 face-to-face groups) randomly selected groups (50%).

To insure uniform identification of ideas in the CM and face-to-face groups by both adjudicators, guidelines suggested by Bouchard & Hare (1970) were adopted. The two basic rules were: (1) Statements that were too general were not counted as an idea because it was difficult to determine their intent. An example of this generality is “Advertise in Europe.” Some groups proposed that advertisements could attract tourists but did not say how. If there was a specific action, such as “Advertise in public transit in big cities such as London and Paris,” it was counted. If the action was too ambiguous, it was not counted. (2) A list of examples was credited as only one idea; however, if distinctions between examples were provided or explained, each was counted as an idea. For example, “Advertise Boston” and “Advertise LA” was counted as one idea, but “Ads about American clothing and restaurants” and “Ads about road trips across the country” could be counted as two ideas. Inter-adjudicator agreement was calculated as $1 - \text{Number of differences} / \text{total codings}$. Each adjudicator came up with a total number of unique ideas for the selected groups. The adjudicators agreed on 375 of 382 unique ideas. Therefore, inter-adjudicator reliability was 98.1% (Dennis, Minas & Bhagwatwar, 2013).

A questionnaire adopted by previous research (Dennis & Valacich, 1993; Dennis, Aronson & Heniger & Walker, 1999) was used to assess participants’ satisfaction. The questionnaire included four items asking about demographic information and nine

items indicating participants' satisfaction. All items used a seven-point Likert scale, with 1 indicating low and 7 indicating high satisfaction. Reliabilities, assessed via Cronbach's alpha were .87 for medium satisfaction (three items), .75 for process satisfaction (5 items) and .63 for performance satisfaction (two items). The recommended minimum level for reliability was .70. The reliability for medium and process satisfaction is adequate. The reliability for performance satisfaction is low. The three satisfaction scores per group were created by averaging the relevant satisfaction items for each measure (Adam, Roch & Ayman, 2005). All questionnaire data was analyzed using ANOVA. The independent variable is the communication medium condition the participants use (face-to-face or computer-mediated), with the dependent variable being satisfaction. Similarly, ANOVA was used for analyzing the hypothesized difference in number of ideas produced across communication medium conditions.

CHAPTER 4

RESULTS

Hypothesis 1

Hypothesis 1 predicted that on generation tasks, computer-mediated groups will outperform (generate more unique ideas) face-to-face groups when using a medium that has a low level of richness of information. The ANOVA procedure revealed that there is no statistically significant difference in the number of ideas generated between the two communication medium conditions, but the results were in the predicted direction ($F(1, 42) = 2.56, p = .117$). The results revealed that face-to-face groups produced on average 12.61 ideas while CM groups generated 16.43 ideas. Table 1 displays the means and standard deviations for group idea-generation across the two conditions.

Table 1 *Means and Standard Deviations for Group Idea-Generation Task*

Variables	N	Mean	Std.Deviation
CM	21	16.43	9.114
Face-to-Face	23	12.61	6.625

NOTE: N refers to number of five-person groups.

There were only 44 groups in this study when interpreting the results. Due to the small sample, power analysis has been taken into account. J. Cohen (1988) identified three types of effect sizes: small, medium, and large and established the minimum statistic power .80. Based on the .05 significance level, the investigator calculated the power in this study using Gpower software. The results showed the power for detecting large, medium and small effects was .83, .32 and .07, respectively.

Therefore, this study only had enough power to detect the largest effect. Thus nonsignificant results may reflect a lack of statistical power in this study.

Hypothesis 2

Hypothesis 2 proposed that on generation tasks, computer-mediated groups will report more satisfaction than face-to-face groups with their task performance, process, and the communication medium. The ANOVA procedure revealed that there is no significant difference between face to face and CM communication conditions with regard to satisfaction with performance ($F(1, 42) = .29, p = .591$), and process ($F(1, 42) = 1.08, p = .305$). However, the two conditions differed significantly on satisfaction with the communication medium ($F(1, 42) = 34.085, p = .000$). FTF group members were more satisfied with the medium than CM group members. Thus, Hypothesis 2 was not supported. Table 2 displays the means and standard deviations for satisfaction across two conditions.

Table 2 *Means and Standard Deviations for Performance, Process and Medium Satisfaction*

Variables	CM Condition			FTF Condition		
	N	M	SD	N	M	SD
Performance	21	5.32	.62	23	5.21	.71
Process	21	5.18	.45	23	5.35	.62
Medium	21	4.46	.69	23	5.69	.70

NOTE: CM = computer-mediated communication; FTF = face to face.

CHAPTER 5

DISCUSSION

Group performance

The analysis revealed that there is no significant difference in the number of ideas generated between communication medium conditions. Although the results didn't support the hypothesis, it should be noted that the CM groups in this study actually outperformed the FTF groups, even though not significant. The results did approach significance and likely would have been significant if the sample size had been increased.

At the start of this thesis, the investigator stated that past research showed one of the reasons for why communication technologies have not been absolutely established to improve group performance is the participants' lack of familiarity with the technology. But this problem may not any longer be an issue today because most users who were born since the late 1990s grew up with, and witnessed the proliferation of, some of these technologies. They are familiar with and quick to learn new communication technologies. WeChat is a social media platform based in, and primarily used by, individuals from China. Therefore, the author chose WeChat because it was believed that the platform may not be familiar to most American students as a communication medium for CM groups. However, in this study, the results showed that the performance between CM and FTF groups had no significant difference which indicated that high technology familiarity may have limited impact on improving CM group performance.

Group idea generation doesn't require a high level of information exchange between group members. If group members could express their own ideas effectively, the group performance could reach a better level. Therefore, an issue that should be noted is to what extent the lack of familiarity with the technology will affect effectiveness of idea expression. It's likely that the relationship between technology familiarity and group performance is not linear. There is a point that should represent the greatest impact of technology familiarity. If the level of user technology familiarity is lower than this point, it will affect group performance significantly. However, if the level of technology familiarity reaches that point, the influence of technology familiarity will be limited even if the participants have higher level than the point.

In this study, although the participants may become acquainted with WeChat very quickly and they had high skills in typing, the lack of familiarity still existed and may have inhibited their discussion at the start. For example, some participants had problems with the user interface at the beginning. If they accidentally clicked a certain button, they were confused with how to go back to the group discussion interface and had to ask for help from the investigator. Incidents such as these may influence CM group discussion process because it may detract the attention of group members from focusing on generating ideas. As a consequence, it lowers the performance of the whole group.

In addition, the effect of being acquainted with technology very quickly may not always be positive. The communication technology used in this study is not similar to

research conducted in the past. As I mentioned above, WeChat is a powerful software which provides text messaging, hold-to-talk voice messaging, broadcast (one-to-many) messaging, video conferencing, video games, sharing of photographs and videos, and location sharing. The students' high skills on becoming acquainted with WeChat in a short time may facilitate discovery of other functions such as the use of emoticons and using them during communication. Although the participants were directed to only use the text messaging function, they may have explored the use of other functions such as sharing of photographs and emoticons. The investigator ensured that participants didn't talk to each other by observing their behavior, but she couldn't monitor how participants communicated with each other in WeChat. The investigator did observe the use of emoticons among members in some groups and it may have influenced idea generation process in CM groups.

Emoticons can be divided into sticker and basic style. "Sticker emoticons are graphic messages specifically designed for use in communication apps and can offer more advanced emoticons than basic emotions. Sticker emoticons typically provide bigger images with more detail, such as illustrations and animation/movie characters" (Chang, 2016, p. 74). That is to say emoticons could enrich the communication process by adding nonverbal cues. For example, receivers of messages could detect senders' tones and feelings through the meanings expressed by emoticons. In addition, emoticons can also represent senders' standpoint such as agree or disagree. However, the most important theoretical principle in this study is there must be a fit between richness of information transmitted through the technology and the richness of

information requirements of the task. The richness of information transmitted through text messaging is the best for idea generation tasks. As a consequence, the nonverbal cues added by emoticons will transmit more richness of information and may lower CM group performance eventually.

Compared to the research done in the past, the performance of CM groups in this study might be improved by participants' high skills on becoming acquainted with technology, but it may also be impacted negatively by explorations of the technology's features. This situation didn't exist in past research due to the limitations in technology at the time. This may be the reason for the non-significant difference in the number of ideas generated between the two conditions in this research. For future research, scholars could use technology that is familiar to American students such as WhatsApp and Snapchat. Because the participants already know what functions this social media provide, they will not be distracted by exploring new functions.

According to research done by Chang (2016), the most commonly used Social Network Sites (Facebook, Twitter and LinkedIn) and communication apps (WhatsApp, WeChat and LINE) are all powerful and multi-functional, just like WeChat. This situation didn't exist in past research due to the limitations in technology at the time. However, investigations on CMC and group performance can't be limited to simple old technologies or the technologies which are rarely used because that's not the current trend. Scholars should investigate based on the frequently used technologies which could give us more implications and directions based in a more grounded reality.

One of the limitations in this research with regard to group performance is that individual participants were not randomly assigned into different groups. The investigator asked the participants to form groups with the persons sitting closest to them in their classroom. That means the participants may have joined groups with other participants with whom they were more familiar. However, member familiarity is a crucial variable to consider when designing work groups, especially CM groups.

Adams, Roch and Ayman (2005) found that member familiarity has a much greater effect in CM groups than FTF groups. The reason is member familiarity could add a richness of information such as nonverbal cues, which is not present within the CMC environment but is already present within FTF environment. For example, prior knowledge with group members may foster a mental picture or memory that increases the sensitivity to communication tone and the understanding of subtleties. Although this phenomenon exists in both CM and FTF communication, it may have a greater impact on CM groups because one of the theoretical principles in this research is the group may be less efficient if the technology provides more information richness than the task requires. The idea-generation task in this research is a task type which theoretically should require the least information richness. As a result, the CM group performance may be lowered. Therefore, the gap between FTF and CM groups regarding group performance may be minimized when the groups comprise members who are familiar with each other.

However, Adams, Roch and Ayman (2005) also found that the increase in member familiarity in CM groups could result in an increase in the efficiency of

social interactions far more than that for FTF groups in general. To be more specific, member familiarity may reduce the expenditure of time on social communication such as “Nice to meet you.” Member familiarity may even produce a reliance on slang terms or abbreviations known by some or all participants. Slang and abbreviated terms (i.e., ga = go ahead) has effect on the process of CMC because it can increase communication efficiency by decreasing the amount of typing. On the contrary, within FTF communication, member familiarity may facilitate conversations not related to the task (Adams, Roch & Ayman, 2005). In other words, the greater the familiarity among group members, the greater the chance for communication not to be focused on the task. In summary, member familiarity may improve communication efficiency in CM groups but not in FTF groups (Adams, Roch & Ayman, 2005). That is to say, it is likely that member familiarity may have maximized the gap between group performance across CM and FTF groups. However, it’s difficult to say how much member familiarity influences group performance in this research because member familiarity wasn’t assessed. As a matter of fact, a lot of research has already investigated how member familiarity influences group decision making (Adams, Roch & Ayman, 2005; Gruenfeld, Mannix, Williams, & Neale, 1996). Less attention has focused on idea generation tasks. This could be a focus for future research.

The second limitation is the possible influence of the differential make up of participants in CM and FTF groups. In the present research, the data for FTF groups were collected from three classes: two 100 level classes and one 300 level class. The data for CM groups were collected from six classes: four 100 level classes, one 300

level class and one 400 level class. Further analysis showed that, within FTF groups, 65.9% of the participants were juniors and seniors and 58% of the participants were majors in Communication Studies. Within CM groups, 59% of the participants were freshmen and sophomores and only 26.3% of the participants were majors in Communication Studies. The participants whose year of study is junior or senior have already been in college for two or three years. They likely have more life experiences pertaining to brainstorming generally, which can be applied to the task used in this study and, consequently might perform well. In this investigation, within FTF groups, 6 groups came from 100 level classes and 17 groups came from a 300 level class. Within CM groups, 14 groups came from 100 level classes and 7 groups came from higher level classes (300 and 400 level class). Due to the insufficient number of groups in higher level classes, we can't compare the performance between groups of different levels of classes. Therefore, one can't conclude that groups of 300 and 400 level classes could perform better than groups of 100 level classes. However, demographics of participants, such as this, should be taken into consideration in future research.

User satisfaction

The findings of this research don't support the hypothesis that CM group members are more satisfied with task performance, process and the communication medium than FTF group members. The results showed that there was no significant difference between different communication medium groups on satisfaction with performance and process; However, CM groups had lower satisfaction with the

communication medium than FTF groups, which was a difference opposite that hypothesized.

The questionnaire adopted in this study also assessed group satisfaction (question 10 and 11), production blocking, evaluation apprehension, free riding, synergy and stimulation and sufficient time. The analysis of this data could help us understand and interpret the results in this study. In order to know the relationship between the variables in this questionnaire, the Pearson correlation coefficient was adopted. Table 3 and Table 4 show the correlation coefficients between the number of ideas generated, satisfaction and other variables in the questionnaire. Although there are no universal guidelines for interpreting the strength of a statistically significant correlation coefficient, a general guideline provided by Guilford (1956) was adopted in this study. Guilford (1956) proposed that if the absolute value of the correlation coefficient is smaller than .20, the relationship is slight and negligible. If the absolute value is smaller than .40 but bigger than .20, the strength of association is a low correlation. If the absolute value is smaller than .70 but bigger than .40, the strength is moderate and the relationship is substantial. If the absolute value is smaller than .90 but bigger than .70, the strength of association is high.

The results showed that within CM communication, there was a moderate correlation between satisfaction with performance and process. In contrast, within FTF communication, there was a moderate correlation between performance satisfaction and process satisfaction, and performance satisfaction and medium satisfaction. The correlation between process and medium satisfaction is high.

Interestingly, there was no substantial relationship between the number of ideas generated and the satisfaction with performance, process and medium for both conditions. Due to the analysis above, we could draw a conclusion that group performance didn't affect satisfaction for both conditions. Similar to this finding, it was found in another study that there were no significant relationships between satisfaction and decision accuracy for an intellective task (Adams, Roch and Ayman, 2005). This similar finding with another type of task, an intellective task, illustrates that the results in the current study are not an exception. The reason might be that there was no gauge for assessing group performance by group members. Within the same group, some members may feel they perform well while others may dissatisfied with their performance. As a consequence, group members may indicate their satisfaction in an opposite direction even if they were in the same group. Future research could calculate the level of within-group agreement and explore whether there is a difference between participants of different class standing with respect to the correlation between group performance and member satisfaction. Because the students who have a higher level of class standing may have more idea-generation experience, they may also have a clearer and more similar gauge for assessing their performance.

Table 3: *Pearson Correlation Coefficient for Number of Ideas Generated, Satisfaction and Other Variables in CM Condition*

Variables	Performance	Process	Medium	GroupSatis	PB	EA	FR	SYN	SUF
N	.180	.087	.319	.291	-.087	.253	.121	-.038	.049
Performance		.440*	.341	.470*	-.335	.477*	.612**	.245	-.374
Process			.140	.657**	-.424	-.043	.582**	.211	.001
Medium				-.086	-.032	.349	.451*	.449*	-.008
GroupSatis					-.154	-.032	.162	-.229	-.170
PB						-.388	-.151	-.171	.539*
EA							.303	.070	-.621*
FR								.357	.075
SYN									.250

NOTE: *p < .05. **p < .01

N = Number of Idea Generated

GroupSatis = Group Satisfaction

PB = Production Blocking

EA = Evaluation Apprehension

FR = Free Riding

SYN = Synergy and Stimulation

SUF = Sufficient Time

Table 4: *Pearson Correlation Coefficient for Number of Idears Generated, Satisfaction and Other Variables in FTF Condition*

Variables	Performance	Process	Medium	GroupSatis	PB	EA	FR	SYN	SUF
N	.373	.058	.302	.165	.158	.386	.308	.365	.295
Performance		.502*	.634**	.488*	.230	.300	.708**	.728**	-.039
Process			.712**	.861**	-.213	.541**	.855**	.623**	-.248
Medium				.688**	-.295	.640**	.713**	.493*	-.274
GroupSatis					-.166	.629**	.783**	.531**	-.301
PB						-.204	.007	.406	.751**
EA							.587**	.474*	.020
FR								.706**	-.072
SYN									.365

NOTE: *p < .05. **p < .01

N = Number of Idea Generated

GroupSatis = Group Satisfaction

PB = Production Blocking

EA = Evaluation Apprehension

FR = Free Riding

SYN = Synergy and Stimulation

SUF = Sufficient Time

It's worthwhile to note that satisfaction with performance and process were significantly correlated for both conditions. However, satisfaction with the medium did appear to correlate with process and performance satisfaction, but for FTF groups only. A potential explanation may be CM groups relied on the knowledge of members because it minimized group members' interaction. Thus, the assessment of medium satisfaction in CM groups was more concentrated in the medium per se. In contrast, FTF groups relied on cooperation between group members which highly depended on interaction. Thus, the medium satisfaction was correlated with process satisfaction in FTF groups.

Furthermore, communication medium per se may not be the only factor that influence member satisfaction with medium. It may also influenced by other variables that are influenced by communication medium such as time (Straus & McGrath, 1996). In the present research, the post hoc analysis of question 22 and 23 dealing with whether participants have sufficient time showed that CM groups wanted significantly more time than FTF groups in the idea generation session ($F(1, 42) = 4.11, p = .049$). The mean score on question 22 and 23 was 2.7 for CM groups and 2.2 for FTF groups. In addition, for CM groups, the current study revealed significant negative correlations between the questions dealing with sufficient time and evaluation apprehension ($r = -.62, p = .003$). There was also a significant correlation between evaluation apprehension and performance satisfaction ($r = .48, p = .029$). The interpretation of this data could be, in CM groups, participants who have more apprehension did want more time, thereby influencing performance satisfaction. This

finding may be due to the fact that one can speak and listen more quickly than type and read text. Therefore, perhaps CM groups will have higher satisfaction if they are given more time to complete the idea-generation task.

For both conditions, there was a significant negative correlation between free riding and satisfaction with performance, process and medium. Free riding usually refers to the phenomena that people take advantage of being a member in a group without contributing to the group. In this questionnaire, free riding was measured by how group members evaluated their own performance. Thus, the higher the score indicated the lower level of free riding. This may give us an additional explanation to why the number of ideas generated in groups has no correlation with user satisfaction. That's because user satisfaction depends more on how they feel about their own performance. If they think they are doing well in this group, they will have high satisfaction. If they contribute less to the group, they may have lower satisfaction even if the whole group performed well.

It should be noted that the reliability of the measure of performance satisfaction ($\alpha = .63$) was lower than the recommended minimum level which was .70. Although this level is not a hard and fast rule and it varies depending on the instruments used and how important reliability is in a particular study, it was low compared to the medium and process satisfaction scales in this study. The performance satisfaction scale consisted of only two items, which may be one reason for the relatively low reliability. This is because Cronbach's alpha is affected by the number of items used by the instrument. If the number of items is too small, the value

of alpha is reduced (Tavakol & Dennick, 2011). Second, Cronbach's alpha was used to measure internal consistency which describes the inter-relatedness of the items within the test. However, in the two items of the performance satisfaction scale, one asked how do you feel about the ideas proposed, the other asked whether there is a diversity of ideas among group members. Do these two items relate to each other closely? It's questionable. The high quantity of ideas could result in high satisfaction with ideas proposed, but does not necessarily mean a high diversity of ideas.

CONCLUSION

This study compared group performance between FTF groups and CM groups on an idea-generation task. The computer-mediated groups used WeChat, a cross-platform instant messaging software, to communicate with each other. This is the first time that this kind of research was conducted based on a social media application. Unlike the software adopted in previous research, the social media application employed in this study was not designed to improve group performance. The purpose of the social media application was to allow people to build online social or private relationships with family, friends, colleagues or even strangers. In addition, most social media applications are so powerful that they allow cross-platform communication. Social media have been very popular which brings about a question. How does social media influence group performance and can it be used to improve group performance?

In the future, the investigator would like to conduct this research based on different social media, such as WhatsApp or LINE. On the one hand, comparing the results between WeChat and WhatsApp, the investigator could know the effect of technology familiarity. On the other hand, comparing the results among these three applications could help us explore the features which make the difference.

APPENDICES

Appendix A: Brainstorming Task

The Tourist Problem:

Each year a great many American tourists go to Europe to visit. But now suppose that our country wanted to get many more Europeans to come to America during their vacations. What steps can you suggest that would get many more Europeans to come to this country as tourists? (Taylor, Berry & Block, 1958, p. 58)

Appendix B: Satisfaction and Outcome Assessment Scale

INSTRUCTIONS: The purpose of this survey is to ask about your experiences with an idea-generation task in groups that use a face to face or an electronic communication medium. There are 4 items asking for demographic information and nine items asking for feedback regarding how you felt with the idea generation process, ideas proposed, communication medium, being a member of the group and the overall experience. In addition, there are two items asking for whether participants had sufficient time. All items use a seven-point Likert scale, with 1 indicating low and 7 indicating high. Please reflect how you think or feel personally, and indicate your answer as accurately as possible.

Group number:

Communication medium: 1.WeChat; 2.face-to-face

Age:

Gender: 1.Male; 2.Female

Major:

Class Standing: 1.Freshman; 2. Sophomore; 3. Junior; 4. Senior

1. How do you feel about the process by which you generated ideas?

Very Dissatisfied			Neutral			Very Satisfied
1	2	3	4	5	6	7

2. The group I was assigned to seemed to cooperate in an effective manner.

Stongly Disagree			Neutral			Strongly agree
1	2	3	4	5	6	7

3. How do you feel about the ideas proposed?

Very Dissatisfied			Neutral			Very Satisfied
1	2	3	4	5	6	7

4. There is a diversity of ideas among my group members.

Stongly Disagree			Neutral			Strongly agree
1	2	3	4	5	6	7

5. How satisfied were you with the communication medium (WeChat or face-to-face) your group used to discuss this problem?

Very Dissatisfied			Neutral			Very Satisfied
1	2	3	4	5	6	7

6. I would use this method of communication (WeChat or face-to-face) in future group idea-generation tasks.

Stongly Disagree			Neutral			Strongly agree
1	2	3	4	5	6	7

7. I enjoyed completing this task because I thought the method of communication (WeChat or face-to-face) was effective for the completion of the task.

Strongly Disagree				Neutral			Strongly agree
1	2	3	4	5	6	7	

8. In my group, all members participated equally.

Stongly Disagree				Neutral			Strongly agree
1	2	3	4	5	6	7	

9. I feel that I participated as much as everyone else in the group.

Stongly Disagree				Neutral			Strongly agree
1	2	3	4	5	6	7	

10. All in all, how satisfied are you with being a member of this group?

Very Dissatisfied				Neutral			Very Satisfied
1	2	3	4	5	6	7	

11. In general, I felt positive about other members of my group.

Stongly Disagree				Neutral			Strongly agree
1	2	3	4	5	6	7	

12. Overall, how enjoyable did you find your experience in this group?

Not at all Enjoyable				Neutral			Very Enjoyable
1	2	3	4	5	6	7	

13. When you thought of an idea,

Could you express it immediately							Did you have to wait to express it
1	2	3	4	5	6	7	

14. Did you express your ideas

Soon after you thought of them							After waiting a while
1	2	3	4	5	6	7	

15. Did you feel any apprehension about generating your ideas?

A lot of Apprehension				Neutral			No apprehension
1	2	3	4	5	6	7	

16. How at ease were you during the idea generation session?

Definitely not at ease				Neutral			Very at ease
1	2	3	4	5	6	7	

17. How much do you feel you participated in this idea generation session?

Not much at all			Neutral			A lot
1	2	3	4	5	6	7

18. How satisfied are you with your own performance on this task?

Very Dissatisfied			Neutral			Very Satisfied
1	2	3	4	5	6	7

19. How stimulating did you find this task?

Not Stimulating			Neutral			Very Stimulating
1	2	3	4	5	6	7

20. How interesting was this idea generation task?

Very Uninteresting			Neutral			Very Interesting
1	2	3	4	5	6	7

21. How motivated were you to generate quality ideas?

Definitely not motivated			Neutral			Very motivated
1	2	3	4	5	6	7

22. For this idea generation session, did you:

Have as much time as you needed			Neutral			Want more time
1	2	3	4	5	6	7

23. Considering all the ideas you thought of, did you:

Have time to express all your ideas			Neutral			Not have time to express all ideas
1	2	3	4	5	6	7

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