A SOCIAL CAPITAL PERSPECTIVE ON COMPUTER-MEDIATED GROUP PERFORMANCE AND CREATIVITY

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Abstract

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In light of the widespread deployment of technology for group collaboration in organizations, this research examines group collaboration with the theoretical lenses provided by distributed cognition. In particular, group processes and outcomes are impacted by the characteristics of the technology that mediate group interaction, as well as the social dynamics that play out within the group. Using a 2x2 factorial design, we empirically examine the combined impact of group memory (a technology factor) and group history (a social factor), on group performance and creativity. Group memory is manipulated with the presence (or absence) of the discussion transcript as an electronic aid that helps with communication recall. Group history is implemented by comparing groups that have worked together before versus those that have not. In addition we incorporate a social capital perspective in the analysis by studying the mediating effects of relational social capital operationalized as relational closeness and relational trust. To the best of our knowledge, this is the one of the few empirical studies to bring in a social capital perspective in computer-mediated group communication. While it remains that performance and creativity are two-fold objectives in most organizations, they may have different drivers. We explore this phenomenon in analyzing the differential impact of group history, group memory and social capital. Our results show that current technological advances have changed the

predictions that are traditionally associated with the impact of group memory and group history on performance and creativity. Traditionally, group history has been associated with low creativity, but our results show that this is not necessarily so. We find that history actually tends to improve creativity, especially in the absence of memory. Group memory, by lowering relational trust, has a positive impact on creativity. Relational social capital has a positive impact on performance but not on creativity. We propose that organizations evaluate the impact of history and memory, not in isolation, but in conjunction with each other and with relational social capital. This is of great relevance to organizations in decisions on group collaboration and technology.

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CHAPTER 1: INTRODUCTION

This research adopts a social capital perspective in investigating group performance and creativity within a synchronous computer-mediated environment. It incorporates a socio-technical view and analyzes the combined impact of technology variables such as group memory and social variables such as group history, on performance and creativity. The research further analyzes the mediating effects of social capital on the above relationships. In doing this, we add a new perspective to the investigation of computer-mediated group communication. This chapter introduces the background and offers the research questions. Chapter 2 offers a theoretical background, while the research method and hypotheses are covered in chapter 3. Chapter 4 describes the research methodology in detail. Chapter 5 discusses the data analysis and results; and finally, chapter 6 contains a comprehensive discussion with contributions, limitations and directions for future research.

1.1. Background

1.1.1 Group Collaboration

There is a growing awareness that to be competitive in a global marketplace, organizations must develop systems that enable employees to collaborate effectively (Strubler & York, 2007). Current trends in organizations highlight the widespread deployment of group structures including virtual teams, self-managed teams and team-based organizations (e.g., Frankforter & Christensen, 2005; Muthusamy et al., 2005; Sundstrom et al., 2000). Surveys have found that self-managed work teams are used by 79% of Fortune 1,000 companies and 81% of manufacturing organizations (Thoms et al., 2002). Several reasons for using work teams have been put forth, such as increased productivity, flexibility in meeting the demands of an increasingly diverse market, enhanced service and product quality, stronger employee

commitment to company goals, improved quality of workers' lives and job satisfaction, and higher customer satisfaction (Chansler et al., 2003). Teams offer the best solution for meeting business and market demands by offering multiple perspectives and combined efforts when compared to individuals, to such an extent that the difference between the success and failure for organizations may no longer lie in technology or methods alone, but in how teams contribute and perform (Bandow, 2001). Research on the dynamics of teams and the factors that make them perform better therefore takes on increasing importance.

1.1.2. Computer Mediated Communication

Collaboration implies the involvement of more than one individual. Research in psychology has shown that when two or more individuals work together, they can solve a problem correctly, than when individuals act alone (Slavin, 1992). Collaboration and group discussion results in the sharing of expertise and in the generation of multiple points of view and alternatives that individuals working alone might overlook. This could result in enhancing individual performance through cooperative learning (Slavin, 1992; Webb, 1992).

Collaboration involves the critical elements of communication and decision making. Communication is defined in Webster's dictionary as the process of transferring information from one entity to another. Decision making is an outcome of cognitive processes leading to the selection of a course of action among several alternatives. Collaboration can take place with or without the use of technology. Collaboration using information and communication technology is broadly referred to as computer-mediated communication (CMC), and the technology or the medium used for the process is referred to as computer-mediated communication system. A computer-mediated communication system (CMCS) is the use of computers to store, structure, process and distribute human communications (Hiltz & Turoff, 1985; Kerr & Hiltz, 1982). It

offers facilities to interact and exchange information for individuals and groups. CMCS fall under the umbrella concept of groupware, which refers to any kind of technological support for groups involved in a common task that requires coordination (Ellis et al., 1991). Groupware can encompass electronic mail, electronic bulletin boards, teleconferencing, group writing and computer-mediated communication system (El-Shinnawy & Vinze, 1998). Recent advances in groupware have enhanced the ways in which groups collaborate and perform (Turoff & Hiltz, 1982). Technology such as email, chat rooms, instant messaging, blogs and social networks has increased the social interaction and performance of groups (Preece, 2002).

Group collaboration can be conducted using CMC in different modes – either synchronously with all the members in the group communicating at the same time or asynchronously with the members communicating in different times. The current research focuses on the synchronous CMC environment.

Research on CMC has typically compared the performance of groups using CMC with those using face-to-face collaboration (Adams et al., 2005; Baltes et al., 2002; Becker-Beck et al., 2005; Dennis et al., 1990, 1991; Dennis & Gallupe, 1993; Flanagin et al., 2004; George, 1990). Research has proposed that while computer-mediated groups perform better in brainstorming (Dennis & Valacich, 1993; Gallupe et al., 1991) and decision-making tasks (Sambamurthy et al., 1993) they do not do so well in conflict management, problem solving or judgment tasks (Straus & McGrath, 1994). In terms of conformity within members, Adrianson and Hjelmquist (1991) found non-computer mediated groups to outperform computer-mediated groups. So the results on performance are mixed. However, group literature in this context indicates that groups are able to outperform individuals simply because of the knowledge they are able to share. Shared knowledge allows the group to access and evaluate the information

possessed by the members. Research has shown that shared knowledge has contributed to interpersonal communication, task performance and learning in groups (Klimoski & Mohammad, 1994; Larsen & Christensen, 1993). Therefore, technology that facilitates this sharing and exchange will be effective. We focus on the element of cognitive processing brought about by the sharing of knowledge by groups and investigate variables in CMC that enhance or impede such cognitive processing.

1.1.3. Group Memory for Cognitive Processing

An important variable in group collaboration that warrants further investigation is group memory. This is similar to individual human memory but is shared by all the members in the group. It is a repository that helps members in cognitively processing information and using it in the group decision making process. For our research, we focus on electronic group memory or the memory offered by the technology medium. Since groups involve multiple sources of information, we consider memory to be a core player in the cognitive processing and subsequent communication of the group. Not much work on knowledge and information sharing in computer-mediated communication has investigated the richness of electronic group memory in facilitating cognitive processing, thereby leading to improved performance. Most of the work has been done in the use of non-electronic memory aids within the context of software development (Espinousa et al., 2001; Lowry et al., 2009; Tyran & George, 2002; Yin & Miller, 2004) or brainstorming (Nunamaker et al., 1991; Satzinger et al., 1999). Work that has looked at the generation of electronic memory has been done in the arena of idea generation where Satzinger et al. (1999) looked at the electronic repository of ideas as group memory and analyzed the ideas as either paradigm-related or paradigm-modifying, denoting the extent to which ideas were similar or radically variant. However, research has not tried to address the concept of group

memory by having sound theoretical perspectives, such as the Media Synchronicity Theory (MST). We address this void and analyze group memory by incorporating insights not only from Information Systems theories such as MST but also from other sociological theories such as distributed cognition (Cole & Engestrom, 1993; Halverson, 2002; Hutchins, 1995a; Salomon, 1993), distributed creativity (John-Steiner, 2000; Paulus & Nijstad, 2003; Sawyer, 2003a; 2006) and team mental model (Cannon-Bowers & Salas, 1990). Our understanding of group memory for performance can be significantly enhanced by recognizing, reviewing, and integrating these separate research streams from other disciplines.

1.1.4. Group History for Cognitive Processing

Another integral construct in group collaboration and cognitive processing is the impact of the variables involving the group. One such variable that involves the group is the way in which the groups are formed. Scholars and management consultants have said that teams contribute to better outcomes due to factors such as improved performance (Applebaum & Batt, 1994), increased productivity (Glassop, 2002; Hamilton et al., 2003), or organizational responsiveness and flexibility (Friedman & Casner-Lotto, 2002). Organizations have typically been deploying work teams in different functional areas. Some teams are created on a long term basis in which the same members work together on different projects. These members have a history of working together over a period of time. Some other teams are created on a short-term basis as temporary work-units composed of people from different functional units, that later disband once the project gets completed. Due to the environment, work teams, in general, are afflicted by high membership volatility arising from transfers, mergers, closures, layoffs, and bankruptcies. This results in teams being composed of members who may have never worked together before. Organizations are therefore constantly evaluating the pros and cons of using

teams in which members have a history of interaction (established teams) versus teams in which the members are relatively new to each other and have no or limited history of interaction (ad hoc teams). Research in this area has provided inconsistent findings. Some claim the advantages of established teams in terms of information sharing (Carley, 1986; Stasser, 1992), cohesion between members (Yoo & Alavi, 2001), decision quality or member perception (Mennecke & Valacich, 1998), trust (Mayer et al., 1995) and enactment of shared mental models (Carlson & Zmud, 1999; Fulk et al., 1987; Kock, 2004; Minsky, 1986; Schmitz & Fulk, 1991). Others claim disadvantages arising from the long history of interaction between members in established teams, such as groupthink (Janis, 1982) (the tendency that induces members to sacrifice consideration of several alternatives in decision making for the sake of consensus and conflict avoidance), evaluation apprehension (fear of being evaluated), conformance pressure (Nunamaker et al., 1991), and domination of a few members. Ad hoc teams are claimed to have diversity in the form of differing views and opinions which could enhance creativity (Shaw & Barrett-Power, 1998; Campion et al.,1993; Guzzo & Dickson, 1996; Jackson, 1991; Magjuka & Baldwin, 1991), and help in arriving at better quality decisions (McGrath, 1984; McLeod & Lobe, 1992), but at the same time, lead to less integration when compared to established teams (Shaw & Barrett-Power, 1998). In the face of such inconsistency in the debate, organizations are often not clear as to which kind of groups, in terms of history (established/ad hoc), would work well to achieve optimal performance. Therefore, there is a clear need to bring in more theoretical insight for understanding the effects of group membership and history on group performance (Guzzo & Dickson, 1996). We address this need in our research by incorporating varied theoretical insights from different domains in addition to information systems in examining group membership and group history of teams.

1.1.5. Social Capital and Group Collaboration

Since group collaboration involves interaction among members, and such interaction gives rise to social capital, we adopt social capital as the lens with which we study the impact of the technology and group related variables on performance and creativity. Social capital is defined as "the set of resources that has positive outcomes to project team members through the member's social relationships, facilitating the attainment of goals" (Gabbay & Leenders, 1999, p. 3). By virtue of a history of interactions, established groups should accrue more social capital than ad hoc teams. Nahapiet and Ghoshal (1998) use the dimensions of social capital in an organizational context to analyze creation of intellectual capital. However, following Kogut and Zander's (1996) conceptualization of the organization as a social community that specializes in the speed and efficiency of knowledge creation and transfer, we incorporate Nahapiet and Ghoshal's (1998) dimensions within the context of group as a social community. We look at the relational dimension of social capital that arises from the personal relationships developed by members from their interactions (Granovetter, 1992). Research has used these dimensions in analyzing the impact of social capital on different variables such as performance of joint ventures (Thuy & Quang, 2005), venture creation (Liao & Welsch, 2005), organizational performance (Lazarova & Taylor, 2009; Moran, 2005), firm competitiveness (Wu, 2008), creativity (Chen et al., 2008), and knowledge contribution (Wasko & Faraj, 2005). However, not much research has adopted the social capital perspective within the context of computer-mediated communication. Our research addresses this gap in the literature by adopting a social capital lens on performance and creativity in computer-mediated groups.

1.2. Research Questions

Our research objective is to use computer mediated communication as the backdrop and to bring in multiple theoretical contributions from domains including social capital, knowledge sharing and distributed cognition, in analyzing the impact of group history and group memory on group performance and group creativity. The primary focus of the research is to investigate the extent to which the technology variable of group memory and the social variable of group history, being mediated by social capital, affect the performance and creativity of groups, within the context of synchronous computer-mediated communication. The overarching research questions that we propose using this perspective are:

> ***Research Question 1****: For small groups operating in synchronous computer-mediated environments, what is the role of social capital in facilitating/impeding group performance and creativity?*
>
> ***Research Question 2****: For small groups operating in synchronous computer-mediated environment, what is the role of group memory in facilitating/impeding group performance and creativity?*
>
> ***Research Question 3****: For small groups operating in synchronous computer-mediated environment, what is the role of group history in facilitating/impeding group performance and creativity?*
>
> ***Research Question 4****: For small groups operating in synchronous computer-mediated environment, what is the relative efficacy of group history and group memory on group performance and creativity?*

In the context of our research, we expect creativity to offer interesting insights in conjunction with performance, within the computer-mediated communication environment. While it is true that performance and creativity are two-fold objectives in many organizations, they often result from diverse factors. While it may be more productive for a group to have a high degree of social capital in terms of trust, shared goals and closeness, the very same factors may not conducive to the creativity of the team. Social capital therefore may have a differential

impact in terms of creativity and performance. Similarly, the presence of an electronic group memory, while enhancing performance of the computer-mediated group activity by increasing information focus, reducing attention blocking and information overload, may, at the same time, dampen the creativity of the team by fostering groupthink, convergent thinking and conformance pressure, thus causing a paradox.

Our research proposes to explore this performance-creativity paradox within a computer-mediated group environment. This is of great relevance to organizations since it offers insight into fostering an environment that can aim towards improving both the factors of performance and creativity. Additionally, organizations need to be cautious in not considering social capital as a panacea for better performance, especially if creativity and innovation are prime objectives.

CHAPTER 2: REVIEW OF LITERATURE

This chapter reviews relevant literature in computer-mediated communication and small group research. Within the domain of small group research, we identify two dimensions - the internal dimension of group relations and the external dimension of group composition. Group relations highlight the social aspects in groups relating to interactions and relationship development among members - which is the social capital. Group composition refers to the way in which the group is formed and the way in which the members synchronize their skills and abilities in a group context as opposed to an individual context. Together, these three broad areas of research (computer-mediated communication, group relations and group composition) provide the background for our investigation of group collaboration and its effects on performance and creativity. Computer-mediated communication offers the technology and related variables that impact group performance and creativity. Social capital or the group relations component brings into focus the interaction and relationships among members and the manner in which such interaction contributes to group behavior and performance. The group composition component reflects the manner in which the groups synergize their efforts and skills for performance and creativity, depending on the way in which the groups are formed. For these three areas of research we draw justification and backing from the theory of distributed cognition as an umbrella theoretical framework and apply it within the context of synchronous computer-mediated group communication. The following section describes the theory.

2.1. Theory of Distributed Cognition as the Umbrella Theory

Research on the role of technology in decision making is usually outcome-based and focuses on the amplification and augmentation perspectives (Angeli, 2008). From the amplification perspective, computers share the cognitive burden of performing tasks that humans

are not that good at - such as performing complex calculations, and storing and retrieving information (Salomon, 1993; Salomon et al., 1991). From the augmentation perspective, computers not only amplify what humans do, but also shape human cognition by facilitating the construction of mental representations of abstract concepts and phenomena through the use of advanced computer visualizations and simulations (Jonassen & Carr, 2000; Jonassen & Reeves, 1996; Pea, 1985; Pea, 2004). However, when computers are integrated into the flow of group activity, a qualitative transformation occurs regarding the ways in which the members interact and make decisions (Angeli, 2008). Cognition in such computer-mediated group interaction is distributed throughout the system, which includes the members, tools, and various artifacts and their interactions. In this context, the potential of technology is best exploited when combined with the members' intellectual, social, symbolic and other physical resources within an environment (Steketee, 2006). These resources offer support in developing and enabling the performance.

The performance effects in terms of amplification and augmentation will be valuable if interpreted within a conceptual framework that adequately reflects technology-enhanced performance as distributed cognitive systems comprising of humans, tools and artifacts (Angeli, 2008). The current research utilizes the framework of distributed cognition to effectively inform and illuminate issues regarding the outcomes of computer-mediated group collaboration.

The Theory of Distributed Cognition theory (TDC) was developed by Hutchins (1995a) and emphasizes the social aspects of cognition. It rests on the principle of cognitive science that acknowledges cognition as distributed rather than the property of an individual mind (Hutchins, 1995b; Salomon, 1993). Distributed cognition is not some new kind of cognition but recognition that all of cognition can be viewed as occurring in a distributed manner (Cole & Engestrom,

1993; Halverson, 2002). Researchers have moved away from viewing cognition as a property of the individual mind alone (Cobb, 1998; Lave, 1988; 1991; Lave & Wenger, 1991; Resnick et al., 1991) to perceiving cognition as a joint system composed of elements within an environment (Haugeland, 1998; Hollan et al., 2000; Hutchins, 1991; Hutchins, 1995a; Hutchins, 1995b; Moll et al., 1993; Norman, 1993; Pea, 1993). The revitalized interest in distributed cognition is ascribed to the fact that people rely on the affordances of their surrounding environment, i.e., other people, tools, and artifacts, to carry out or perform tasks.

The TDC focuses on mechanisms that make up cognitive processes which result in cognitive accomplishments. Since cognition involves coordination between individuals and artifacts, distributed cognition views a system as a set of representations and models the interchange of information between these representations. The representations could be internal (occurring in the mental space of the individuals) or external (available or created in the environment, as an artifact). In this way, distributed cognition involves two main features: one, it involves a cognitive process which may be distributed among multiple persons; and second, in the process, people use or create artifacts or external representations that are integral to the cognitive processing. Distributed cognition focuses on the interaction between the individual(s) and some technological devices (lo Storto, 2009; Rogers, 2004; Suchman, 1987; Trochim & Hover, 1996) or between the human and the physical artifacts (Giere, 2006), to perform a task.

The current research adopts the concept of cognition as distributed among people, tools, environment (Hutchins, 1995a; Salomon, 1993) and the interactions among these components (Rogers, 2004; Suchman, 1987; Trochim & Hover, 1996). Figure 2-1 depicts our vision of the theory of distributed cognition as an umbrella theoretical framework encompassing the three streams relating to our research.

Figure 2-1: Research Domains and Umbrella Theory

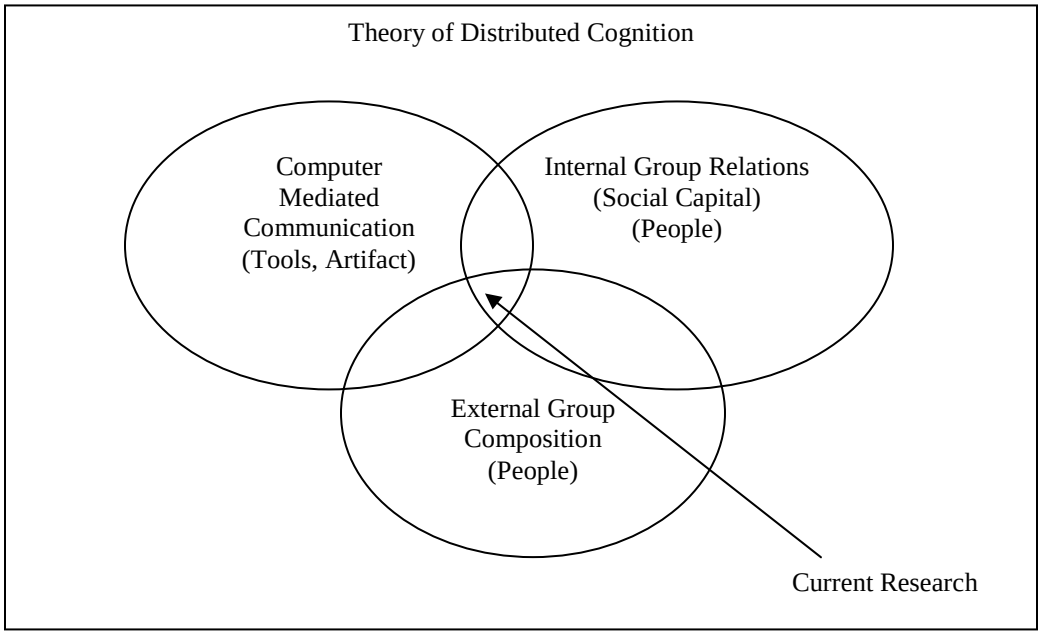


Figure 2-1 shows the current research at the junction of the three streams. The *people* component refers to the attributes regarding the external composition of the group and the internal relations among the group members (social capital). The *environment* refers to synchronous computer-mediated communication in which all group members communicate at the same time. The *tools* component refers to the technology that fosters the synchronous communication (the collaboration system), and the *artifacts* refer to things that are used in the process to enhance and improve cognition (such as electronic memory, external memory aids etc.). We conceptualize the computer-generated electronic group memory as an artifact that could be utilized to enhance performance. In the context of group memory, we also draw from the Media Synchronicity Theory (Dennis et al., 2008) in terms of the capability of the tool to offer the facility of reprocessability in communication.

The following section discusses the three streams of research in detail. Within each stream, we will review some relevant theories that further add to our understanding of the research context.

2.2. Computer-Mediated Communication (CMC)

With the rapid explosion of the internet in this digital era, contemporary organizations are adopting computer-mediated communication (CMC) for their operations (Li, 2007). Since communication is becoming ubiquitous with text-based messaging and other collaborative technology, more and more organizations are resorting to conducting their teamwork via CMC. Although organizations are eager to reap the benefits from integrating computer networks in their group work, they are also concerned about the performance outcomes from CMC in groups.

In this regard, many studies have been conducted to examine the incremental performance benefits and effectiveness in using CMC groups when compared to face-to-face groups (Adams et al., 2005; Baltes et al., 2002; Becker-Beck et al., 2005; Flanagin et al., 2004). However, research findings are not conclusive and sometimes even conflicting. Some studies suggest that CMC groups are superior to face-to-face groups in brainstorming (Dennis & Valacich, 1993; Gallupe et al., 1991) and decision-making tasks (Sambamurthy et al., 1993), but are less adept at performing other tasks such as conflict management and problem-solving (Straus & McGrath, 1994). Adrianson & Hjelmquist (1991) found evidence of lower degrees of conformity in teams relying on CMC than in face-to-face groups. Some studies report that CMC can increase group decision quality (Smith & Hayne, 1997), group participation, effective group leadership behavior (Smith & Hayne, 1997), democratic decision making process, decision satisfaction, process satisfaction (Huang et al., 2003; Martz & Shepherd, 2000), and the number of creative ideas. Some others have contrary findings that CMC actually reduces process

satisfaction (Benbasat & Lim, 1993; Dennis & Garfield, 2003; Dennis et al., 2001; Fjermestad & Hiltz, 1998-99). In the domain of information exchange, there have been a lot of inconsistent results with some studies showing that CMC groups exchange more information (Dennis, 1996), and others showing that this was not so, especially if information was not distributed equally among the members (Murthy & Kerr, 2003).

In the face of such conflicting results, organizations are in a dilemma whether to continue deploying CMC for groups, or resort to face-to-face discussions. However, in the realm of the current global economy, face-to-face communication is becoming increasingly infeasible. Part of the reason for the inconsistencies in findings lies in the fact that there are many variables and factors involved in team performance, other than task and technology. The same technology with the same task may result in different findings depending on the group that is using it. Therefore, outside of the task and the technology, the social component of the groups in terms of the interactions and the relationships that develop from working together, has a major impact on the group outcomes. It would therefore be viable to study the phenomenon of computer-mediated group communication using an integrated theoretical framework such as TDC, incorporating the multiple domains of information systems, cognitive psychology and sociology.

In addition to the need for adopting an integrated theoretical lens to study CMC is the fact that the portfolio of research in CMC in the field of Information Systems has been myopic in focusing on certain constructs and overlooking others. Fjermestad and Hiltz (1998-99) in their extensive meta-analysis of research on the process and outcomes of CMC show that the majority of research: focused on using the preference or brainstorming type of task from McGrath's (1984) typology; included more ad hoc than established groups; measured the outcomes of decision quality and satisfaction much more than creativity or consensus; and focused more on

non-facilitated group process structure rather than a facilitated one with leadership or facilitation. There is a void in research in terms of viewing the central role played by cognition as a group rather than as an individual function. Irrespective of the kind of technology or task deployed in CMC, cognitive processing is integral to group performance. Therefore, anything that facilitates or enhances cognition is an integral part of group activity. O'Donnel & Dansereau (1992) propose that group interaction involves a combination of cognitive/motor, affective, metacognitive and social activities. Cognitive/motor activities include comprehension, recall and skilled activities; affective activities include motivation, anxiety and concentration; metacognitive activities include comprehension, performance monitoring, error detection and correction/awareness of performance levels; and social activities include awareness of, and effective communication with others in the group setting. All of these activities point to having a technological facility that can enhance information storage, processing, recall and exchange - in short - an equivalent to a human memory, in a group context. Sarmiento and Stahl (2008) refer to this as 'group remembering.' A manifestation in CMC that allows such group remembering would be an electronic group memory. However, there has been little research that has looked at the pros and cons of having an *electronic* memory for groups to access and use. Two things that stand out in this arena are: first, there is a paucity of research that looks at the implications of electronic or computer-mediated memory; and second, even research that has investigated electronic memory (Tyran & George, 2002) has not looked at the comparative effect of computer-mediated groups performing with and without an electronic group memory. From an organizational perspective, this kind of research is vital since it determines the effectiveness of offering memory aids as representations and artifacts to work teams.

In addition to group memory, another important component in computer mediated group communication that warrants discussion is the history of the group. An organization is composed of a combination of employees who have worked for many years and those who are new to the organization. Some teams are formed with members who have worked together for a period of time, thereby building a rich history of interactions. However, not all teams have this characteristic. Due to economic and social factors, there is high level of transient team membership caused by layoffs, turnover, and other trends, resulting in teams with members who may have never worked together earlier. Although research explicates the pros and cons of having teams with and without history, there is no consistency in findings.

A thorough examination of these two integral components of group memory and group history in computer-mediated group communication therefore requires insight into strong theoretical foundations. In the current research, we investigate these components with the two theoretical perspectives used in CMC research - the media dependent perspective and the social construction perspective.

2.2.1. The Media Dependent Perspective and Group Memory

The media-dependent perspective to CMC focuses on the ability of the media to facilitate communication interactions and task performance. This perspective presumes the mechanical characteristics of the medium as inherent and looks at the fit between these characteristics and the type of task that the medium supports as impacting the outcome of the task (Yoo & Alavi, 2001; Li, 2007). The Media Synchronicity Theory falls in this perspective.

The Media Synchronicity Theory (MST) originally proposed by Dennis and Valacich (1999) and later expanded by Dennis et al. (2008) focuses on the ability of the medium to support synchronicity, which is “the extent to which individuals work together on the same

activity at the same time; i.e. have a shared focus" (Dennis & Valacich, 1999, p. 5). In other words, synchronicity is a shared pattern of coordinated behavior among individuals as they work together. Media vary in their ability to offer synchronicity. MST looks at any communication as being composed of the two basic processes of conveyance and convergence. Conveyance involves the transmission or dissemination of a variety of information to participants. Convergence involves the shared understanding or interpretation of information that has been transmitted. These two processes are enabled by one or more of the five capabilities that a medium offers: transmission velocity - the speed of the medium to deliver messages and feedback; parallelism - the ability of the medium to deliver multiple messages; symbol sets - the number of ways that the medium allows encoding messages using cues and non-verbal means; rehearsability - the extent to which the medium enables the sender to fine-tune or rehearse the message before sending (Rice, 1987); and reprocessability - the extent to which the medium enables the receiver to reexamine and reprocess the information during receipt (Dennis et al., 2008).

There is a dearth of research that has deployed MST as a theoretical framework. Chang (2005) used MST as a basis to study the differential effects of time pressure and synchronicity on group cohesion in face-to-face, synchronous and asynchronous teams working on a convergence task. Maruping and Agarwal (2004) adopt MST to identify and map the functionalities of a wide range of information and communication technologies within the context of conflict management, motivation, confidence building and affect management. However, this is not an empirical study but one that offers theoretical propositions for future research. Therefore, there has not been much research that empirically tests concepts from MST.

Unlike most other theories, MST focuses on communication performance rather than media choice. This fits well into our research framework that underlies communication performance of groups; additionally, since our research centers on computer-mediated communication, MST is appropriate in its focus on media capabilities to support the communication process. We specifically draw theoretical insights from the function of *reprocessability* as a facility offered by the medium to enhance communication performance. Reprocessability affects information processing by allowing a recipient to spend more time decoding messages either by revisiting prior messages for additional consideration (Dennis et al., 2008), or by providing a memory that can help new participants understand past activities (Nunamaker et al. 1991). The reprocessability of a medium can impact the transmission of information since it enables both senders and recipients to review and reconsider prior messages before engaging in communication. Reprocessability therefore offers a group-equivalent to a human memory in terms of facilitating group remembering and recall. When offered by the technology or medium for CMC, this is an electronic group memory.

Not much research has empirically tested the specific construct of electronic group memory. Research has looked at group memory in the context of the impact of anonymity on idea generation (Hayne et al., 2003), information exchange in hidden profile task (Dennis, 1996; Dennis et al., 1997-98), and information recall (Stasser & Titus, 1985; 1987; Stephenson et al., 1986a, 1983, 1986b). To our knowledge, Tyran and George (2002) are one of the few to have empirically tested group memory in the context of software inspection meeting process. They compared software inspection across three settings: face-to-face groups with no group memory, face-to-face groups with a non-electronic group memory, and computer-mediated groups with an electronic group memory. They found that while all groups reported satisfaction with the

process, computer-mediated groups with the electronic memory performed better than all others. However, their research, while focusing on the differences between face-to-face groups with and without memory, and computer-mediated groups, failed to analyze the differences between computer-mediated groups with and without memory. We address this void in our research as we compare computer-mediated groups having access to an electronic group memory with computer-mediated groups not having access to an electronic group memory.

2.2.2. The Social Construction Perspective and Group History

The social construction perspective (Yoo & Alavi, 2001) rests on the foundation that the social context of technology (meaning the way in which the technology is used and by whom it is used) sometimes alters the perception of the mechanical strength of certain media (Chidambaram, 1996; Carlson & Zmud, 1999; McGrath et al., 1993; Walther, 1995), which in turn impacts performance. For example, traditionally considered lean media that are not rich in communication cues may be perceived to be rich by groups that are highly cohesive and have a high degree of social awareness among members. Therefore, perception of the features of the medium depends on the extent to which the members of the group know each other and interact with each other. In particular, it has been shown that the richness of communication interactions using the same medium sometimes can be increased in groups with individuals who know each other or who have a rich history of working with each other. Walther (1995) found that the exchange of social information over leaner media became as effective as richer media over a period of time, as the members got to know each other. Chidambaram (1996) also found that the perceived social presence increased as group members spent more time with their communication partners.

The group history or the history of prior interactions between members in a group is therefore an important component in group communication. Groups with members who have a history of interactions and have worked together (established groups) will perceive things differently from groups with members who have no history or very limited history of working together (ad hoc groups).

However, there is no conclusive evidence in research on the advantages or otherwise of established versus ad hoc teams. Although some empirical evidence points to the advantages of ad hoc teams with limited or no history in terms of diversity (Watson et al., 1993), it has also been suggested that the same diversity may result in intragroup conflict (Jarvenpaa & Leidner, 1999; Jehn & Mannix, 2001; Jehn et al., 1999; Lau & Murnighan, 1998; Maznevski & Chudoba, 2000). Therefore even though research has compared established with ad hoc teams (Carlson & Zmud, 1999; Fulk et al., 1987; Hayne et al., 2003; Kock, 2004; Mennecke & Valacich, 1998; Minsky, 1986; Schmitz & Fulk, 1991; Stasser & Titus, 1987; Yoo & Alavi, 2001), there has not been much work that has investigated the impact of group history in conjunction with the presence or otherwise of an electronic group memory. In the current research we investigate the differential impact of group history in conjunction with group memory, on the performance and creativity of groups.

We now look at the second broad research stream in our study, which is the internal group relations or the social capital that arises from the relationships and interactions of group members.

2.3. Social Capital (Internal Group Relations)

Group collaboration involves an underlying element of relationship development. Relationships are generally created through exchanges between group members. It is the pattern

of the linkages and relationships built through such exchanges between members that form the foundation for social capital (Nahapiet & Ghoshal, 1998). In the broadest sense, 'social capital' encompasses those social relationships that help people get along with each other and act more effectively than they could as isolated individuals. We offer this as a separate stream of research since it sheds new light on the phenomenon of computer mediated communication.

The term social capital was first coined by Jacobs (1961) who pointed out that the central role of social capital for the survival and functioning of city neighborhoods is the networks of strong personal relationships developed over time that provide the basis for trust, cooperation, and collective action in such communities. Early usage only indicated the significance of social capital for the resources inherent in family relations and in community social organizations. Later on, Coleman (1990) suggested treating social capital in accordance with the premise that it is an asset benefiting the actors who have possession of it. Coleman also developed a comprehensive theory of social capital and his work inspired the diffusion of the use of the theory in relation to the study of actors who are pursuing interest-driven goals.

Bringing social capital to a group context, it can be said that group members need to network or interact with each other to exchange, transfer, and diffuse knowledge or information necessary to complete a task. The networks of relationships constitute a valuable resource for the conduct of social affairs, providing team members with the collectively owned capital (Bourdieu, 1986). Because the ultimate value of a given form of social capital also depends on contextual factors, four levels of analysis have been suggested for studying social capital namely individual, group, organizational, and national (Gabbay & Leenders, 1999). In the current research, we study social capital at a group level within a network (group) through which the members have access to needed resources for collaboration. Analysts of social capital are centrally concerned with the

significance of relationships as a resource for social action (Bourdieu, 1986; Burt, 1992; Coleman, 1988; 1990).

Research has viewed social capital as a multi-dimensional construct. Nahapiet and Ghoshal (1998) identified three dimensions of social capital - structural, relational, and cognitive - based on Granovetter's (1992) concept of structural and relational embeddedness. Structural social capital is the configuration of linkages or connections between the people (actors) in a network. It refers to who you reach and how you can reach them (Burt, 1992). Relational social capital describes the kind of personal relationships people develop with each other through a history of interactions (Granovetter, 1992), such as respect and friendship, which in turn, influence their behavior. Research on relational social capital has included concepts such as trust and trustworthiness (Putnam, 1993), norms and sanctions (Coleman, 1990; Putnam, 1995), obligations and expectations (Burt, 1992; Coleman, 1990; Granovetter, 1985) and identity and identification (Hakansson & Snehota, 1995). The third dimension, cognitive social capital, refers to those resources providing shared norms, representations, interpretations, and systems of meaning among parties such as shared language and codes (Arrow, 1974; Cicourel, 1973; Monteverde, 1995) and shared narratives (Orr, 1990). Tsai and Ghoshal (1998) conducted an empirical study to examine the relationship between the three dimensions of social capital in terms of social interaction, trust and shared goals, and found that they were linked. Incorporating the work of Nahapiet and Ghoshal (1998) and Tsai and Ghoshal (1998) we conceptualize social capital as encompassing social interaction (relational closeness) and trusting relations (relational trust and shared goals) – the relational social capital dimension.

To the best of our knowledge, research on social capital thus far has not been incorporated into the domain of CMC. Research has studied the impact and creation of social

capital through observations of manual interactions of people within a social network (Chen et al., 2008). In our research however, we study the impact of social capital as experienced through computer-mediation, and analyze its effect on group performance and creativity. We explore the relational dimensions of social capital. We find it appropriate to focus only on the relational rather than the structural dimension of social capital, since our attention is on intra-group rather than inter-group interaction in a network. The following sections describe the literature on the relational dimension of social capital which is relevant to our research.

2.3.1. Relational Social Capital

Relational social capital represents the quality of interpersonal relationships between members. Though structural social capital determines the potential for a person to access resources that are within reach, relational social capital shapes the willingness of the other party to actually *make* such resources available for exchange. For example, although an actor may have access to several people who are potentially critical sources of information, one's personal experience and the quality of past interactions will often influence whom he or she is likely to approach and who is likely to offer or exchange information. From an organizational view, social relationships, as a source of relational capital, are considered to be valuable capital in business networks (Dyer & Singh, 1998). Relational capital helps inter-firm collaboration and enables provision of accurate and timely information about other firms' competence and is also relevant for new venture creation (De Carolis et al., 2009).

Attributes of social relations that research has used to characterize relational social capital include relational closeness (Dillow et al., 2009; Miller & Thomas, 2005; Moran, 2005) and relational trust (Dyer & Chu, 2003; Lewicki & Bunker, 1996; Moran, 2005; Saparito et al. 2004; Zahra et al., 2006). These represent progressively deeper degrees of relational quality: from

propensity to provide resources via personal familiarity (relational closeness) to a deep sense of the contact's reliability and faithfulness in resource exchange (relational trust).

Relational closeness refers to the extent of personal familiarity in a relationship (Moran, 2005). Relationships can be classified on a continuum from arm's length to close relationships (Uzzi, 1996, 1997). The relevance of social capital arises from lasting and durable social relations that require expending significant time and energy (Bourdieu, 1986). Relational closeness has been investigated in the context of managerial performance (Moran, 2005), innovative ventures (Nohria, 1992; De Carolis et al., 2009), information exchange in terms of willingness to take time to explain or listen to novel ideas (Granovetter, 1985; Uzzi, 1996; Hansen, 1999), and willingness to disclose unethical behavior of team members (Miller & Thomas, 2005). The current research investigates the impact of relational closeness on group performance and creativity.

Relational trust is another component of relational capital. Trust is an essential prerequisite for most forms of interdependent relationships. It offers an assurance that one can rely on the intentions and behavior of specific others, in the face of uncertainty and vulnerability, in order to make decisions and act (March & Simon, 1958). Trust is both an outcome and an antecedent of relationships. It is the basis on which relationships are built and therefore generates social capital. It is also built from relationships (Zahra et al., 2006) and therefore arises out of social capital (Nooteboom, 2007). Trust can be built within relationships on a personal basis (interpersonal or relational trust) or on the basis of institutions (institutionalized trust) (Nooteboom, 2007; Bachmann, 2000). Another form of trust that exists in groups is swift trust that develops in temporary teams that are formed with a finite lifespan (Meyerson et al., 1996). Due to the time pressure that prohibits the ability of members to develop expectations of the

others based on prior knowledge, members in such teams import expectations of trust from settings with which they are familiar. They use categorical information processing to form initial stereotypical impressions of other members, thus resulting in a form of swift trust. However, swift trust de-emphasizes the interpersonal dimensions and is based purely on categorical social structures and action, while traditional trust is primarily based on interpersonal relationships (Jarvenpaa & Leidner, 1999). Also, according to the Time Interaction and Performance theory (McGrath, 1991), teams engage in the activities of member support (member inclusion, loyalty, commitment) and group well-being (interaction and member roles), both of which are overlooked in swift trust. The functions of member support and group well-being are said to relate directly to relationship development which describes the relational links between the members. These relational links between the members and the rest of the group are of paramount importance especially for new teams with no common past (McGrath, 1991). Based on this, there is a high need to investigate the phenomenon of relational trust or interpersonal trust in teams.

Trust facilitates the transfer and exchange of information, which is a critical element in group communication (Saparito et al. 2004). It can be viewed as the basic ingredient of social capital that allows a person to reliably expect to obtain and use the resources made available through contacts (e.g., Gambetta, 1988; Ring & Van de Ven, 1994; McAllister, 1995; Nahapiet & Ghoshal, 1998). Trust creates anticipation of value through social interaction with others and thus motivates actors to deepen relations and pursue interactions (Nahapiet & Ghoshal, 1998). Additionally, trust has a positive effect on information sharing (Dyer & Chu, 2003) by mitigating the information asymmetries that are inherent in information exchanges and encouraging open exchange of information.

Research on interpersonal trust suggests that it is a multidimensional construct which has a cognitive and an affective element (Lewis & Weigert, 1985; McAllister, 1995). The cognitive element includes individual beliefs about competence, reliability, and professionalism, while the affective element includes emotional investment in the relationship leading to reciprocal feelings of caring, benevolence and shared goals (McAllister, 1995). Cognition-based trust is team members' beliefs about one another's ability and reliability to carry out the task (Kanwattanachai and Yoo, 2001). Affective foundations consist of people making emotional investments in relationships, leading to feelings of care and concern for the partners, in a mutually reciprocal manner (Pennings & Woiceshyn, 1987; Rempel et al., 1985). We adopt this multidimensional view of relational trust and study the affective component of interpersonal trust and the cognitive component of perception of shared goals in carrying out the task. We will henceforth call this variable *relational trust and shared goals*.

In the current research, we study the impact of relational closeness, and relational trust and shared goals, on performance and creativity, in teams using electronic communication. We are interested in seeing if teams that start with a high level of relational closeness and relational trust maintain, increase or decrease performance through their technology-enabled interactions. This phenomenon of investigating relational capital using computer-mediation has not been done in earlier studies.

In the following section, we discuss the third major stream of research that is relevant to our study, the group capabilities that impact performance and creativity.

2.4. External Group Composition

Groups have become an integral part of organizational activities. Therefore research on factors that impact group effectiveness and performance has become prevalent. Many factors

have been identified as impacting the effectiveness of group performance. Among these, the composition of the group or the way in which the group is formed is an important component. In this section, we draw from relevant group theories that reflect the group in terms of its composition and the impact on performance and creativity.

In group literature, the quality of group communication has been consistently discovered to play an important role on the effectiveness of group decision making. Hence, much effort has been exerted to identify the characteristics of group communication that are able to differentiate effective decision-making groups from ineffective ones (Collins & Guetzkow, 1964; Gouran & Hirokawa, 2003; Harper & Askling, 1980; Hirokawa, 1992; Salazar et al., 1994; Li, 1998; Hirokawa & Salazar, 1999; Kuhn & Poole, 2000).

Small group research is prolific in studies that compare the performance of groups with that of individuals in different kinds of activities such as memory recall, problem solving, decision making and physical activity. The discrepancy in performance has been substantiated with various theories relating to group behavior and dynamics. We highlight some relevant ones here that offer insight into our research context.

2.4.1. Complementary Task Model

Steiner's (1966) complementary task model assumes that each group member possesses abilities unshared by other members and that by combining these abilities groups could surpass the performance of persons working independently (Laughlin et al., 1969r). Such complementary skills also allow members to engage in divergent thinking that enhances the creativity of the group. It leads to more diverse input due to the differentiation in abilities and styles. It is widely recognized that access to non-redundant and diverse information leads to more creativity and innovation (Granovetter, 1973; Tsai & Ghoshal, 1998; Burt, 2000). In our research since we use

ad hoc teams in which members have limited or no history of working together, we expect them to be divergent in their thinking and interactions and in this way have complementary skills. Therefore using the principle of synergy, we expect the complementary task model to offer insight into the impact of the diverse or homogeneous skill sets on performance and creativity.

2.4.2 Social Facilitation

This theory has been used to explain improvements in a member's performance and drive, due to the presence of significant others. Zajonc (1965r) proposed that the presence of another member of same species increased the arousal or drive in the person performing the task. In our research, established groups that have members with a history of interaction may experience a high level of social facilitation due to the high degree of closeness, thereby increasing the drive to perform and collaborate better than ad hoc teams.

2.4.3. Collaborative Creativity

Creativity has been defined as the ability of individuals and groups to produce "novel ideas that are useful and appropriate" to a given situation (Unsworth, 2001, p. 289). Therefore, creative solutions to a given problem possess novelty, uniqueness, or originality (Butler & Kline, 1998). Creativity research has suggested that creative performance is affected by many different variables, including social and cognitive stimulation (Paulus, 2000), work and non-work support (Madjar et al., 2002), training (Mumford et al., 2001), team structure and process (Drach-Zahavy & Somech, 2001; Sosik et al., 1998; Taggar, 2002), the environment (James et al., 1999), and individual contributions (Grawitch et al., 2003; Taggar, 2002).

In the 1950s, the first wave of creativity research focused on the personality of the creator. Through the 1990s, a second wave referred to as collaborative creativity pursued the idea that creativity is found in collaboration and group dynamics (Farrell, 2001; John-Steiner, 2000;

Paulus & Nijstad, 2003; Sawyer, 2003a, 2006). This second wave of research has provided a new perspective on creativity. It shows how creativity is embedded in social groups, and how creative products emerge from collaborative networks (Hewett, 2005; Shneiderman et al., 2006; Sawyer & DeZutter, 2009). Group or collaborative creativity can be fostered by supporting interactional mechanisms like referencing, remembering, and bridging. Referencing refers to referencing of objects in a shared space, remembering refers to collective remembering of history of interaction, and bridging refers to bridging across related episodes of the group's activity (Sarmiento & Stahl, 2008). In this research, we use group memory as an interactional mechanism that offers referencing and remembering tools, and has a differential impact on performance and creativity.

CHAPTER 3: RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

In the current research, we seek an empirical explanation of the effects of group memory and group history on performance and creativity of groups in a synchronous computer-mediated environment. In addition, we explore the mediating effects of relational closeness, and relational trust and shared goals, on the above relationships.

Our independent variables are group history and group memory which are between-subjects manipulations. We incorporate the mediator variables of relational closeness and relational trust and shared goals, for the relational social capital dimension. We study the impact of the independent (Figure 3-1) and mediator variables (Figure 3-2) on the dependent variables of performance and creativity.

Figure 3-1: Main Investigated Effects

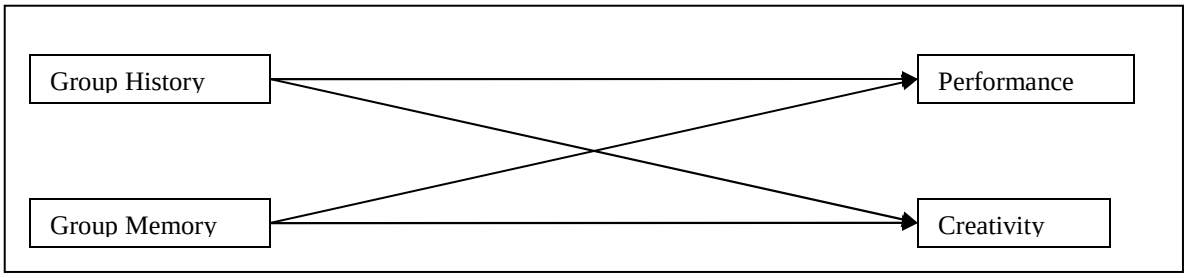
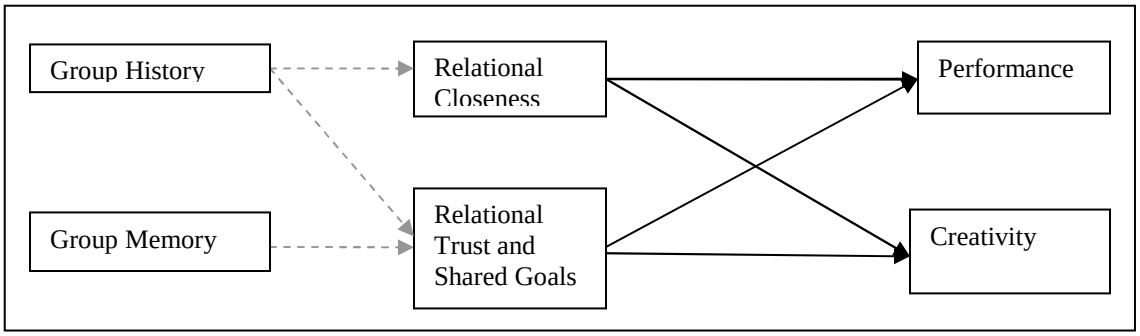


Figure 3-2: Intermediary Effects



The theoretical support for the investigation of the main effect of the independent variables of group history and group memory on performance and creativity of computer-

mediated communication comes from the Media Synchronicity Theory (Dennis & Valacich, 1999; Dennis et al., 2008) representing the media dependent perspective for the technological variable of group memory, and the social construction perspective for the social variable of group history.

The Media Synchronicity Theory reiterates the importance of reprocessability as an integral feature for communication using a medium. Reprocessability offers users the facility of reevaluating and reconsidering the options that are available and that are discussed before arriving at a decision. We operationalize reprocessability as the electronic group memory feature offered by the technology for group communication. Most previous studies have focused on a non-electronic memory component such as recall from human memory and manual memory aids. Additionally, previous studies have not manipulated the electronic group memory as a variable of interest in impacting performance.

The social construction perspective (Yoo & Alavi, 2001) states that the social context of technology - the way in which the technology is used and by whom it is used alters the perception of the mechanical strength of certain media (Carlson & Zmud, 1999; Chidambaram, 1996; McGrath et al., 1993; Walther, 1995). In other words, different groups perceive the same media in different ways depending on some social factors associated with the group. Perception of the features of the medium depends on the extent to which the members of the group know each other and interact with each other. In particular, it has been shown that the richness of communication interactions using the same medium sometimes can be increased in groups with individuals who know each other or who have a rich history of working with each other (Chidambaram, 1996; Walther, 1995). Established groups with a history may interact differently and use the technology in ways that vary from those of the ad hoc groups.

As an attempt to completely understand the main effect, we conduct a full examination of the intermediary effects of relational social capital that will further throw light on the main effect.

The theoretical support for the investigation of the mediating effects comes from the social capital theory. Group collaboration involves an element of relationship development. Relationships are built through exchanges between the members of a group. Such linkages and relationships represent the social capital which is the social relationships that help people get along with each other and act more effectively than they could as isolated individuals. This network of relationships provides team members with the collectively owned capital (Bourdieu, 1986). As social capital depends on contextual factors, research suggests four levels of analysis for studying it, namely individual, group, organizational, and national (Gabbay & Leenders, 1999). In the current research, we focus on the group level of analysis of social capital.

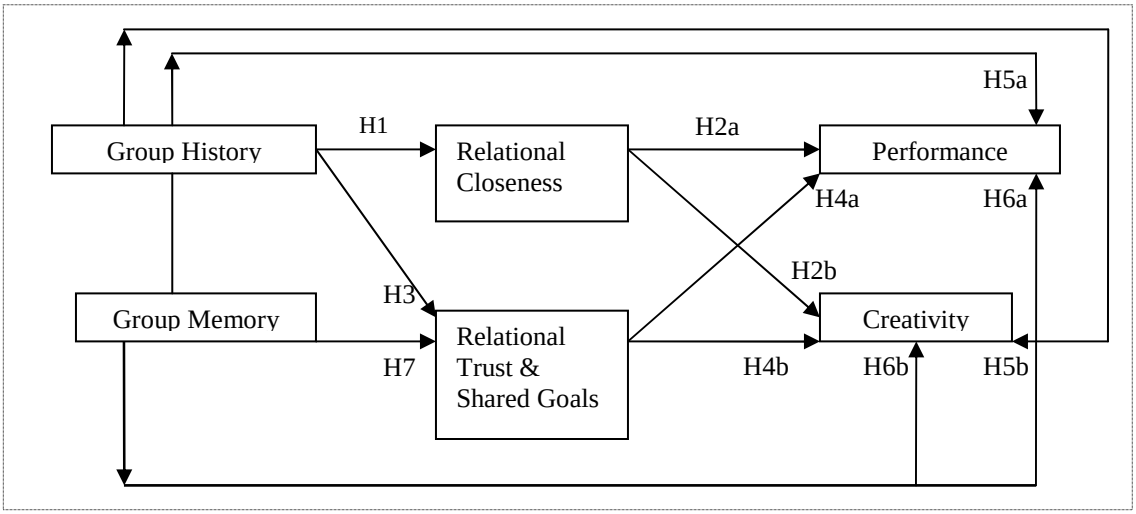
As mentioned earlier, the current research focuses on relational social capital which describes the kind of interpersonal relationships people have developed with each other through a history of interactions (Granovetter, 1992). This concept emphasizes the particular relations that people have such as respect and friendship that influence their behavior. We do not include the structural dimension of social capital proposed by Nahapiet and Ghoshal (1998). This dimension rests on the impact of the structure and resulting ties from such structure within a social network context. Our emphasis is on groups working independently rather than interacting within a network. As such, we consider interactions within a group rather than between groups. We have not used the cognitive dimension of social capital since we are using subjects who do not have the potential to have interacted for a long enough period of time to have developed a set of shared norms and preferences. We believe this to be a prospect for longitudinal research

where the teams develop and mature to a degree in which the cognitive capital arises. Therefore, we find it appropriate to focus on the relational dimension only. Following Kogut and Zander's (1996) conceptualization of the organization as a social community that specializes in exchange of knowledge, we adapt Nahapiet and Ghoshal's (1998) dimensions from an organizational context into our research context of a social community.

Performance and creativity are our dependent variables of interest. In evaluating performance we incorporate productivity measures and affective/perceptual measures. Productivity measures include the quality of output in terms of different dimensions of presentation, depth, strength and other criteria. Affective/perceptual measures include satisfaction with the process, satisfaction with the outcome and willingness to work with each other again. We also investigate the creativity of the team in terms of the output. Group memory is a variable that has been historically associated with lower creativity while group history has been historically associated with higher performance. However, the current research shows that the impact is even more significant when mediated by relational closeness and relational trust.

Figure 3-3 shows a combined model incorporating the main effects from Figure 3-1 and the intermediate effects from Figure 3-2. In addition we also incorporate the relationships between the independent and the mediator variables. The contribution of our model lies in the novel social capital lens that is used to study the impact of technological and social variables on group performance and creativity in computer-mediated communication.

Figure 3-3: Integrated Research Model



The following section describes the integrated research model with a detailed discussion of the hypotheses extracted for each set of relationships between the independent, mediator and dependent variables. We offer theoretical justification for these hypotheses. The section is organized to discuss the hypotheses in order.

3.1. Group History and Relational Closeness

Group history refers to the extent to which the group members have worked together in the past. The groups with members who have a history of working together are referred to as established groups and those with members that do not have history are ad hoc groups. CMC research has suggested that members of established groups, due to the history of interactions, have well-developed feelings about other members and the group as a whole (Mennecke & Valacich, 1998).

Relational closeness refers to the extent of personal familiarity in a relationship (Moran, 2005) and is a dimension of relational social capital (Nahapiet and Ghoshal, 1998). The theory of social capital states that social capital resides in the relationships between members, and that a lasting social relationship requires significant investment of time and energy of the members

(Bourdieu, 1986). The more the exposure and time spent by the members with each other, the more the potential for a high degree of familiarity and mutual regard (Bourdieu, 1986; Moran, 2005), which translates to relational closeness.

The social capital theory focuses on the concept of tie strength (Granovetter, 1973), which characterizes the closeness and interaction frequency of the relationship between two parties. Tie strength can range on a continuum from strong ties to weak ties (Granovetter, 1973). Strong ties represent frequency of interaction and closeness of relationship. These strong ties are important because they represent accessibility and willingness to help and exchange information (Krackhardt, 1992). Strong ties are also important conduits of knowledge (Ghoshal et al., 1994, Hansen 1999; Szulanski 1996; Uzzi 1996, 1997). Established groups that have a history of interaction will have strong ties and therefore high relational closeness (Moran, 2005).
Based on the above, we hypothesize that:

> *H1: Groups with history will have a higher degree of relational closeness than other groups.*

3.2. Relational Closeness and Performance / Creativity

While the existence of a tie (Granovetter, 1973) or relationship between two parties only offers the *potential* to exchange or share resources or information, it is the level of relational closeness that provides the *willingness* to actually do such exchange or sharing (Nohria, 1992). The information sampling model (Stasser & Titus, 1987) shows that both shared and unshared information needs to be discussed in order for teams to make effective decisions. In order for teams to get to the level of sharing, there needs to be a willingness to exchange information in each member. Teams that have a high degree of relational closeness will have members with a high level of willingness to share and exchange information. These members will take the time to listen, discuss and explain each other's suggestions (Moran, 2005).

Granovetter (1985) refers to contacts with high relational closeness as strong ties and those with low relational closeness as weak ties. While weak ties provide access to information and resources beyond those available in their own social circle, strong ties are the ones that offer the real motivation to make such resources available. This motivation to make resources available and willingness to exchange the resources leads to better performance in terms of less time taken to arrive at a decision, better quality of report, satisfaction with process, and satisfaction with task. In summary, information and resources can be exchanged mutually more effectively in groups with high relational closeness.

We also draw from the role played by social capital within the domain of knowledge management. Strong ties indicate high relational closeness that lead to better exchange of tacit knowledge (Levin & Cross, 2004) and useful knowledge (Ghoshal et al., 1994, Hansen 1999; Szulanski 1996; Uzzi 1996, 1997) which in turn, results in better performance. High level of closeness leads to more positive performance with process and solution (Dorfman & Stephen, 1984; Evans & Dion, 1991).

The literature on CMC shows that established groups have a high degree of cohesion, which refers to the members' attraction to the group (Hogg, 1992; Yoo & Alavi, 2001). Kerr and Jermier (1978) suggest that cohesion meets the group's affiliative needs. Cohesive groups will have warm, sociable and personal interactions between members (Yoo & Alavi, 2001). Based on this, we draw an analogy between cohesion and relational closeness. Group cohesion also appears to influence task participation and performance (Evans & Dion, 1991; Hogg 1992; Hoogstraten & Vorst 1978; Klein & Mulvey 1995; Narayanan & Nath, 1984; Podsakoff et al. 1997; Spink & Carron, 1994).

Due to increased positive, personal, and favorable interactions (Hogg, 1992; Lott & Lott, 1965; Piper et al., 1983), established groups exhibit increased performance since communication is less inhibited and more task-related.

Based on the above theoretical backing for relational closeness and performance, we hypothesize that:

H2a: Groups that exhibit a high level of relational closeness will outperform others.

Research on CMC suggests that processing of information is also affected by the convergence or divergence of opinion within a group (Dennis et al., 1997-98; Nemeth, 1986). Convergence of opinion arises at times when members align their thoughts in sync with each other. This leads to non-consideration of different perspectives which hampers creativity. Divergence of opinion exists when there are different perspectives that members bring into the discussion and the discussion takes on various threads. This enhances the creativity of the group. Established groups tend to have convergent thinking due to the high level of relational closeness that leads members to adhere to the opinions of the colleagues. Ad hoc groups by virtue of having low relational closeness due to the lack of prior interaction between the members will be characterized by multiple perspectives and divergent thinking. This will enhance the group creativity.

According to Steiner's (1966) complementary task model, each member brings a unique set of skills to the table and by combining these abilities, groups can perform better than individuals working alone (Laughlin et al., 1969r). Such complementary skills also allow members to engage in divergent thinking that enhances the creativity of the group. It leads to more diverse input due to the differentiation in abilities and styles. It is widely recognized that access to non-redundant and diverse information leads to more creativity and innovation (Burt,

2000; Granovetter, 1973; Tsai & Ghoshal, 1998). In our research since we use ad hoc teams in which the members do not have a history of working together, we expect them to be divergent in their thinking and interactions and in this way have complementary skills of interaction. The interaction results in all members deploying more cognitive effort, reexamining more options, and considering more perspectives (Ocker, 2005), thereby resulting in more novel and creative solutions (Nemeth, 1986; Nemeth & Chiles, 1988; Nemeth & Kwan, 1987; Nemeth & Wachtier, 1983).

Groupthink (Janis, 1982) is a phenomenon that groups with a high degree of cohesiveness suffer from (Yoo and Alavi, 2001), hampering independent thought and action. Established groups are inherently more cohesive since the members are familiar with each other and have a high degree of interaction. The members of established groups tend towards groupthink with members trying to align their thoughts with the other members, with the intention of appearing relationally close. This inhibits the creativity in established groups. Ad hoc groups on the other hand tend to be more diverse and varied and do not have the potential for groupthink. They will therefore be more creative.

Based on the above, we hypothesize that:

> *H2b: Groups that exhibit a high level of relational closeness will have lower creativity than others.*

3.3. Group History and Relational Trust/Shared Goals

Relational trust and shared goals is interpersonal trust that is constructed through personal interactions and experiences with the other party (McAllister, 1995; Rousseau et al., 1998; Moran, 2005).

The theory of social capital relies on the fundamental premise that people often require resources that are controlled and held by others, thereby introducing an element of uncertainty

and reliance (Coleman, 1990). Most interdependent relationships or group activities entail some form of trust (Moran, 2005). Trust offers people some assurance that one can rely on the intentions and behavior of others to take decisions and act (March & Simon, 1958). Trust develops when there is a history of favorable past interactions that lead participants to expect positive future interactions (Preece, 2002). Repeated interactions between members develop interpersonal or relational trust as the values and goals of the members become mutually intertwined (Uzzi, 1996). As members work with each other, trust is built among individual members because of the close personal ties (Kale et al., 2000). Established groups in which members have interacted previously will therefore have more interactions and by virtue of that, more relational trust (Zahra et al., 2006). Members of established groups that have a history of interaction and an expectation that they will interact again in the future, will consider it rational to cooperate. Additionally, this decreases the potential for members to act opportunistically (Jones & George, 1998), leading to increased trust.

From the point of view information assimilation, members in established teams accumulate detailed information about each other over time (Gabarro, 1987) offering more chances to instill trust and confidence in each other (Blau, 1986). This will motivate members to make greater contribution to the social exchange of the group (Mayer & Gavin, 2005).

Ad hoc teams in which members are not as familiar with one another are at a disadvantage in interpreting one another's behavior when compared to established teams. Ad hoc team members may misinterpret another's contribution to be disrespectful or undermining one's expertise, thus being detrimental to relational trust (Mayer et al., 1995). Groups with an established history of interaction therefore will have a higher level of relational trust and shared

goals, compared to ad hoc teams with no or very little history of interaction (Rousseau et al., 1998).

Based on these we hypothesize that:

> *H3: Established groups will have a higher degree of relational trust and shared goals than others.*

3.4. Relational Trust/Shared Goals and Performance/Creativity

Research on CMC suggests that teams with a high level of trust are proactive, have frequent interactions with substantive feedback and have shared goals (Jarvenpaa et al., 1998), all of which positively impact performance. On the other hand, teams with a low level of trust tend to be more reactive, have infrequent interactions with non-substantive feedback, and look at task goals with an individual approach rather than a shared view (Jarvenpaa et al., 1998), all of which adversely impact performance.

Trust also mitigates the information asymmetries that are inherent in information exchanges by encouraging open sharing of information (Bolino et al., 2002; Tsai & Ghoshal, 1998; Wu, 2008) which leads to better performance. Trust enables members to reliably expect to obtain and utilize the resources held by another member through one's contacts (Gambetta, 1988; McAllister, 1995; Nahapiet & Ghoshal, 1998; Ring & Van de ven, 1994). This has a positive impact on the performance of the group. Established groups that have a high degree of relational trust and shared goals therefore will have better performance.

A team with high levels of relational trust and shared goals makes better decisions (McEvily et al., 2003) due to the fact that they share more information and feel safe expressing their opinion (Dyer & Chu, 2003). Relational trust increases the extent to which the members can predict each others' behavior, thereby increasing their capability to coordinate activities and

willingness to help each other. Conflict resolution becomes easier with open information exchange thereby improving the overall decision making performance (Zahra et al., 2006).

Drawing from social capital literature in the knowledge management domain, trust can lead actors to establish relations and deliver knowledge more efficiently (Granovetter, 1973). A stronger relationship between entrepreneurial team members can lead to a stronger emotional attachment and further influence them to share knowledge and information (Reagans & McEvily, 2003).

Based on the above, we hypothesize that:

H4a: Groups with a high degree of relational trust will outperform other groups.

Trust causes a member to rely more implicitly on the other person's information and knowledge, and to pay less attention to the veracity of the information (Krishnan et al., 2006*).* It Trust creates insufficient and incomplete responses to the challenges posed to the group since it causes strategic blindness and limits cognitive behavior (Chen & Wang, 2008). In established teams that have a high level of trust, there is the tendency to adopt the information at face value (McEvily et al., 2003; Uzzi, 1997) which reduces the creativity of the group and makes the group lean towards the phenomenon of groupthink. However, ad hoc teams that do not have a high level of trust will have members who scrutinize the information objectively without having the pressure of conformance. The members will be open to receiving diverse opinions and thinking, enhancing creativity.

Relational trust can introduce rigidities and barriers to creativity and innovation by causing errors or judgment (Zahra et al., 2006). Excessive trust causes cognitive immaturity as a result of which an individual does not develop a threshold of trust, which, when exceeded, should trigger the need to revise expectations, attitudes and behaviors (Deutsch, 1973).

Accordingly, an individual may ignore evidence that would falsify previous assumptions of trustworthiness (Nooteboom, 2002).

Relational trust can cause overreliance on heuristics (Bazerman, 1998). Heuristics come into play especially in environments when information is limited and uncertainty exists. Since the phenomenon of availability heuristics leads one to only look for familiar information, new or novel points of view may be overlooked, thereby compromising creativity (Zahra et al., 2006).

Alternately, there is a body of research that suggests a positive relationship between relational trust and creativity (Chen et al., 2008; Dakhli & De Clercq, 2004) based on the fact that increased trust leads to willingness to share knowledge which in turn fosters creativity. High levels of trust can mitigate conflict and allow task conflict to be fully and constructively resolved, which by itself becomes a learning process for members allowing them to recognize new insights and become more creative (Simons & Peterson, 2000). According to these arguments, project team members with close interaction should be more likely to develop trust and trusting relationships, which lead to physical and emotional support for their project completion process, making them more open to new ideas and discussions (Liao & Welsch, 2003).

Combining the two perspectives we can surmise that varying levels of relational trust have an impact on the levels of creativity in teams. We therefore hypothesize that:

> *Hypothesis 4b: Groups with different levels of relational trust and shared goals will have different levels of creativity.*

3.5. Group History and Performance/Creativity

The CMC literature suggests that groups with a history will engage in an information sharing process that is different from newly formed groups (Carley, 1986; Stasser, 1992) and decision making. Members who have a history of working together have prior knowledge of

relevant cues such as other members' status, expertise, authority, role, conflict, positions on various issues, and language styles. Carlson and Zmud's (1999) concept of channel expansion posits that prior familiarity and experience with partners increases the ability to utilize a medium for wider range of communication purposes. Walther (1992, 1993, and 1995) showed that users of computer-mediated communication systems can develop personal impressions of other participants through repeated interactions or collaboration. These personal impressions help in facilitating information sharing and communication. Groups that have a history of working together establish a set of self-reinforcing rules governing what actions are appropriate to enable the group to coordinate the activities successfully (Weber, 2006) which leads to better performance. Yoo and Alavi (2001) suggest that for established groups, the cohesion among the members influences social presence and task participation, which then positively impact group performance.

According to the functional theory which represents an explanation for the relationship between communication and group effectiveness, several critical task requirements have to be performed for a group to achieve effective decision making. The group relies on group interaction to satisfy these critical task requirements. Established groups have superior decision-making since they are characterized by interactions that are able to successfully satisfy their task requirements (Gouran & Hirokawa, 1996, 2003; Hirokawa, 2003; Hirokawa et al., 1996) thereby improving performance. Moreover, when these interactions are stored in an electronic memory, it will further facilitate performance.

Based on the above, we hypothesize that:

H5a: Groups with history and memory will outperform other groups.

For a team to be creative, it is essential to have candid debates that foster diversity (Sethi et al., 2002). Established teams have a high degree of social cohesion among team members, which can actually suppress the forthright exchange of opinions and hamper creativity (Hogg, 1992; Yoo & Alavi, 2001) since members may perceive debate as a sign of dissention. Established groups focus more on maintaining relationships and thus tend to seek concurrence which will have an adverse effect on creativity (Janis, 1982; Sethi et al., 2002).

Flexibility or the variety of ideas is one criterion for evaluating creativity (Paulus, 2000). More variety of ideas is relevant in contexts in which diverse perspectives are represented within the problem-solving context, as in the case of ad hoc teams or organizational cross functional teams. In the face of a variety of ideas, the members will make a more concerted cognitive effort to consider more options and perspectives (Ocker, 2005), thereby resulting in more novel and creative solutions (Nemeth, 1986; Nemeth & Chiles, 1988; Nemeth & Kwan, 1987; Nemeth & Wachtier, 1983). On the other hand, established groups tend to be more homogeneous, making it less possible for different perspectives to surface (Grawitch et al., 2003).
Therefore we hypothesize that:

H5b: Groups without history will be more creative than other groups.

3.6. Group Memory and Performance/Creativity

The impact of group memory on group performance and creativity can be justified using different theoretical bases.

According to the information processing theory, individuals seldom have access to all relevant information and therefore when critical decisions need to be made, organizations typically deploy a team to work collaboratively. In information processing, the function of

information recall is affected by factors such as individual preferences, amount of information, the extent of familiarity with the information (Hightower & Sayeed, 1996; Stasser & Titus, 1987), and other cognitive limitations (Stasser et al., 1995) that impose restrictions on recalling larger information sets in their entirety, reducing the likelihood of even one item being recalled (Stasser et al., 1995). Having a group memory can mitigate these cognitive limitations on information recall by offering a repository for members to refer to and recall from (Rao & Jarvenpaa, 1991) thereby enhancing the performance of the group.

Computer-mediated communication and group research suggests that CMC groups sometimes have difficulty processing others' contributions due to the intense focus on trying to recall information or in making their own contribution (Nunamaker et al., 1991; Steiner, 1972), thereby overlooking the varied perspectives from others (Tyran & George, 2002). A group memory feature allows the group members to recollect everyone's contribution at their own pace and time, due to the maintenance of a group repository. The memory also helps new participants join the discussion at any time and still follow the thread of the discussion (Nunamaker et al., 1991). Additionally, in groups, due to the multiple sources, there is often information overload. Group memory helps counter information overload by facilitating filtering and reviewing information with modularity (Tyran & George, 2002). It offers an opportunity for group members to revisit prior messages for additional consideration (Dennis et al., 2008). Revisiting and reconsidering information enhances group thinking since it enables them to consider a gamut of alternatives rather than go with the most-discussed ones, thereby enhancing performance.

According to the theory of distributed cognition (Hutchins, 1995a) which is our umbrella theoretical base, cognition is viewed as distributed across people, tools and environment (Hutchins, 1995; Salomon, 1993). Groups of people are likely to accrue performance benefits

when they work together since they enhance their cognitive skills by using external representations as artifacts (Flor & Hutchins, 1992). Group memory is one such external representation that is an artifact that is used by the group. The recording of meeting interactions offered by group memory can be taken as evidence of the extent to which ideas represent cognitions that have been more or less processed by group discussions – that is, distributed cognition (Derry et al., 1998). Also, the memory supports the group interaction process by offering the facilities of referencing, remembering and bridging (Sarmiento & Stahl, 2008) by offering a larger span of alternatives (Flor & Hutchins, 1992). Based on the above we hypothesize that:

H6a: Groups with memory will outperform the other groups.

There are varying perspectives on group creativity and group decision making. Some researchers propose that group collaboration and problem solving has a positive impact on creativity while others claim an adverse effect. We present both perspectives here.

Individual creativity involves mental efforts to pursue ideas as well as interaction with a variety of physical artifacts that are meaningful to the individual (Sarmiento & Stahl, 2008). In a group context, this process must be extended and shared by the group members so they can have a shared understanding of the problem, with enough commonality to work towards a group accomplishment. Sarmiento and Stahl (2008) suggest that to support group creativity, one has to support building and maintaining a shared problem space, referencing of objects in that space, and collective remembering of relevant histories. In this context, group memory serves as an object which helps in the reasoning and recall functions of members, enabling members to explore a larger span of the problem space (Dennis & Valacich, 1994) leading to enhanced creativity. Group problem solving and decision making can bring together individual members

who hold different and unique sets of information thereby improving the creativity (Stasser & Titus, 1987).

Newell and Simon (1972) suggest that human cognitive processing is controlled by production rules which, when activated by external stimuli, produce ideas (Satzinger et al., 1999). Each of these rules is weighted according to some previous experience. The stimulus activates similarly weighted rules together, as a cluster. This implies that any external stimulus, presented in the form of an idea or a suggestion, will activate the production of closely related ideas in the brain (Dennis et al., 1996), which on the outset seems to reduce creativity. However, Satzinger et al. (1999) show that group memory can be used as a stimulus to induce creativity in the direction that is desired. Groups using a group memory can focus their solutions along a desired theme as well as explore alternative themes, depending on the objective on hand.

There is a body of research that postulates a negative impact of group memory on creativity. Group memory, with its repository of ideas, simulates a climate that induces members to be influenced by the paradigm relatedness of ideas (Nagasundaram & Bostrom, 1994-95), more than by their own preferred styles. Such paradigm-preserving or related ideas represent convergent thinking which reduces the motivation to consider diverse perspectives, thereby reducing creativity (Dennis et al., 1997-98; Nemeth, 1986; Satzinger et al., 1999). Additionally, groups with access to a history of interactions (group memory) among members will have a memory of social and content cues, allowing members to attribute authorship to even anonymous comments (Hayne et al., 2003). Due to this, members may experience evaluation apprehension which is fear of being exposed for proposing anything that is different from what has been proposed by the other members. This adversely impacts creativity.

Carley (1986) suggests that as a group develops, the members develop shared frames of reference that impact behavior. The shared frame of reference in turn leads to shared understanding of ideas, shared vocabulary and a shared knowledge base. This affects communication (Mennecke & Valacich, 1998) because such a shared perspective leads to the assumption of a lower need to communicate information since they think the others will understand through cues and signals without explicit communication. The members even tend to overlook and not use the memory based on the perception of this shared perspective. In such cases, groups with memory will have lower creativity from groups not utilizing the memory feature to enhance their cognitive processing skills.

From the two perspectives to the impact of group memory on creativity, we would like to hypothesize that:

H6b: Groups with memory will have different levels of creativity than other groups.

3.7. Group Memory and Relational Trust/Shared Goals

Groups with memory will have high levels of relational trust and shared goals.

The literature on knowledge contribution discusses two kinds of knowledge that an organization pursues – exploitative and exploratory (March, 1991). Exploitative knowledge builds on an existing base to create incremental solutions (Dewar & Dutton, 1986) while exploratory knowledge refers to radical solutions that are different from the existing knowledge base (Kang et al., 2007). Exploitative knowledge sharing will be best served by shared perception and shared goals.

The literature on *team mental model* (Cannon-Bowers & Salas, 1990) is relevant to the concept of group memory and shared goals. Team mental models are team members' shared, organized understanding and mental representation of knowledge about key elements of the

team's relevant environment (Cannon-Bowers et al., 1993; Klimoski & Mohammed, 1994). The general thesis of the team mental model literature is that team effectiveness will improve if members have an adequate shared understanding of the task, team, equipment, and situation (e.g., Duncan et al, 1996). This translates to the shared goals that is represented in our research by the variable relational trust and shared goals. Group memory helps achieve a shared understanding of goals by offering a repository that enables recall and reprocessing. It is an important contributor to creating a mental model of shared understanding of goals among the group members.

Based on this, we hypothesize that:

H7: Groups with memory will have higher levels of relational trust and shared goals than others.

Table 3-1 summarizes all of the hypotheses.

Table 3-1: Summary of Hypotheses

H#	Hypothesis
H1	Groups with history will have a higher degree of relational closeness than all other groups
H2a	Groups that exhibit a high level of relational closeness will outperform other groups
H2b	Groups that exhibit a high level of relational closeness will have lower creativity than others.
H3	Groups with history have a higher degree of relational trust and shared goals than other groups
H4a	Groups with a high degree of relational trust and shared goals will outperform other groups
H4b	Groups with different levels of relational trust will have different levels of creativity.
H5a	Groups with memory and history will outperform other groups
H5b	Groups without history will be more creative than other groups
H6a	Groups with memory outperform the other groups.
H6b	Groups with memory will have different levels of creativity than other groups
H7	Groups with memory have higher levels of relational trust and shared goals than other groups

CHAPTER 4: RESEARCH METHODOLOGY

In conducting quantitative research, one has to make several choices and decisions (Trochim, 2000). The primary decision involves the research method to adopt in terms of an experiment or a survey. Once a method has been selected, the researcher needs to decide on the subjects to use for the research. Since data will be collected from the subjects, an associated decision would be the unit for data collection and data analysis (individual or group). Caution needs to be taken in ensuring that the levels of analysis between data collection and data analysis are consistent (Gallivan & Benbunan-Fich, 2005). Further, if an experimental design is selected, then an implementation decision needs to be made on the way in which the subjects are dispersed among the different experimental conditions – whether the same pool of subjects are used for all conditions or a different pool for each condition. Finally, decisions need to be made in the selection of software, task, and the experimental procedure.

In this section we discuss each of these components in our research methodology.

4.1. Experimental Design

In research, the selection of methodology is guided by the research questions that are being explored. The two commonly used methods for quantitative research include experimental design and survey. Experimental design involves deployment of a controlled lab experiment and is used when the research investigates the impact of one or more variables (independent) on other variables (dependent) (Kirk, 2009). It uses manipulation and controlled testing to comprehend the causal relationships between the independent and dependent variables. The experimental manipulation of the independent variable, referred to as the *treatment*, is seen as a predominant reason for differences in the behavior of the dependent variable. There may be varying levels of the treatment in studying the impact on the dependent variable. Research using

an experimental design aims at making statements about a larger population or phenomenon of interest, based on the cause and effect relationship (Kirk, 2009). The extent to which such statements can be made is referred to as *generalization*. Research that allows the statements to generalize to the population at large is said to have high *external* validity or generalizability (Lee & Baskerville, 2003). Research that is successful in eliminating confounding variables within the research itself is said to have high *internal* validity.

A survey research methodology, on the other hand, is a non-experimental, descriptive one that is employed in research on phenomena that cannot be directly observed such as trends, attitudes or opinions of a population. Surveys are conducted by studying a sample of the population with the intent of generalizing from the sample to the population (Weisberg et al., 1989). These inferences of the population are based on the characteristics of the sample that is surveyed (Groves et al., 2009). Surveys usually collect data using questionnaires or interviews, and include both quantitative and/or qualitative measures.

There are pros and cons to using experiments and surveys (Weisberg et al., 1989). Experiments, through the use of controls and manipulations, while resulting in high internal validity, often suffer from low external validity due to the lack of generalizability to a larger population. Surveys, on the other hand, offer high external validity or generalizability, but suffer from low internal validity due to the presence of confounding variables that cannot be controlled. Therefore, the choice of either methodology is driven by the research objective and the research questions that one is trying to explore.

In the current research, we are interested in analyzing the cause-and-effect phenomenon between the variables of interest. Also, the research questions focus on the impact of the independent and mediator variables on the dependent variables. We therefore found it

appropriate to deploy an *experimental design* for our research methodology. Since we are interested in the effects of two factors (group history and group memory), each at two levels (with and without), a *2x2 factorial* design representing four treatments or conditions is used (Figure 4-1). The treatments represent two forms of group history (with and without group history), crossed with two types of reprocessability or group memory (with and without group memory). The mediator variables in the research design include the social capital dimensions of relational closeness, and relational trust and shared goals. The dependent variables are group performance and group creativity.

Figure 4-1: 2x2 Factorial Design

		Group History	
		With History (established)	**Without History (ad hoc)**
Group Memory	**With Memory**	Condition I	Condition II
	Without Memory	Condition III	Condition IV

4.2. Groups and Group Sizes

Using a 2x2 factorial design, the next decision was in using groups or individuals for the experiment. In keeping with our research objective of exploring the impact on group performance and creativity in a synchronous computer-mediated environment, we used the group as the unit of assessment for data collection and analysis.

An important consideration was the appropriate size of the group to employ for the design. We decided to use an optimal group size of three. We draw theoretical justification for this decision from Fjermestead and Hiltz (1998-99) that a group of two is not really a group but a pair, and the modal size for a group is three, since it is the optimum size for a majority/minority or maximum/minimum effect to occur. Groups of four and more are good, but are logistically

difficult to implement for synchronous chat environments because of the total number of subjects required. Further, larger groups are more likely to use too few subjects and groups to detect significant effects (Fjermestead & Hiltz, 1998-99).

4.3. Between Versus Within Subjects Design

Using group as the unit of collection and analysis, we evaluated whether to use the same pool of subjects for all the four experimental conditions or to have a different pool for each condition. The former case is referred to as repeated measures or within-subjects design (Kirk, 2009; Shuttleworth, 2009) and the latter case is called between-subjects design. The choice of the design has ramifications on how participants are selected and allocated and how the data is collected and analyzed. In our research we adopted the *between-subjects design* in which different pool of subjects were used in each condition, since we had access to a large sample of subjects, facilitating random assignment to conditions. Additionally, we wanted to avoid the practice and carry-over effects predominant in the repeated measures design.

4.4. Subjects

Subjects were recruited from a subject pool of an undergraduate course in Information Systems at Baruch College. The subjects earned class credit for participation. Those who opted out of the experiment were given an alternate assignment that was equitable in terms of time and effort. A power analysis reveals that in order to detect a medium size effect (delta=.75) at an 80% confidence level, it is necessary to have at least 8 teams for each of the four treatments, making a total of 32 teams (96 subjects considering 3-subject teams). To detect a smaller effect size (delta=.50) at an 80% confidence level, 18 teams per treatment are needed totaling 72 groups (216 subjects considering 3-subject teams). We recruited a total of 357 subjects in 119

groups, which is well over the limit needed for an acceptable effect size. Teams were randomly assigned to a system either having or not having the group memory feature.

4.5. Manipulations

The first factor of the experiment, group history (see Figure 4-1) is the manipulation in terms of the extent to which the members had worked together before the experiment. Groups with members who have worked together before represent the with-history condition (established groups). Groups with members who have never worked together before represent the without-history condition (ad hoc groups). The integrity of the group history manipulation was tested in the pre-test questionnaire. For this manipulation, we asked the subjects in each class to self-organize into groups of three if they knew or had worked with another person, earlier to the current experiment. These groups were formed prior to the experiment, and constituted the with-history (established) condition.

The second factor (see Figure 4-1) is the manipulation regarding the reprocessability or group memory. *Group memory* is a technological facility that allows checking, reviewing and reprocessing of the information shared by members during the group discussion process (Dennis et al., 2008). In this experiment, we utilize the transcript of discussion generated by the chat software as the group memory component. This transcript provides a record of the discussion of among the group members. To manipulate this factor, we set up the experiment to have two categories of groups – some groups with access to the chat transcript (with-memory condition) and some with no access to the chat transcript condition (without-memory condition). At the start of the experiment, groups were randomly assigned to one of these two conditions.

4.6. Task

All groups worked on a common task that entailed decision making and creativity. In a business context, this type of task is prevalent and reliant upon the history of interactions between the members. The task requires groups to use the synchronous group communication system to discuss and come up with a written report showing recommendations on a university's emergency management website. The recommendations needed to address the design and content of the website. The task represents a scenario that is current and relevant to students, and further encourages creativity. It also fosters a rich discussion that can be analyzed for future research. Appendix A contains the task.

4.7. Measures

At the start of the session, participants were asked to fill out an online pre-task questionnaire with questions on demographics, the extent of usage and level of comfort with synchronous communication. A manipulation check for group history was included in the pre-task questionnaire (Appendix C). The questionnaire was administered online using survey monkey. On completion of the pre-task questionnaire, the participants were assigned the task. After completing the task, participants were directed to a post-task questionnaire that was also administered online via survey monkey. The post-test questionnaire had questions that measured their experiences during the task, reflecting the constructs of our research model (relational closeness, relational trust and shared goals). Other measures include affective (perceptual) outcomes such as satisfaction with the experience, satisfaction with the process, and output (perceived performance). We also had checks for the manipulation of group history and group memory. Outcomes of group work were measured in terms of productivity (group report) and perceptual measures (perceived performance) collected using the post-task questionnaire.

The productivity of the group (actual performance) was measured using the group reports, by a panel of three judges who were blind to the experimental condition. Later, however, one of the judges was unable to complete the evaluation due to an emergency situation, and so the ratings of the other judges were only incorporated. This is described in detail in chapter 5 on results of data analysis. The judges were given a set of criteria to evaluate the reports. The criteria included dimensions on performance and creativity. The dimensions of presentation, strength, breadth, depth, and overall quality were used for performance, and the dimension of innovativeness was used to evaluate creativity. The judges' questionnaire, also administered online using survey monkey, contained a 7-point scale of ratings for each dimension (Appendix G). The inter-rater reliability of the judges' ratings was computed and is described in detail in chapter 5 - data analysis.

4.8. Software

The software that was deployed for the task was google applications (google apps) (http://www.google.com/apps/intl/en/business/index.html) by Google Inc. This is a web-based collaboration and messaging application suite that includes a combination of messaging (mail, chat, google calendar), and collaboration (google docs, google sites) applications. Users can log in, send messages and chat interactively with each other using google group chat. The chat feature allows more than two people to chat at a time, using its group chat interface. Additionally, members can collaboratively share and work on a document using the google docs interface. Since our group involves three members, we will be deploying the group chat facility in google apps as the discussion interface. The software generates an interactive transcript of the discussions that ensue between the members during the chat session. The availability of the chat transcript was manipulated as an operationalization for group memory. The groups in the with-

memory experimental conditions were given access to the chat transcript in developing their final report. The groups in the without-memory conditions were not offered access to the chat transcript. The software facilitates synchronous communication in which all the members communicate at the same time. To prepare the infrastructure for synchronous communication during the experiment, the researcher, in the role of a systems administrator, set up different domains in servers, each with a specified number of accounts designed with appropriate roles, access, and privileges for intra-group collaboration. About half of the accounts were set up to allow access to chat transcripts to represent the with-memory condition. The accounts had to be prepared before the experiment, to selectively allow only the members within a group to chat and collaboratively work on the document with each other.

4.9. Procedure

Prior to the experiment, about half the participants were asked to self-select members with whom they had worked with earlier, and for a group of three. These constituted the with-history (established) condition. Of the remaining half, groups of three were formed to constitute the without history (ad hoc) condition. In this assignment, care was taken to ensure that the ad hoc groups were formed with members who had not worked with each other prior to the experiment. All subjects participated by coming to a laboratory which was reserved for the experiment. This lab was equipped with workstations that had access to the internet and to gmail and google docs. Every effort was made to have the group members sit apart from each other so as to prevent verbal, and ensure, online communication. All subjects had to sign up for specific time slots, before the day of the experiment.

Upon arrival, each subject was required to sign a consent form that was authorized by the Institutional Review Board of Baruch College (see Appendix B). The researcher then checked

the name of the student with the sign-up sheet to see if they belonged to the with-history (established) condition, which had been pre-assigned. If they had been pre-assigned, they were randomly assigned to one of the two established conditions of with-memory and without-memory. If they were not pre-assigned, they were assigned by the researcher with two others they had not worked with earlier, and given one of the two conditions of with or without memory. All assignments were recorded by the researcher in order to provide appropriate credit. Each participant was then given a general instruction sheet and an index card, based on the condition. The general instruction sheet was customized for each of the four experimental conditions. Appendix F shows all these versions (F1 to F8).

The general instruction sheet laid out the three parts of the experiment – the pre-task questionnaire, the task, and the post-task questionnaire. Participants were asked to check off each step as it was completed. One person in each group was assigned by the researcher to be the *chat starter*. This person was given additional instructions on starting the group chat session. These instructions for staring the chat session were also customized for each condition. Appendix E shows al these versions E1 to E4. The index card listed the participant's account information in terms of the username and password. The username had been customized to indicate only to the researcher, the condition to which the subject is assigned so as to ensure accuracy in distributing the handouts.

To begin the experiment, after receiving the handouts and being assigned to a workstation, each participant filled out the online pre-task questionnaire using survey monkey (see Appendix C). On completion of the pre-task questionnaire, they were directed to the instructions for starting part II – the task (see Appendix A).

To start the task, each participant was required to sign into a unique account using the username and password provided on the index card. The task was divided into two exercises. The first exercise was a chat session where the group members discussed the task. In this part, the chat starter initiated a group chat session using the instructions given, and invited the other two members to chat. After the chat session, the groups moved on to the second exercise which was to collaboratively create a group report using google docs. The general instructions sheet for each member had directions to complete this exercise. At the end of the second exercise, the chat starter for each group was assigned the responsibility to save the group report. Each of these two exercises was timed so as to ensure uniformity for all participants. At the end of the first exercise, the researcher monitored the procedure by walking around the laboratory to ensure that all participants moved on to the second exercise.

On completion of the task, the participants were directed to Part III – the online post task questionnaire (see Appendix D). On completion, the participants were thanked for their participation and dismissed. The researcher then collected all the sheets and the index cards. During the experiment, the research walked around to ensure that the procedures were followed judiciously.

4.10. Questionnaires

Pre task questionnaire: The pre-task survey instrument is designed to collect information to be used as controls. These include demographics, usage of and comfort with synchronous communication, and extent of group history before the experiment. Demographics include age, academic level, and gender. To assess how experienced subjects are with synchronous communication, they were asked to report on their frequency of use and comfort with the features of chat and google docs using the following questions:

- How frequently do you communicate using chat?
- How comfortable do you feel communicating with chat?
- How frequently do you use google docs or any other file-sharing feature?
- How comfortable do you feel using google docs or any other file-sharing feature?

Additionally participants are asked to self-report on how well they type. Appendix C shows the pre-task questionnaire.

Post-task questionnaire: The online post-task instrument is designed to assess the experience of the participants during the experiment. Each of the theoretical constructs in the research model is operationalized and measured. The dependent variable, group creativity, is measured using scales from Song et al. (2007) and Amabile et al. (1996). The perception of performance was measured using perception of satisfaction with process and outcome (in addition to the ratings provided by the experts as described in the section on Measures). These scales are adapted from Dennis (1996) and Jarvenpaa et al. (2004). The manipulation check for group history is also included in the post-task questionnaire so as to determine the extent of the control. The other variables that are shown to impact performance and creativity in the research model are also measured and operationalized in the post-task questionnaire using validated scales. Relational closeness is measured using an adaptation of scales from Wheeless (1978), Moran (2005), and Berscheid et al. (1989). These questions are designed to elicit the extent to which a group member feels close to the group. The relational trust and shared goals measure includes the dimensions of cognitive trust and affective trust and is adapted from Moran (2005). Appendix D shows the post-task questionnaire.

The wording of the items was analyzed for fit with the current task and slightly modified in cases where the task in the original study was not similar. Each instrument's items come in the form of a sentence to which participants are asked to rate on a 5-point Likert scale the extent to which they agree or disagree with the statement. For the satisfaction items, the 5-point semantic

differential scale is anchored with very unsatisfied/very satisfied. See Appendix H for the scale items in the post-task questionnaire.

4.11. Pilot Studies

Before commencing the actual data collection for the experiment, we ran pilots as a process of refining the experimental procedure to avoid any potential difficulties in its execution. The pilot study tested the viability of the task and of the technical and procedural aspects of the experiment. It consisted of the exact procedure that was going to be employed for the experiment. We conducted two sets of pilots spread over a span of three months.

The first pilot was conducted in a Baruch undergraduate class of 30 students, divided into groups of three. Out of the 30 students, 5 groups of three each (15 students) were used to constitute the with-history (established) condition. Of these 3 groups (9 students) were given computer accounts with access to the chat transcript to constitute the with-history/with-memory condition. The remaining 2 groups (6 students) were not given access to the chat transcript, constituting the with-history/without memory condition. Of the remaining 15 students in the class, groups of three were formed after ensuring that the members of each group had not worked with each other prior to the current pilot. These constituted the without-history condition (5 groups/15 subjects). Of these, 2 groups (6 subjects) were given computer accounts with access to the chat transcript to constitute the without-history/with-memory condition. The remaining 9 subjects (3 groups) were assigned accounts with no access to the chat transcript to constitute the without-history/without-memory condition. The students were instructed to bring laptops and a classroom with internet access was used to conduct the pilot. One person in each group was assigned to be the chat starter. The researcher created a domain to use for the pilot and created accounts to assign to each student. Each student was given an index card with the username and

password at the beginning of the pilot. Three handouts were distributed – task, general instructions, and chat starter instructions. The task was for the groups to discuss and create a report containing recommendations on content and design of a university emergency management website. The pilot was divided into three parts – the pre-task, task and post-task. The pilot gmail group chat feature for the chat discussion and google docs to collaboratively create a group report containing recommendations for a university's emergency management website. From this pilot, lessons on the logistics of the written instructions were learned. Students were not very comfortable in reading instructions that were longer than a page in length. Also, the format of the instructions had to be specific in which the students did not have to use much discretion. As far as the technology was concerned, it became clear that it would make it easier if the accounts had facilities that would make it easier for the chat starter to recognize the second and third members of the group. This can be done if the members automatically appear as contacts in the chat window in gmail. In order to achieve this, the researcher went into each chat starter account and set it up so that the other two members will show up as contacts in the chat window. This will ensure that the chat starter can immediately see who to invite for the group chat.

Based on the experiences from the first pilot, the instruction sheets were progressively refined and modified to make them more comprehensible. Separate general instruction sheets were designed for each experimental condition. We also decided to make the chat starter instructions customized for each condition. Therefore, four sets of general instructions (one for each condition) and four sets of chat starter instructions (one for each condition) were developed, each being less than a page in length. Additionally, the directions were made very specific so as to have no room for discretion on the part of the students. The task handout was also refined to

keep it simple and specific. As mentioned above, the computer accounts for the chat starters were set up to facilitate and invite the other two members of the group for chat.

We now conducted a second pilot study in another undergraduate class with 30 students. The class had groups of three that were already formed, similar to the first pilot study. This time, the pilot was conducted in a computer lab that we planned on using for the actual experiment. For this second pilot, we repeated exactly the same procedure as the first pilot as far as formation of groups and assignment to experimental conditions, only with the modified instructions and customized accounts. The distribution among the experimental conditions was exactly the same as for the first pilot. The results proved that the modifications and changes were favorable and improved the viability of the task and of the technical and procedural aspects of the experiment. Overall, we learnt from the pilot that it pays to have things customized and ready for subjects so as to allow less room for discretion and subjectivity, even if it involves more preparatory and administrative work on the part of the researcher.

CHAPTER 5: ANALYSIS OF RESULTS

5.1. Descriptive Statistics

After testing and refining the procedure and task, a total of 357 participants were recruited to participate in the experiment over a span of 2 semesters. The subjects were distributed among the four experimental conditions as follows. About half, 180 participants, were assigned to teams of three (for a total of 60 groups), with members they had worked with before. These constituted the with-history experimental condition. Of these teams, 93 participants (31 groups) were given computer accounts with access to the group chat transcript (with history/with memory) and 87 participants (29 groups) were given computer accounts that did not give them access to the group chat transcript (with history/without memory).

The remaining 177 participants were assigned to teams of three (for a total of 59 groups), with members they had not worked with before, to constitute the without-history condition. Of these, 87 participants (29 groups) were given accounts that gave access to the chat transcript (without history/with memory) and the balance 90 participants (30 groups) were given accounts that did not give access to the chat transcript (without history/without memory). The distribution is summarized in Table 5-1.

Table 5-1: Distribution of Sample (individual and group) by Condition

	With History (established)	Without History (ad hoc)	
With Memory	Ind = 93 Grp = 31	Ind = 87 Grp = 29	Ind 180 Grp 60
Without Memory	Ind = 87 Grp = 29	Ind = 90 Grp = 30	Ind 177 Grp 59
	Ind 180 Grp 60	Ind 177 Grp 59	

5.1.1. Demographic Information

Since the participants were recruited from classroom announcements and a subject pool for an introductory business course in Information Systems, the sample is expected to have a similar demographic distribution to that of the general Baruch College population. Subjects were given credit for participation in the experiment. Those who did not participate were given an alternate assignment that is equitable in terms of time and effort (Appendix I). Demographic information from participants was collected using a pre-task questionnaire (Appendix C). These variables are used to describe the sample, and to check whether there was proper randomization in the assignment of subjects to conditions. A majority of the participants (76%) were between the ages of 18 and 24, while 21% were between 25 and 34, with about 3% between 35 and 44. The gender distribution was 51% male and 49% female. The sample consisted of all undergraduate students (100%) because it was drawn from a core undergraduate business course.

Other relevant characteristics of the sample, such as familiarity with chat software and with google docs, and typing skills, were also collected using the pre-task questionnaire. In order to detect any potential effects from chat or google docs, subjects were asked about their frequency and comfort with using a chat feature and a file sharing feature such as google doc. In terms of frequency of usage, about 44% reported as using the chat feature very often, 24% as using it very rarely, and about 31% as never having used it. For the google docs, about 50% reported using the google docs or a similar file sharing feature frequently, and about 47% reported as never having used the file sharing feature. In terms of comfort level with chat, a majority (about 67%) reported as being comfortable to very comfortable, while 31% reported being uncomfortable. For comfort with google docs, the percentage of subjects who were comfortable to very comfortable is about 43%, while that of being uncomfortable is about 54%.

Participants were asked to describe their typing ability. About 49% reported their typing skills as good, 19% assessed their skill as excellent, while about 30% reported “rough or casual” typing skills. 2% described their typing skills as “hunt and peck”.

In order to accommodate the small minority that expressed either discomfort or no experience with chat or google doc, a brief training session was held before the beginning of the experiment to demonstrate the basic usage of chat and google doc, so as to facilitate their progress with the experiment. The demographic information collected pre-task is summarized in Table 5-2.

Table 5.2: Demographic Information

Characteristic	Percentages	Mean	Std. Dev.
Age*	18-24: 76% 25-34: 21% 35-44: 3% 45-50: 0% >51: 0.3%	1.27	.533
Gender	Male: 51% Female: 49%	1.53	.500
Level	Undergrad: 100%	1.00	.000
Frequency of Chat	never: 31% often: 32% very rarely: 24% very often: 12% neutral: 1%	2.71	1.487
Comfort level with Chat	very uncomfortable: 2% uncomfortable: 29% neutral: 2% comfortable: 50% very comfortable: 17%	3.49	1.150
Frequency with Google docs	never: 47% often: 29% very rarely: 1% very often: 21% neutral: 2%	2.03	1.240
Comfort level with Google docs	very uncomfortable: 8% uncomfortable: 46% neutral: 3% comfortable: 39% very comfortable: 4%	2.84	1.153
Typing Skill	Hunt & pack : 2% rough &casual: 30% Neutral: 0% good: 49% Excellent: 19%	3.51	1.170
*Age was measured with an ordinal scale.			

5.1.2 Controls

In order to ensure true randomization of the sample, it is important to check for any systematic differences among experimental conditions for each individual characteristic (Trochim, 2000). Three of the individual characteristics (gender, level and age) are categorical in

nature. Gender is divided between male and female categories, while level is divided between undergraduate and graduate categories, and age is divided among several categories (actual age was not recorded). Of the remaining pre-task variables, typing skill, frequency with chat, and frequency with google docs are ordinal, because they represent an incremental progression from one response to another. Comfort with chat and comfort with google docs are interval variables because the responses are incremental with equal intervals between responses. Each variable was appropriately tested in order to determine its distribution among experimental conditions.

For variables that were categorical in nature, a chi-square test was done to determine if the individual characteristic was randomly distributed among the conditions, or if one experimental cell had a greater frequency of the characteristic than the others. Based on the frequencies per cell of gender, level, and age range (Table 5-3, Table 5-4, and Table 5-5), the chi-squares were not found to be significant, as shown in Table 5-6. Therefore, none of the categorical variables were used as controls in the experimental analysis.

Table 5-3: Gender Frequency by Cell

	With History	Without History	
With Memory	M F 47 46 51% 49%	M F 45 42 52% 48%	M F 92 88 51% 49%
Without Memory	M F 45 42 52% 48%	M F 46 44 51% 49%	M F 91 86 51% 49%
	M F 92 88 51% 49%	M F 91 86 51% 49%	

Table 5-4: Level Frequency by Cell

	With History	Without History	
	U G	U G	U G
	93 0	87 0	180 0
With Memory	100% 0%	100% 0%	100% 0%
	U G	U G	U G
	87 0	90 0	177 0
Without Memory	100% 0%	100% 0%	100% 0%
	U G	U G	
	180 0	177 0	
	100% 0%	100% 0%	

Table 5-5: Age Frequency by Cell

	With History	Without History	
With Memory	18-24: 63 68% 25-34: 25 27% 35-44: 4 4% 45-50: 0 0% >51 : 1 1%	18-24: 65 75% 25-34: 19 22% 35-44: 3 3% 45-50: 0 0% >51 : 0 0%	18-24: 128 71% 25-34: 44 24% 35-44: 7 4% 45-50: 0 0% >51 : 1 0%
Without Memory	18-24: 70 81% 25-34: 17 20% 35-44: 0 0% 45-50: 0 0% >51 : 0 0%	18-24 : 73 81% 25-34: 15 17% 35-44: 2 2% 45-50: 0 0% >51 : 0 0%	18-24: 143 81% 25-34: 32 18% 35-44: 2 1% 45-50: 0 0% >51 : 0 0%
	18-24 : 133 74% 25-34: 42 23% 35-44: 4 2% 45-50: 0 0% >51 : 1 1%	18-24: 138 78% 25-34: 34 19% 35-44: 5 3% 45-50: 0 0% >51 : 0 0%	

For the ordinal variables - typing skill, frequency of chat, and frequency of using google docs, the Kruskal-Wallis test was conducted, calculating a chi-square value to compare the Wilcoxon ranked order to an expected distribution. Neither variable resulted in a significant chi-square value (see Table 5-6). Therefore, they will not be used as controls in the data analyses.

The interval variables - comfort level with chat and comfort level with google docs, were tested using analysis of variance (ANOVA), to detect if the means of each variable differed among the four experimental conditions. Neither characteristic was found to be significantly different among cells, eliminating the need to use them as controls in the experimental analyses.

Table 5-6 shows a summary of the results of the tests for differences in individual characteristics among experimental conditions.

Table 5-6: Pre-Task Differences by Condition

Characteristic	Test	Chi-Square Value	F	Prob
Age*	Chi-Square	1.315		.233
Gender	Chi-Square	1.482		.223
Frequency of Chat	Kruskal-Wallis	3.375		.337
Comfort level with Chat	GLM		.338	.798
Frequency with Google docs	Kruskal-Wallis	4.334		.510
Comfort level with Google docs	GLM		.428	.751
Typing Skill	Kruskal-Wallis	1.534		.674
*Age was measured with an ordinal scale.				

5.2. Instrument Validation

In this research, each theoretical construct was operationalized and measured using a scale consisting of several items in the form of survey questions. Although the scales used were adapted from previously used and validated scales, in order to ensure appropriateness of application for this context, the validity of each one was assessed.

5.2.1. Factor Analysis

For this validation, a Principal Component Analysis (PCA) with a varimax rotation was used (with SPSS software). PCA reduces multidimensional constructs to their underlying components by creating a correlation matrix with factor loadings for each item. The PCA produced five factors whose eigenvalues are greater than one, indicating that five components can be extracted from the dataset. Table 5-7 is a comprehensive listing of the factor loadings, eigenvalues and the variances explained for each factor.

Table 5-7: Factor Loadings and Eigenvalues

	Factor				
Items	1	2	3	4	5
RC4	**0.826**	0.104	0.191	-0.032	0.079
RC1	**0.819**	0.119	0.197	0.041	0.193
RC3	**0.804**	0.084	0.193	0.132	0.220
GH1	**0.779**	-0.029	-0.037	0.118	0.295
RC2	**0.732**	0.244	0.314	0.012	0.116
RC5	**0.727**	0.233	0.061	-0.020	0.035
RT1	**0.661**	0.185	0.400	0.095	-0.039
S4	0.112	**0.787**	-0.021	-0.174	-0.032
S1	0.077	**0.768**	0.308	-0.002	0.158
S2	0.061	**0.765**	0.320	-0.032	0.136
S3	0.115	**0.741**	0.247	-0.090	0.211
GC1	0.198	**0.635**	0.315	-0.071	0.117
GC3	0.107	**0.634**	0.352	0.043	0.075
GC2	0.388	**0.631**	0.045	-0.033	0.109
RT3	0.156	0.354	**0.747**	-0.047	0.252
RT2	0.237	0.193	**0.731**	-0.087	0.195
SN1	0.366	0.217	**0.671**	0.125	0.160
SN3	0.114	0.504	**0.664**	-0.126	0.114
SN2	0.325	0.365	**0.584**	0.009	0.124
GM1_rev	0.100	-0.079	0.019	**0.931**	0.034
GM2_rev	0.034	-0.041	-0.055	**0.929**	0.033
GM3_rev	0.065	-0.126	-0.033	**0.911**	0.035
GH3	0.279	0.056	0.135	0.140	**0.810**
GH4	0.159	0.206	0.144	0.000	**0.759**
GH2	0.187	0.250	0.344	-0.025	**0.715**
Eigenvalues	9.432	3.526	2.132	1.438	1.110
Variance explained (%)	37.727	14.103	8.529	5.751	4.439
Cumulative Variance explained (%)	37.727	51.829	60.359	66.110	70.549

The factor loadings (Table 5-7) reveal five factors with multiple items loading on each factor. An item is considered to load onto the factor for which it has the highest factor loading value. A summary of these factors and their names is given in Table 5-8.

We also checked for the common methods bias in the research constructs, using the results from factor analysis (Table 5-7). Common methods bias is defined as the “variance that is attributable to the measurement method rather than to the constructs the measures represent” (Podsakoff et al. 2003, p. 879) and is a major contributor to systematic measurement error

(Bagozzi & Yi 1991). Like all forms of measurement error, if common methods bias is sufficiently high, then incorrect conclusions may be drawn about relationships between constructs. We conducted the Harman's one-factor test to check for common method bias. The objective of this test is to determine whether a single factor that explains the majority of the variance emerges from the factor analysis (Siponen & Vance, 2010). As can be seen in Table 5-7, when all of the variables were entered into the Exploratory Factor Analysis using principal components, more than one factor was obtained. The total variance of the first factor was 37.72%, with five factors containing an eigenvalue over 1. Therefore, a single factor did not explain the majority of the variance, thus suggesting that common method variance is not likely to confound our results.

Each factor shown in Table 5-7 has the potential to be used as a scale to measure a theoretical construct, if it proves to exhibit internal consistency. So, the next step was to conduct a reliability analysis of the items in each factor, in order to assess to what extent the items are measuring the same construct. Cronbach's alpha was used in SPSS to assess the reliability. Any scale that produces a coefficient of Cronbach's alpha of .7 or higher is considered reliable (Nunally, 1978.). Table 5-8 shows that all the factors extracted from PCA do have an acceptable coefficient for Cronbach's alpha and therefore qualify as reliable. The items in each of these scales are shown in Appendix H.

Table 5-8: Scale Reliability

Factor	Scale Name	Number of items	Cronbach's Alpha
1	Relational Closeness	7	.913
2	Perceived Performance	7	.887
3	Relational Trust & Shared Goals	5	.868
4	Group Memory	3	.926
5	Group History	3	.784

In the current research, all of these factors are perceptual measures collected at an individual level from the participants. Table 5-9 shows the correlation, means and standard deviations for the factors at an individual level. The number of items (N) is 357.

Table 5-9: Description of Individual level Measures

$Scale_i$	Mean	Std Dev	Correlations				
			Relational Closeness	Perceived Performance	Relational Trust & Shared Goals	Group Memory	Group History
Relational Closeness	2.997	.968	1	.419(**)	.565(**)	.111(*)	.474(**)
Perceived Performance	3.855	.640	.419(**)	1	.688(**)	-.139(**)	.421(**)
Relational Trust & Shared Goals	3.822	.681	.565(**)	.688(**)	1	-.040	.537(**)
Group Memory	2.90	1.217	.111(**)	-.139(**)	-.040	1	.082
Group History	3.82	.650	.474(**)	.421(**)	.537(**)	.082	1
*Significant at .05 level; **Significant at .01 level; ***Significant at .001 level $Scale_i$: Individual level measures N=357							

5.2.2. Aggregation of Measures to Group Level Indices

In order to aggregate the individual level measures shown in Table 5-9 to group level indices, we calculated the James index (r_{WG}) for each measure within each group. James index (r_{WG}) measures the homogeneity of members' perceptions within a group. Within-group aggregation is considered appropriate if the median of the scale is greater than.70 (George, 1990). Table 5-10 shows the median of each scale with the James index.

Table 5-10: Description of James Index for aggregation to group level

Factor	Scale Name	James Index Median	Aggregation*
1	Relational Closeness	.89	Valid
2	Perceived Performance	.95	Valid
3	Relational Trust & Shared Goals	.94	Valid
4	Group Memory	.93	Valid
5	Group History	.93	Valid
*Valid if median > .70			

Since the medians shown in Table 5-10 are all above the threshold of .70, the individual level measures for these factors were aggregated to group level measures. These group level measures are described in Table 5-11. These composite group level measures were then used for hypothesis testing at the group level, as explained in the section on hypotheses testing.

Table 5-11: Description of Group Level Indices

$Scale_g$	Mean	Std Dev	Correlations				
			Relational Closeness	Perceived Performance	Relational Trust & Shared Goals	Group Memory	Group History
Relational Closeness	3.00	.828	1	.447(**)	.620(**)	.095	.511(**)
Perceived Performance	3.85	.463	.447(**)	1	.732(**)	-.221(*)	.455(**)
Relational Trust & Shared Goals	3.82	.517	.620(**)	.732(**)	1	-.083	.597(**)
Group Memory	2.90	1.073	.447(**)	-.221(*)	-.083	1	.062
Group History	3.82	.477	.511(**)	.455(**)	.597(**)	.062	1

**Significant at .01 level; *Significant at .05 level
$Scale_g$: Group level measures

When we analyzed each index in detail, we discovered noteworthy issues in two of them – perceived performance (factor 2) and relational trust & shared goals (factor 3). The details about perceived performance are discussed in the upcoming section on "Performance Measures." The factor "Relational Trust and Shared goals" represents two sets of items that were conceived separately but loaded together in the factor analysis. One set represents items on competence and integrity of members, and the other represents items on perception of shared goals of the members (these items are shown in Appendix H). Prior studies on trust have reported trust as a multi-dimensional construct that represents affective components such as belief in integrity and competence of the others, and cognitive components such as perception of shared goals to carry out the task. Our extracted factor thereby incorporates this integrated perspective (Lewis &

Weigert, 1985) of the affective element represented by relational trust, and the cognitive element represented by shared goals.

5.3. Performance Measures

5.3.1. Group Report

Performance is a dependent variable that is measured at a group level based on the written report that each group produced in response to the experimental task. The report contained recommendations for a university emergency management website. The participants were given instructions on certain key phases in emergency management to include in the report. A panel of three independent judges was formed to assess each report independently. Two of the judges were professors with a doctorate in Information Systems, and the third judge was a doctoral student in Information Systems. The judges were all blind to the experimental conditions and the reports did not contain any information identifying the condition in which they were produced.

Judges were given 6 dimensions to assess and evaluate each report. The dimensions represented criteria for both performance and creativity. The dimensions were presentation, strength, breadth, depth, and overall quality. These represented the criteria for performance. In addition, the judges were given a dimension of innovativeness to evaluate the creativity of the reports. An online form was given to the judges to evaluate a report by rating each dimension on a scale of 1 to 7. Appendix G shows the judges' evaluation form. The reports were given to the three judges and a debriefing was done on the evaluation criteria. However, one of the judges had an emergency that entailed him to become unavailable to complete the rest of the evaluation, even though he had completed half of the reports. Due to time and resource constraints in

recruiting, training, and sending material to a new judge, we used the ratings from the remaining two judges only, for the experimental analyses.

In order to conduct analyses using the ratings from the judges, a composite score was calculated using the average of the two judges' scores. A composite score can be used only if there is a high level of agreement between the raters. Inter-rater reliability was computed in SPSS using the Intraclass Correlation Coefficient (ICC) reliability analysis. Table 5-12 shows the inter-rater reliability ratings along with some descriptive information for each of the grading dimensions. From the table, it is evident that all the dimensions exhibit high inter-rater reliability, thus validating the aggregation of the judges' ratings for each.

Table 5-12: Expert Ratings Using ICC

Dimension	Inter-Rater Reliability		Index Mean	Index Std Dev	Index Min	Index Max
Presentation	.701	R	5.206	1.397	1.0	7.0
Strength	.832	R	5.008	1.336	1.0	6.5
Breadth	.733	R	4.769	1.540	1.0	7.0
Depth	.821	R	4.508	1.596	1.5	7.0
Innovativeness	.840	R	4.601	1.377	1.0	6.5
Overall[1]	.885	R	78.55	10.591	50	99
R=Reliable; NR=Not Reliable; N=119 [1]Represents a rating from 1-100						

5.3.2. Factor – Perceived Performance

In addition to the group report as a measure for performance, our factor analysis revealed a factor (factor-2) which showed loadings for items measuring subjects' perception of performance in terms of the output (report), the process, and the creativity of the group (Appendix H). This factor is therefore a combined perceptual measure for the multi-dimensional construct of performance and creativity. We call this factor "perceived performance" and use this multi-dimensional construct for testing, in addition to the hypotheses, as discussed in the section on Hypotheses Testing. As described earlier, the responses collected at an individual level for

perceived performance, as for the others, were aggregated to a group level using James index (see Table 5-11).

Table 5-13 depicts the spread of the 119 groups among the four experimental conditions, in order to reflect the distribution in hypotheses that test group level measures.

Table 5-13: Group Distribution by Condition

	With History	Without History	
With Memory	31	29	60
Without Memory	29	30	59
	60	59	(Tot:119)

5.4. Hypotheses Testing

We have main effects and intermediate effects in our research model. The main effects include hypotheses that describe the impact of the independent variables of group history and group memory on the dependent variables of performance and creativity. The intermediary effects represent an explanation of how and why the main effect takes place and include hypotheses on the mediating role played by the other experimental variables.

5.4.1. Levels of Analysis

The hypotheses are primarily tested using Analysis of Variance (ANOVA). The experiment includes an unbalanced design in which the number of observations in each cell is unequal (see Table 5-13), for which the GLM procedure is appropriate (Cody & Smith, 1997, p.171). Since the data for relational closeness, relational trust, perception of group history, and perception of group memory are all collected at the individual level, an individual level of analysis is appropriate. However, the treatments have been applied in a group setting. Therefore an appropriate statistical method to be used is a form of ANOVA that takes into account any

effect attributable to the group. Hierarchical Analysis of Variance (HANOVA) is the selected method of analysis (Gallivan & Benbunan-Fich, 2005; Walczuch & Watson, 2001). HANOVA calculates the effects of the group and treats it as an error term, reducing the main effect to account for it. This ensures that we do not mistakenly attribute any significant differences to the treatments when they are instead coming from the participants working together as a group. The hypotheses that use dependent variables as perceptual measures collected at the individual level such as relational closeness (H1), and relational trust (H3 and H7), have been tested using HANOVA.

The hypotheses that link individually collected perceptions of relational closeness and relational trust, with group outcomes of performance (H2a, H4a) and creativity (H2b, H4b) have been tested by aggregating at the group level following the procedure in Gallivan and Benbunan-Fich (2005).

Performance is a dependent variable that is collected as a report at the group level and is evaluated by the judges. The measure used for performance in hypotheses testing is the dimension called “overall rating” given by the judges. As demonstrated earlier, a high inter-rater reliability between the judges’ ratings for all the dimensions validated using a composite score for overall rating (Table 5-12).

Creativity is another dependent variable that is measured at a group level using the report that each group produced for the task. Creativity is measured using the dimension of “innovativeness” in the judges’ evaluation (shown in Table 5-12). Appendix G shows the judges’ evaluation form. A high inter-rater reliability for the dimension of innovativeness (Table 5-12) validated using a composite score for testing hypotheses relating to creativity. The following section discusses the testing for each hypothesis in sequence.

5.4.2. Hypothesis 1: Group History to Relational Closeness

Hypothesis 1 predicted that groups with history (established groups) will have a high degree of relational closeness than other groups.

H1: Groups with history will have a higher degree of relational closeness than all other groups

HANOVA is used to test this hypothesis which uses the dependent variable of relational closeness as a perceptual measure collected at the individual level. HANOVA, with the experimental factor (history) and the group factor, tests for the effects of history on relational closeness, while controlling for the effects of the group. The marginal and cell means are reported in Table 5-14. Instead of arithmetic means and standard deviations, least square means (LSMeans) and standard errors are reported, due to the unequal number of observations in each condition. By using LSMeans, the means are adjusted for the unbalanced design.

Table 5-14: HANOVA Results of Relational Closeness

LSMeans by History

	With History	Without History
LSMean	3.62	2.36
Std. Error	.05	.05
N	180 (60)	177 (59)

HANOVA Results (R^2=73%)

	F	P
Model	5.39	<.0001***
History	373.69	<.0001***
Group Effect[1]	2.24	<.0001***

*Significant at the 5% level; **Significant at the 1% level; ***Significance at the .1% level
[1] History is still significant at 1% when the group is considered as the error term

Table 5-14 shows that there is a significant impact of history on relational closeness, $F(118, 238) = 5.39$, $p<.0001$. The two factors history and group are also significant, both at $p<0.0001$. The distribution of the means shows that groups with history do have a higher degree of relational closeness than other groups. Therefore, H1 is supported.

5.4.3. Hypothesis 2: Relational Closeness to Performance and Creativity

Hypothesis 2 consists of two parts - one on performance (H2a) and one on creativity (H2b). Since this hypothesis links individually collected perceptions of relational closeness with the group outcomes of performance and creativity, we use the group-level measure of relational closeness that was aggregated as explained earlier. We conducted a linear regression test for the hypotheses.

H2a states that groups that exhibit a high level of relational closeness will perform better than all other groups.

H2a: Groups that exhibit a high level of relational closeness will perform better than other groups.

To test this hypothesis on performance, the judges' overall rating measure was used as a dependent variable in a regression. The results of the test indicate that the model is significant at $p<.05$, with an R^2 of .044. Even though a small percentage of the variance (4.4%) is explained by relational closeness, this relationship is significant at $p< .05$. Therefore, H2a is supported using the judges overall rating as the measure (Table 5-15).

As can be seen, the value of R^2 is low in our results. We conducted a residual analysis to verify these results and found that the data are approximately symmetric. Generally, R^2 value is an indicator of how well the model fits the data. However, a major limitation of all regression techniques is that while we can ascertain the relationships between the variables, we can never be sure about the underlying causal mechanisms that may explain the variance. Therefore in the above hypothesis the low values for R^2 (about 4%) indicates that there are other alternative variables that need to be considered. Also, the fact that the two variables of relational closeness and performance come from two different sources – the former is an individual perceptual

measure that is aggregated, while the latter is a group measure from the actual output – could contribute to this result.

Table 5-15: Regression Model for Relational Closeness on Performance and Creativity

Dependent Variables: Performance; Creativity Independent Variable: Relational Closeness						
	N	F	R2	Coefficient	t-value	p-value
Relational Closeness to Performance[a]	119	5.360	.044	.209	2.315	.022*
Relational Closeness to Creativity	119	16.783	0.125	.354	4.097	.000***
Relational Closeness to Perceived Performance[b]	119	29.220	.200	.447	5.206	.000***
*Significant at the 5% level; **Significant at the 1% level; ***Significance at the .1% [a]Performance measure using overall rating from judges [b]Combined factor measure for both performance and creativity						

H2b states that groups that exhibit a high level of relational closeness will have a lower level of creativity than other groups.

H2b: Groups that exhibit a high level of relational closeness will have lower creativity than others.

To test the hypothesis on creativity, the measure of innovativeness from the judges' evaluations is used in linear regression. The analysis (Table 5-15) shows that the model is significant at $p<.0001$, with an R^2 of .125. This translates to the fact that about 13% of the variance in creativity is attributed to relational closeness. As compared to performance, a higher percentage of the variance in creativity is accounted for by relational closeness. Therefore, H2b is supported.

As an additional test, we incorporated the factor that was extracted from PCA, called perceived performance. As explained earlier, this is a combined indicator of both performance and creativity as a construct. We ran a regression test of relational closeness on this construct. The results are shown in Table 5-15. The results indicate that the model is significant at $p<.001$ with an R^2 of 0.2. Therefore, relational closeness accounts for 20% of the variance in this combined construct of performance and creativity, indicating a strong influence. Therefore,

viewing performance as a combined construct, the hypothesis of relational closeness on this combined construct is supported. Table 5-15 shows the results of all the regression tests for relational closeness.

5.4.4 Hypothesis 3: Group History to Relational Trust/Shared Goals

Hypothesis 3 states that groups with history (established groups) will have a higher degree of relational trust than other groups.

H3: Groups with history have a higher degree of relational trust and shared goals than other groups

Similar to H1, since this hypothesis uses as a dependent variable, a perceptual measure collected at the individual level (relational trust), HANOVA is used to test it. The least square means and standard errors from HANOVA are reported in Table 5-16. The results show that the model is significant, $F(118, 238)=2.69$, $p<.0001$. The distribution of the means emphasizes the fact that groups with history (established groups) certainly have a higher mean for relational trust than those without history (4.01 vs. 3.63). H3 is therefore supported.

Table 5-16: HANOVA Results of Relational Trust and Shared Goals

LSMeans by History

	With History	Without History
LSMean	4.01	3.63
Std. Error	.04	.04
N	180 (60)	177 (59)

HANOVA Results (R^2=57%)

	F	P
Model	2.69	<.0001***
History	44.5	<.0001***
Group Effect[1]	2.34	<.0001***

*Significant at the 5% level; **Significant at the 1% level; ***Significant at the .1% level

[1] History is still significant at 1% when the group is considered as the error term

5.4.5. Hypothesis 4: Relational Trust/Shared Goals to Performance and Creativity

Hypothesis 4 predicts the impact of relational trust and shared goals on the two dependent variables of performance and creativity. Since this hypothesis links individually collected perceptions of relational trust and shared goals with the group outcomes of performance and creativity, we use the aggregated group level measure of relational trust, as described earlier and shown in Table 5-11.

H4 is bifurcated into two sub hypotheses – one on performance (H4a) and one on creativity (H4b). Regression was used to test both of these.

H4a states that groups with high level of relational trust and shared goals will perform better than other groups.

H4a: Groups with a high degree of relational trust and shared goals will outperform other groups.

To test H4a, we used the judges' overall rating as a measure of performance. The results of this regression test indicate an R^2 value of .164 and p-value of .000 for the model. This means that 16% of the variance in performance is attributed to relational trust and shared goals, and the relationship is significant at $p < .001$. Therefore, H4a is supported using the judges overall rating as the measure (Table 5-17).

H4b predicts that groups with different levels of relational trust will have different levels of creativity.

H4b: Groups with different levels of relational trust will have different levels of creativity.

To test H4b, the group-level measure for innovativeness from the judges' evaluation was used for creativity. Regression was used to test the hypothesis. The analysis indicates an R^2 value of .190 and a p-value is .000. This indicates that 19% of the variance in creativity can be attributed to relational trust and shared goals. The overall model is highly significant at $p<.0001$.

Therefore H4b is supported. The results for the regression tests for both the dependent variables are shown in Table 5-17.

An additional analysis test was done incorporating the factor perceived performance as a combined measure of the construct for performance and creativity. A regression test was run for this analysis. The results from this test indicate an R^2 value of .2 with a p-value of .000 for the model. This shows that relational trust accounts for 20% of the variance in the combined construct of performance and creativity. The model is significant at $p<.001$. Therefore, H4a is supported using the factor measure for performance and creativity combined. Table 5-17 shows the results of all the tests involving relational trust on performance and creativity.

Table 5-17: Regression Model for Relational Trust and Shared Goals on Performance and Creativity

Dependent Variables: Performance; Creativity Independent Variable: Relational Trust and Shared Goals						
	N	F	R^2	Coefficient	t-value	p-value
Relational Trust and Shared Goals to Performance[a]	119	22.871	.164	.404	4.782	.000*
Relational Trust and Shared Goals to Creativity	119	27.388	.190	.436	5.233	.000***
Relational Trust and Shared Goals to Perceived Performance[b]	119	135.075	.536	.732	11.622	.000***
*Significant at the 5% level; **Significant at the 1% level; ***Significance at the .1% [a]Performance measure using overall rating from judges [b]Combined factor measure for both performance and creativity						

5.4.6. Hypothesis 5: History and Memory to Performance and Creativity

Hypothesis 5 is divided into two parts – one on performance (H5a) and one on creativity (H5b). H5a posits that groups with history (established) and memory will perform better than other groups. H5b posits that groups without history (ad hoc groups) will be more creative than other groups.

For H5a and H5b, the treatments (history and memory) and the dependent variables (performance and creativity) are measures shared by the members in each group. Since the level of analysis for all of these is the group, the number of observations (N) in each cell will be the

number of groups and not the number of individuals (see Table 5-18). Analysis of Variance (ANOVA) at the group level will be used to test these hypotheses.

H5a relates the experimental factors to performance. It predicts that the interaction of history with memory will have a positive impact on performance.

H5a: Groups with memory and history will outperform other groups.

As with earlier tests, performance is tested using the measure of judges' overall rating. A two-factor ANOVA test for the impact of history and memory on performance using the overall rating was conducted in SPSS. The resulting marginal and cell means for the impact of memory and history on the measure of performance using the judges overall rating is reported in Table 5-18.

Table 5-18: ANOVA Results for Interaction of History and Memory on Performance using Judges Overall Rating

	With History			**Without History**			**Total**		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
With Memory	31	78.03	13.357	29	76.59	8.688	60	77.33	11.273
Without Memory	29	79.67	8.244	30	79.92	11.226	59	79.80	9.790
Total	60	78.55	10.591	59	78.28	10.113	119	78.55	10.591

GLM Results (R^2=2%)

	F	**P**
Model	.626	.600
Memory	1.621	.205
History	.095	.759
Interaction	.187	.666

From the results in Table 5-18, we see that the overall model is not significant, $F(3,113)=.626$, $p>.05$. Neither is the model for history, $F(1,115)=.095$, $p<.05$, nor the model for memory, $F(1,115)=1.621$, $p>.05$. The interaction of memory and history therefore does not seem to have a significant impact on performance using the judges' overall rating as a measure. Although the overall model is not significant, there are some noteworthy patterns from the distribution of the means in Table 5-18. Of all the conditions, the best performance is from

groups without memory and without history, followed by groups with history and without memory. This is contrary to our hypothesis that groups with history and memory will outperform others. Ad hoc groups seem to do the best without memory. But they did not perform well enough when they had access to memory. On the other hand, established groups (with history) do not show much variation in performance whether they had access to memory or not. Although these patterns are worthy of note, they are not significant. In sum, H5a is not supported using the performance measure of the judges' overall rating.

H5b predicts that groups without history will have greater creativity than other groups.

H5b: Groups without history will be more creative than other groups.

To test H5b, a one-factor ANOVA test was conducted for the impact of history on creativity, using the group level measure of the judges' innovation ratings for creativity. The results of this test are displayed in Table 5-19.

Table 5-19: ANOVA Results of History on Creativity

	N	Mean	Std Dev	F	p-value
With History	60	4.892	1.359	5.608	.020*
Without History	59	4.305	1.342		
*Significant at 5% level					

From Table 5-19, it is notable that the overall model is significant, $F(1,118)=5.608$, $p<.05$. But a closer look at the distribution of the means illustrates the direction of the relationship between history and creativity. Groups with history are more creative than those without history, which is contrary to the prediction in the hypothesis. Therefore, although the overall model is significant at $p<.05$, the hypothesis H5b is not supported. The significance is in the opposite direction. The explanations and implications of this phenomenon will be discussed in the Discussions chapter.

As an additional analysis, we considered the impact of the interaction of history and memory on the overall performance and creativity construct that we extracted, called perceived performance. The results of the two-factor ANOVA test are displayed in Table 5-20. The results show that although the overall model is highly significant, $F(3,115)=6.538$, $p<.001$, the means indicate that, contrary to the prediction of the hypothesis, the performance of groups with history and without memory was higher than the other groups. Therefore history and memory have no significant impact on the combined construct of performance and creativity.

Table 5-20: ANOVA Results for Interaction of History and Memory on Combined Factor Measure – Perceived Performance

	With History			Without History			Total		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
With Memory	31	3.868	.467	29	3.580	.451	60	3.729	.478
Without Memory	29	4.077	.357	30	3.894	.446	59	3.984	.412
Total	60	3.969	.427	59	3.749	.472	119	3.855	.463

GLM Results (R^2=15%)

	F	P
Model	6.538	.000***
Memory	10.846	.001**
History	8.816	.004**
Interaction	.434	.511

*Significant at 5% level; **Significant at 1% level; ***Significant at .1*%

5.4.7. Hypothesis 6: Memory to Performance and Creativity

Hypothesis 6 predicts the impact of memory on the dependent variables of performance and creativity. The first part of the hypothesis is on performance (H6a) and the second part is on creativity (H6b).

H6a states that memory has a positive impact on the performance of groups.

H6a: Groups with memory outperform the other groups.

To test this hypothesis, a one-way ANOVA was conducted to test the effect of memory on performance using the judges' overall rating. Table 5-21 shows the result of this test.

Table 5-21: ANOVA Results of Memory on Performance, Creativity and Both

	N	Mean	Std Dev	F	p-value
Performance[a]:					
With Memory	60	77.33	11.273	1.618	.206
Without Memory	59	79.80	9.790		
Creativity:					
With Memory	60	4.525	1.427	.365	.547
Without Memory	59	4.678	1.332		
Perceived Performance[b]:					
With Memory	60	3.729	.478	9.727	.002**
Without Memory	59	3.984	.412		

*Significant at the 5% level; **Significant at the 1% level; ***Significance at the .1%
[a]Performance measure using overall rating from judges
[b]Combined factor measure for both performance and creativity

From Table 5-21, it can be noted that using the judges' overall rating as a measure of performance, the overall model is not significant, $F(1,117)=1.618$, $p>.05$. The means for the groups without memory are higher than for those with memory. Therefore H6a, using the judges' overall rating as a measure of performance, is not supported.

H6b predicts the impact of memory on creativity. It proposes that groups with memory will have different levels of creativity than groups without memory.

H6b: Groups with memory will have different levels of creativity than other groups.

To test H6b, a one-way ANOVA test was conducted on creativity using the group level measure for the dimension of innovation from the judges' ratings. These results are also shown in Table 5-21. The results reveal that the overall model for the impact of memory on creativity is not significant, $F(1,117)=.365$, $p>.05$. The distribution of the means reveals that there is not much variation in the level of creativity between the groups with memory and without memory, translating to the fact that memory does not significantly impact the level of creativity. Therefore H6b is not supported.

We conducted an additional test on the hypothesis for memory using the factor of perceived performance, representing the combined construct for performance and creativity. A

one-way ANOVA was run for this. The results for this are included in Table 5-21. The results show that the model is significant, $F(1,117)=9.727$, $p<.01$. Also, there does not seem to be a notable difference in the difference between the means of the groups with and without memory. So, on the basis of this, we can surmise that memory does have a significant impact on the combined construct of performance and creativity.

5.4.8. Hypothesis 7: Memory to Relational Trust/Shared Goals

Hypothesis 7 proposes that memory has a positive impact on the level of relational trust and shared goals in groups. Groups having memory therefore are posited to have higher levels of relational trust than other groups.

H7: Groups with memory have higher levels of relational trust and shared goals than other groups.

HANOVA is used to test this hypothesis which uses a dependent variable (relational trust) as a perceptual measure collected at the individual level. Using HANOVA, the least square means and standard errors are reported in Table 5-22. The least square means are adjusted for the unbalanced design with unequal number of cells in conditions.

Table 5-22: HANOVA Results of Relational Trust and Shared Goals

LSMeans by History

	With Memory	Without Memory
LSMean	3.741	3.905
Std. Error	.041	.041
N	180 (60)	177 (59)

HANOVA Results (R^2=57%)

	F	P
Model	2.69	<.0001***
History	8.07	.0049**
Group Effect	2.65	<.0001***

*Significant at the 5% level; **Significant at the 1% level; ***Significance at the .1% level

Table 5-22 shows that the model is significant, F(118,238)=2.69, p<.0001. However, the distribution of the means reveals an interesting pattern. Groups without memory have higher creativity than groups with memory. The impact of memory on relational trust is therefore significant, but in the opposite direction of what was predicted in the hypothesis. The implications of this will be discussed in the Discussions chapter. Since the means indicate a direction that is contrary to the one predicted in the hypothesis, we surmise that H7 is not supported.

5.4.9. Additional Analyses

Finally, in order to get a well-rounded, comprehensive understanding of the impact of the independent variables on the dependent variables, we conducted a HANOVA test of memory and history, on the combined factor variable perceived performance, which is a measure of both performance and creativity. The results of this test are shown in Table 5-23.

Table 5-23: HANOVA of all variables using the Factor Measure of Perceived Performance

	With History			Without History			Total		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
With Memory	93 (31)	3.771	.048	87 (29)	3.769	.048	180 (60)	3.770	.031
Without Memory	87 (29)	3.818	.056	90 (30)	4.061	.059	177 (59)	3.939	.032
Total	180 (60)	3.795	.042	177 (59)	3.915	.042			

GLM Results

	F	P
Model	5.06	<.0001***
Memory	13.71	.0003**
History	2.85	.0926
Interaction (Mem*Hist)	6.71	.0102**
Relational Closeness	4.28	.0396*
Relational Trust & Shared Goals	105.0	<.0001***
Grp (Mem*Hist)	1.60	.0014**

*Significant at 5% level; **Significant at 1% level; ***Significant at .1*%

Table 5-23 shows that the overall model with all the variables is significant, $F(120,236)=5.06$, $p<.0001$. The coefficient for memory is also significant (13.71, $p<.0003$); as is the coefficient for relational closeness (4.28, $p<.05$); and for relational trust (105.0, $p<.0001$). The interaction of memory and history is also significant (6.71, $p<.05$). It is noteworthy that using perceived performance as dependent variable, the impact of history is not significant (2.85, $p>.05$). The implications of this will be discussed in the next chapter. The distribution of the means reveals that the groups without history (ad hoc) and without memory have the best performance, followed by the groups with history and without memory. The lowest overall performance is from groups with memory but without history. The results show that the overall group factor of history and memory, combined, is significant (1.60, $p<.001$) demonstrating that what occurs within groups plays an important role influencing the perception of performance. The dynamics within each group significantly affect perceived form and this influence is not accounted for in the other variables of the model. The implications of this result will be enunciated in the section on Discussions.

It is also noteworthy is that, while there was no significant impact from the interaction of history and memory on performance measured by the judges' overall rating, it is not so, on the combined factor measure of perceived performance which encompasses creativity also. Again, the implications of this result will be presented in the discussions chapter.

In conclusion of this chapter, Table 5-24 summarizes the results of all the tests of hypotheses presented above.

Table 5-24: Summary of the Test of Hypotheses

H#	Hypothesis	Result
H1	Groups with history will have a higher degree of relational closeness than all other groups	S
H2a	Groups that exhibit a high level of relational closeness will outperform other groups	S
H2b	Groups that exhibit a high level of relational closeness will have lower creativity than others.	S
H2[c]	*Groups that exhibit a high level of relational closeness will have higher performance and creativity combined), than all other groups.*	*S*
H3	Groups with history have a higher degree of relational trust and shared goals than other groups	S
H4a	Groups with a high degree of relational trust and shared goals will outperform other groups	S
H4b	Groups with different levels of relational trust will have different levels of creativity.	S
H4	*Groups that exhibit a high level of relational trust and shared goals will have higher performance and creativity combined, than all other groups.*	*S*
H5a	Groups with memory and history will outperform other groups	NS
H5b	Groups without history will be more creative than other groups	NS*
H5[c]	*Groups with memory and history will have higher performance and creativity combined than all other groups.*	*NS*
H6a	Groups with memory outperform the other groups.	NS
H6b	Groups with memory will have different levels of creativity than other groups	NS
H6[c]	*Groups with memory will have higher levels of performance and creativity combined than all other groups.*	*S*
H7	Groups with memory have higher levels of relational trust and shared goals than other groups	NS*

S=Supported; NS=Not Supported; *Significant in the opposite direction;
[c]combined factor measure of perceived performance

CHAPTER 6: DISCUSSION AND CONCLUSIONS

6.1 Discussion

In the current research, we explore the impact that group history and group memory have on group performance and creativity, within a synchronous computer-mediated environment. We also investigate the role that relational social capital plays in these relationships. To this effect, a laboratory experiment was conducted, where groups of three students were assembled. About half of these groups had members who had worked together before (with history), while the other half had members who did not know each other (without history). Thus, group history was manipulated as a treatment at the group level to represent groups that had worked together prior to the current experiment (established), and groups that had no history of prior interaction (ad hoc). These groups were randomly assigned to working with or without memory. The memory manipulation consisted of generating a transcript of the group discussion and making it available to the group. The groups that worked "without memory" did not have access to a record of their discussions. Therefore, group memory was manipulated at the group level to represent groups that had access to an electronic group memory (chat transcript) and groups that did not.

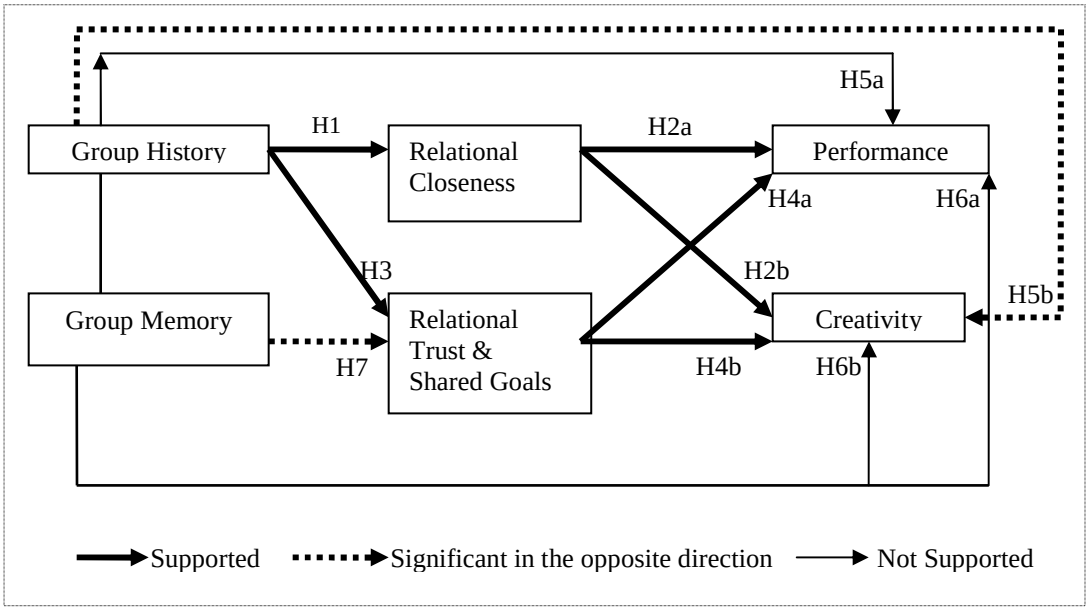
The groups were given a task that required them to use the synchronous group communication system to discuss and come up with a written report showing recommendations on the content and design of a fictional university's emergency management website. The participants were given instructions on the phases of emergency management to focus upon. The task represents a scenario that is current and relevant to students, encourages creativity, and fosters a rich discussion that can be analyzed for future research. The discussions were done using gmail group chat and the group report was collaboratively developed using google docs. Appendix A shows the task.

A total of 119 groups of three members per group (totaling up to 357 participants) were recruited over a span of two semesters. The groups were distributed across the four experimental conditions as follows: About 60 groups were assigned to teams with members they had worked with before, to constitute the "with-history (established)" experimental condition. Of these, 31 groups were given access to the chat transcript to constitute the "with history/with memory" condition, and the remaining 29 groups were not given access to the chat transcript constituting the "with history/without memory" condition. The remaining 59 groups (out of 119) were assigned to teams with members they had not worked with before, to constitute the "without-history (ad hoc)" condition. Of these, 29 groups were given access to the chat transcript constituting the "without history/with memory" condition and the balance 30 groups were not given access to the chat transcript constituting the "without history/without memory" condition.

The data sources consisted of the actual group reports that were graded by a panel of experts, and the answers to a post-test questionnaire that each participant filled out at the conclusion of the experiment. Thus, to test the hypotheses objective performance ratings and subjective perceptions were used.

The results show that six out of eleven hypotheses were supported while the remaining five were not. However, two hypotheses that were not supported had significant findings in the opposite direction. Figure 6-1 depicts the research model with the results of the hypotheses testing. The hypotheses that were supported are shown in bold lines, those that were not supported in plain lines, and the hypotheses that had results in the direction opposite to that predicted, in dotted lines.

Figure 6-1: Research Model with Results of Hypotheses Testing



In terms of outcomes, performance and creativity were both independently evaluated by external judges from the reports produced by the groups. In addition, we also use a perceptual measure extracted from factor analysis called perceived performance that encapsulates both performance and creativity in one composite measure. The following sections are organized to first discuss the hypotheses that were supported, followed by those that were not supported, or had findings in the opposite direction of the predictions.

6.1.1. Research Findings on Supported Hypotheses

Our predictions for the impact of group history on the relational social capital variables of relational closeness (H1) and relational trust (H3) were both supported. Groups with history (established) had high levels of relational closeness and relational trust. These findings are consistent with the social capital theory which states that, the more the exposure and time spent by members with each other, the more the potential for the relationship to have a higher degree of relational closeness (Bourdieu, 1986), and the more the capacity for members to assimilate

information about other members over a period of time (Gabarro, 1987). This, in turn instills trust and confidence in each other (Blau, 1986). Groups without history (ad hoc), by virtue of having less exposure and interaction with each other exhibited lower levels of both relational closeness and relational trust.

Both of our mediator variables, relational closeness and relational trust, show a significant impact on the dependent variable of performance. Relational closeness had a significant effect on performance measured by the overall rating from the judges (H2a). This is in line with the literature on the strength of ties from social capital theory (Granovetter, 1985), which states that contacts with high relational closeness have strong ties that provide the motivation to share and exchange information. Such exchange encourages positive performance, as evidenced from our results. In addition, knowledge management literature states that strong ties or high relational closeness allows open exchange of tacit and useful knowledge (Ghoshal et al., 1994) which in turn leads to better performance.

With respect to relational trust and performance, the findings indicate that groups with a high degree of relational trust and shared goals performed better than other groups, as predicted (H4a). Trust between members, by reducing information asymmetries, can encourage open information sharing (Wu, 2008), which in turn leads to better performance. A high level of trust also increases the members' ability to coordinate and synergize their efforts towards better performance.

In terms of creativity, as with performance, relational closeness and relational trust proved to be significant indicators. As hypothesized, groups with high relational closeness showed lower levels of creativity than other groups (H2b). The literature on group cohesion reinforces this result. Cohesion refers to the level of members' attraction to the group (Hogg,

1992) and to the level of personal interaction between members (Yoo & Alavi, 2001), which is analogous to relational closeness. Groups with history, by virtue of being cohesive, are characterized by the phenomenon of groupthink that endears them to be homogeneous and less creative.

Our prediction on relational trust having a significant influence on the creativity of the groups was supported (H4b). Groups with different levels of relational trust exhibited different levels of creativity. About one-fifth of the variance in creativity can be attributed to relational trust, which is a significant proportion.

6.1.2. Research Findings on Unsupported Hypotheses

Our results on the interaction of group history and group memory, on performance measured using the judges' overall rating, was not supported (H5a). Interaction effect typically shows how the level of one factor is affected by the other factor, in impacting the dependent variable. In our research, there was no effect from the interaction between history and memory, on performance, when the measure of performance was the ratings provided by the judges.

Additionally, group history, by itself, did not significantly impact the creativity of the groups, as measured by the judges. Our prediction that groups without history have a higher level of creativity than other groups (H5b) was not supported. Interestingly, history seemed to impact creativity in the opposite direction to what was predicted – that is, groups with history had more, rather than less, creativity. We had based our prediction on the premise that groups without history had lower cognitive consensus (Yoo and Alavi, 2001; Sethi et al., 2002; Ocker, 2005) and more diversity (Paulus, 2000), leading to higher levels of creativity. Cognitive consensus refers to similarity among group members on how key matters are conceptualized, and is based on the premise that such consensus develops over a period of time. The flip side of this

phenomenon is that groups with history, due to the cognitive consensus, have a higher level of homogeneity of opinions, leading to less variation in ideology or, in effect, less creativity. However, in our research, since the results are contrary, an explanation could be that the groups in the experiment have not yet reached the level at which the phenomenon of cognitive consensus starts developing. Our groups were established within the tenure of the school academic year, and not necessarily over a long period of time, as in corporate teams, within a professional environment.

The second independent variable, group memory, did not have a significant impact on either performance or creativity, as measured by the judges who evaluated the final reports. The results indicate in terms of performance that groups with memory did not outperform others as predicted (H6a). In terms of creativity, we posited that groups with memory will have different levels of creativity than others (H6b). For H6b, although the distribution of the means indicates that groups without memory have more creativity than other groups, the difference is not significant enough to make an impact.

The explanation for the non-significance of memory on outcomes can be ascertained by examining it from two perspectives. The first is related to the nature of the current experiment. Our operationalization of memory in the form of gmail chat transcript seems to be influenced by the capabilities of the collaborative environment that was offered to create the group report (Google docs). Google docs, with the built-in functionality of collaboration that allows one to use the same workspace as a task document as well as a medium of communication with the other members may have contributed to overcoming the limitation of not having a memory. So, groups actually may have improvised and used the collaborative software to compensate for the unavailability of memory, by developing an ongoing dialogue within Google docs. This also

goes to show the dexterity and skill of the sample in improvising and adapting technology, which is a critical revelation for decisions regarding technology choice.

The second possible explanation for the non-significance of memory on outcomes is related to the nature of the experimental task. The current task required groups to come up with recommendations for an emergency management website. They were given instructions in covering the different phases of emergency management such as planning, notification, recovery etc. It appears that if the task is one that lends itself to modularity in a way that different members can work on different parts without having to wait for the others' input, the impact of memory may be diminished. In contrast, for tasks that require sequence and inter-dependence, such that one member's output is another member's input, memory is likely to have a more significant impact on performance and creativity. In the current experiment, the task was such that members could work on different phases of emergency management at the same time using Google docs, without having to wait for a trail. So, hypothetically, a programming task that requires a unit of code to be completed and then used as a basis for the second unit of code, would probably manifest more need for memory than the current task.

In the impact of relational trust and shared goals, we hypothesized that groups with memory will have higher levels of relational trust and shared goals (H7). Although the overall model for this test was not significant, the distribution of the means reveals an effect in the opposite direction to the one predicted – groups with memory actually showed lower levels of relational trust and shared goals than other groups. As an explanation for this phenomenon, we draw from the literature on knowledge contribution which discusses two kinds of knowledge - exploitative and exploratory (March, 1991). Exploitative knowledge builds on an existing base to create incremental solutions (Dewar & Dutton, 1986) while exploratory knowledge refers to

radical solutions that are different from the existing knowledge base (Kang et al., 2007). Exploitative knowledge sharing will be best served by shared perception and shared goals. In the current research, the task requires more of exploratory, rather than, exploitative knowledge, in the sense that the groups are not incrementally building on an existing base, but are really starting from scratch in developing recommendations for an emergency management web site.

6.1.3. Additional Findings

In addition to the hypotheses that we depicted in our research model, the results from our analyses using the factor measure of perceived performance to represent performance and creativity combined, show a noteworthy pattern. These additional hypotheses were shown in Table -24 at the end of the previous chapter, in italics and with a superscript ^{c} next to the hypothesis number ($H2^{c}$, $H4^{c}$, $H5^{c}$, $H6^{c}$). It appears that all of the variables - relational closeness, relational trust and shared goals, and group memory - with the exception of group history have a significant impact on perceived performance.

The impact of relational closeness on this combined construct was significant in that the members of groups with high levels of relational closeness had high levels of perceived performance ($H2^{c}$) Similarly, the impact of relational trust and shared goals on this combined construct was also supported in that high levels of relational trust within the members actually showed high levels of perceptions on perceived performance ($H4^{c}$). This reiterates the literature that feelings of well-being and positive interactions actually enhance the perception of performance.

In terms of the interaction between memory and history, even though the interaction had no impact on performance using the judges' overall rating, it had a significant impact on perceived performance ($H5^{c}$). Since perceived performance is a conglomerate of performance

and creativity, the results prompt us to believe that the interaction has a stronger impact when creativity is included in the equation, than when performance is evaluated individually.

Interestingly, although group memory was not significant in impacting performance using the judges' overall rating measure, it actually shows a significant impact on perceived performance ($H6^{c}$). This shows that groups with memory actually perceive their level of performance and creativity to be high. Their perception of their group outcome was positive even if the judges felt otherwise.

6.1.4. Individual and Group Level Analysis

The hypotheses were tested either at the individual or at the group level depending upon the unit at which the measures were collected. Recall that objective performance and creativity were ascertained by the judges, who evaluated the group reports and produced ratings for each group. These are shared measures that only exist at the group level (Gallivan & Benbunan-Fich, 2005). In contrast, the perceptual variables were collected at the individual level via a post-test questionnaire. Since individual participants were nested in groups when they experience the treatment, their perceptions might be correlated. The nesting of individual participants in groups and the subsequent correlation of their perceptions violates the assumption of independence of errors, which is essential for analyses of variance.

To avoid potential mismatch of level of analysis when testing hypotheses, we used two different approaches. First, to test hypotheses at the group level, the individual measures were tested for within group homogeneity and aggregated for each group (using the James index as a criterion for aggregation). Second, to test hypotheses at the individual level, HANOVA (hierarchical analysis of variance) was used. This approach accounts for the fact that individuals are nested in groups when they participate in the experiment. In fact, the group is considered as a

separate factor that explains the variance in the dependent variables. In all of the reported HANOVA analyses, the group effects (i.e. additional group factor) were significant. This finding indicates that the particular dynamics that take place within groups cannot be discounted. The group factor is an important source of variation in the dependent variables that is not accounted for in the other variables of the model.

6.2 Limitations

While we draw strength from the experimental nature of our research, some limitations are introduced by the laboratory setting as well. Some logistic and technological issues sometimes prevent the ideal experimental condition. For example, it was somewhat difficult to schedule established groups with the same extent of experience and interaction. So, any group that had worked together prior to the current experiment was designated as a group with history, when in fact the degree to which these groups were truly established could not strictly controlled. In addition, the unbalanced number of observations in each condition was also unavoidable due to the nature of the experiment and the logistics of scheduling sessions. However, the actual number of participants and groups is similar and the total number of subjects provides adequate power for the statistical analyses.

It is also important to note that the generalization of these results to other settings and populations should be made with caution. The subjects who participated in this experiment were college students working on a creativity task relevant to their age group and compensated with class credit. Different subject pools or tasks may produce different results. Testing the research model with other subject populations and in other contexts provides fruitful directions to extend the findings reported here.

As with any experimental setting, some external validity was traded off in favor of high internal validity. Furthermore, the use of a particular software - Google apps (Gmail and Google docs), which supported reprocessability for the memory manipulation, is also a source of limitation, as the results may not be replicable in other systems with slightly different implementations of this feature. Another possible extension for this research consists of implementing an alternative manipulation of group memory and investigate in-depth the extent to which group members use memory-aids (i.e. transcripts of their group discussions), as opposed to their own memory (i.e. personal recollection of their discussions) to solve the task and compose the final report.

6.3. Contributions

Our research makes significant contributions in the area of synchronous computer-mediated group performance. It shows that the same technology with the same task may result in different findings depending on the group that is using it. It emphasizes the social dynamics or the social capital of the groups in terms of the relationships and interactions that ensue between the members, as an integral component to group outcome. By incorporating the social capital lens into computer-mediated communication, we highlight that, performance and creativity in a group context, are actually influenced by the level of relational social capital within the group.

The research adopts a socio-technical flavor by investigating the technical variable of group memory and the social variable of group history as the two factors impacting performance and creativity.

Our research offers interesting insight that contradicts the traditional perspective of history among team members not being beneficial for creativity. We draw some backing from the knowledge integration literature to enunciate this very significant contribution. The literature

on knowledge integration posits that teams that have a shared perspective of the problem have the ability to integrate internally existing knowledge, by combining and reformulating existing knowledge to produce new insights and solutions (Mitchell, 2006; Nonaka 1994; Okhuysen & Eisenhardt 2002) which foster creativity. This shared perspective or mutual understanding (Alavi & Tiwana, 2002; Cramton, 2001) has been stated to be a key source for effective communication and collaboration in team settings (Clark, 1996; Clark & Carlson, 1982; Clark & Marshall, 1991). Such understanding occurs because of the ability of members to formulate their contributions with an awareness of what other team members do and do not know (Krauss & Fussell, 1990). Absence of work history among members, dispersion of members in terms of space and time, and diverse expertise/culture are some circumstances that constrain the development of a shared understanding (Alavi & Tiwana, 2002). History therefore helps teams have a high level of mutual understanding because of the members' awareness of the others' expertise and level of knowledge. This awareness helps them identify and integrate knowledge by encouraging open discussion which may stimulate creative conflict (Alavi & Tiwana, 2002). Teams with lack of history, on the other hand, do not have the level of awareness of the others' expertise and knowledge level and may not have the level of comfort with each other, to resort to open discussions, or may resort to discussions which may lead to unresolved issues. Therefore, we emphasize that history among members can impact creativity positively, contrary to the traditional prediction.

Our research is the one of the few to empirically test the concept of reprocessability within the context of computer-mediated communication. We used the group memory (chat transcript) as an operationalization for reprocessability. Group memory, though important as an artifact for collaboration and cognition, assumes a new perspective in our research. We propose

that memory should not be viewed as a separate entity but as a vehicle that affects performance through the medium of relational social capital of the group. Since memory lowers the level of relational trust among members, it may be a good component to consider only for groups with a history of interaction. Groups with history do not rely upon memory to build impressions of trust about the other members, since the legacy of interactions leads them to build trust and confidence in other members. On the contrary, groups without history do not have any foundation to build their trust upon. This necessitates the members to invest cognitive effort to understand other members, reexamine the options, and communicate, so as to develop personal ties that will help build trust. If these groups are offered a group memory, they would not make the concerted cognitive effort to interact and would simply rely on the memory to recollect the other members' actions. Therefore, groups that have no history would benefit from not having access to group memory so they can make efforts to improve their relationships with each other, which in turn will positively impact performance.

The results of this study shed new light on the Media Synchronicity Theory (MST). While MST proposes the importance of reprocessability as a capability of the medium for impacting information processing and performance, we show that reprocessability (memory) needs to be viewed, keeping in mind the social dynamics of the group (level of relational closeness or trust), and the objective of the group collaboration (performance or creativity).

6.4. Implications

There are practical implications that our results offer in the domain of computer-mediated communication and small group research. In terms of performance, our research emphasizes the importance of considering self-efficacy in groups as an indicator of performance. Self-efficacy is a person's belief in his or her ability to succeed in a particular situation (Bandura, 1982). People

with a strong sense of self-efficacy will be motivated to accomplish tasks, taking them on as a challenge. We use the perceived performance measure as an indicator of overall performance and creativity. As some of our results suggest, the results of performance perceptions (performance and creativity factor) may not always be consistent with externally provided assessment of performance or creativity, by third parties (i.e. expert judges). These perceptions are nevertheless important to promote positive feelings about group interaction with the conditions implemented by this study.

The results of the study offer practical implications with respect to the value of incorporating different types of group history and group memory into the synchronous computer mediated environment. For practitioners and academicians alike, it is important to know the best combination that works in a setting. This study shows that for a task that requires creativity, it is best to deploy groups without history and without memory. It seems that under these conditions creativity can be unleashed without restrictions.

Also, we see the impact that the nature of the task has on the role of group memory in performance and creativity. If a task requires coordination between different members in the sense that one member's output becomes another's input, memory will assume a pivotal role. On the other hand, if the task is characterized by modularity that allows independent performance by members with limited coordination, the significance of memory will be undermined.

In today's digital era of globalization and connectivity, there is a preponderance of virtual teams and cross-functional teams. Additionally, economic trends often result in high fluidity of such teams due to employee turnover, layoffs, mergers and others. In the face of such changes in team composition it is vital for managers to study the impact of group history and member interactions on group performance and creativity.

Finally, for practitioners, it is important to know the technological features that enhance the social capital component in groups. Most studies look at the generation of relational social capital within a non-electronic medium. Our research shows the role of relational social capital in an electronic medium of exchange. It shows how memory as a technological component lowers the level of relational trust among members, and therefore can be used to modulate the group dynamics. The research also sheds light on how high levels of relational social capital positively impact performance, but not necessarily creativity.

The research also sheds light on the necessity to change the way in which we perceive collaborative development. With the sophistication of today's technology, collaborative process is characterized by discussion and writing/development occurring in parallel, rather than in sequence. Groups now discuss and share ideas, while continuing to work on the task, since most collaborative technology offers the interactive discussion feature within the development interface itself. The traditional process of discussion first and development next has been superseded. Therefore our implementation of memory as a component that is a repository of the discussions which can be useful in the post-discussion process of development needs to be reshaped to a component that offers the functionality of discussion and development in parallel. Research testing the importance of memory should focus on components that are external to the collaborative environment (e.g., from an external source), the availability of which can then be manipulated.

These implications are important in considering the group dynamics and the medium for group interaction and collaboration.

6.5. Future Research

The future research plans for this project fall into categories. As discussed, memory did not directly impact performance as predicted. Neither did it impact creativity as expected. Rethinking the model in terms of the lessons learned in this experiment is a good way to get insight into what is happening to memory in relation to performance and creativity. A preliminary plan is to investigate alternatives to either Google docs as a file-sharing environment for group activity, or the chat transcript as a medium for memory.

The software (Gmail chat) provides the ability to save the communications between the members of each group. In order to triangulate the results obtained here and to gain more insight into the internal processes of the groups, the transcripts will be content analyzed. For instance, the extent of memory that was really used can be analyzed; also, a comparison can be made between the amount of information that was exchanged during discussion, and the amount that got transferred to the actual group report; in addition, an estimate can be made as to the work patterns in terms of time management of each group. Further, the content analysis of transcripts could open up the breadth of this research by discovering other underlying phenomena that may be at play in the group dynamics of each experimental condition. This analysis could offer some insights into the particular dynamics captured by the group factor in the HANOVA analysis.

Also, the theory of distributed cognition offers potential for exploring the cognitive process of the group in terms of the processes and insights that went into the group outcome. Since there were no designated leaders in the group (except to start the chat session and submit the report), we can further analyze the transcripts to see if there are any emergent leadership qualities in some members. Associated with this would be any leadership styles that are inherent from the interaction.

This research also opens up avenues in the arena of distributed creativity in groups. Using the transcripts as a starting point for analyzing creativity, we can compare the concept of distributed creativity in a team with the individual level of creativity in members to observe synergies at play.

Finally, since this is the first study to empirically test reprocessability within the context of synchronous computer-mediated systems, there exists great potential in extending this line of research further by testing the effects of reprocessability under different settings and using different tasks. An interesting stream that can be analyzed in the future would be to study the impact of artifacts, other than memory, in influencing the distributed cognitive processes and ultimately the performance of groups.

6.6. Conclusions

This research integrates literature from computer-mediated communication and small group research relating to group relations (relational social capital) and group capabilities. It is one of the first in incorporating the social capital lens into the computer-mediated communication phenomenon. By proposing a controlled experimental design as our research methodology, we analyzed the social and technical dimensions involved in synchronous group communication. The technical dimension looked at the use of technology in terms of group memory, and the social dimensions studied the interaction of the group members in terms of social capital and group history.

Our research makes significant contributions to the body of research on computer-mediated communication and small group dynamics. To the best of our knowledge, while reprocessability has been examined as a media characteristic within the context of CMC, ours is the first innovative experimental design to examine reprocessability and group work within the

context of the latest technologies available such as Google apps (specifically, Google chat and Google docs). With the prevalence of the internet, it is most current and relevant to do research on academic topics, and place them in the context of upcoming technological environments.

Finally, we draw theoretical justification for our results, not only from Information Systems but also from social psychology and sociology, in incorporating the theory of distributed cognition and social capital, in addition to the Media Synchronicity Theory. This theory allows us to draw rich inferences from the social component arising from the use of technology by small groups. The research sheds light on the concept of distributed cognition as a critical component in group interaction, within the context of computer-mediation. In this manner, it expands the original concept of cognition as an individual trait and analyzes it as a group characteristic that is impacted by technological variables such as electronic group memory.

APPENDICES

Appendix A – The Task

Design of an Emergency Management Website for a University

Emergencies can arise in universities and corporations at any time and from various natural or manmade causes. The best way to minimize potential loss, and speed up the recovery from events such as hurricanes, snow storms, fires, or terrorist acts, etc. is to plan ahead. Emergency management (EM) function is critical in both the academic and the corporate sectors. In academia, the universities need to ensure that the campus continues to function in the event of an emergency.

With this objective in mind, ABC University has created an Emergency Management Operations Center that has several teams working towards emergency planning, preparedness, response and recovery. You are part of a Special Team that has been assigned to develop an emergency management website for the university. Your responsibility is to ensure that ABC provides information on how it can respond to, recover from, and mitigate the effects of a wide variety of disasters that could adversely affect the health, safety, and/or general welfare of its students, faculty, staff and visitors.

Your task is to discuss with your group members and develop a report with recommendations on how the university's emergency management (EM) website should be designed. The report should contain the following parts:

- ***1. Location of the page link***: indicate where within the overall university webpage you want the EM link to be located (e.g., you want the EM link within Student Safety etc.)

- ***2. Phases:*** The report should address the following parts. For each part, describe what information you would show (content) and how you would show the information (design). For example, for emergency notification, you can include that you will have a form asking for contact information and show that text messages will be sent to those numbers.
    - Part A: ***Emergency planning*** – what measures can be taken to plan for different kinds of emergencies Make sure you think of the different kinds of emergencies that can arise in a university setting.
    - Part B: ***Emergency notification/alert***– how to notify the entities either before or after an emergency. What measures do you suggest to make the students, staff, and faculty aware (you can think about ways in which you can spread the message).
    - Part C: ***Emergency recovery*** – after the occurrence of an emergency, what resources does the university offer to restore the campus to a functional stage.

You are encouraged to be as creative as possible in how you can include the functionality of Web 2.0 in the EM web page.

Your report should contain your group member userids and the recommendations.

Please remember to log off the computer at the end of the experiment.

Appendix B – Recruitment Statement

Informed Consent Form

The primary purpose of this study is to examine group work within computer-mediated synchronous communication using various forms of group interaction history and technological memory. Students will be given a task to develop a web page for emergency management for a fictional university using a system that either offers a memory feature or does not. The groups will be asked to prepare a group output. By participating in this study, you will help advance research and gain experience in online group collaboration. We anticipate many sessions that will take place in the Vertical Campus and require about an hour per session. A student can only participate in one session.

Students do not need to bring or have anything to participate in the study. All instructions will be distributed and fully explained before the actual experiment. Participation is completely voluntary. *In order to participate, you must be 18 (years of age) and over*. You may discontinue participation at any time without losing the credit for participation.

All records of this study will be kept confidential. No one other than the PI (Viju Raghupathi) will have access to the data, which will be archived in a secure location after use. If desired, you may see the data collected from only your participation. Any resulting publications from this study will not identify individual participants but will refer to aggregate results.

If you have any questions regarding this research, you can call Viju Raghupathi at (646) 312-3368 or Dr. Raquel Benbunan-Fich at (646) 312-3375. If you have any questions concerning your rights as a participant in this study, you can contact the Baruch IRB office at (646)-312-3785.

The IRB (Institutional Review Board) is a college committee that protects the rights of human subjects in research. For information on how your rights are protected if you participate in this experiment, please contact Keisha Peterson, IRB Administrator (Keisha.Peterson@baruch.cuny.edu).

By signing below, you understand and accept the terms of this research study as stated above and that your participation is completely voluntary.

Please check box to indicate consent:
☐ I consent to the experiment

_____ _____
Student Signature Researcher Signature

_____ _____
Student Full Name (please print as LAST, FIRST) Date

Appendix C – Pre-Task Questionnaire

1. Introduction

Please fill in complete and accurate information. The information you enter will be useful in conducting research in the area of synchronous communication. Thank you.

* **1. Please enter the userid (not the full email address) that is given to you on your index card (e.g., EN1MEMB1).**

* **2. Please enter your professor's name. If you are not sure of the name, please enter the course and the days/times that the class meets (this info is needed to give you credit for participation).**

* **3. Please select your gender.**

◯ Male ◯ Female

4. Please select your student level.

◯ Undergraduate ◯ Graduate

* **5. Please select your age from the following ranges.**

◯ 18 - 24 ◯ 25 - 34 ◯ 35 - 44 ◯ 45 - 50 ◯ 51 and Over

* **6. How often have you used the CHAT feature in gmail or any other messaging facility?**

◯ Never ◯ Very rarely ◯ Neutral ◯ Often ◯ Very often

* **7. How comfortable do you feel using the CHAT feature in gmail or any other messaging facility?**

◯ Very uncomfortable ◯ uncomfortable ◯ Neutral ◯ Comfortable ◯ Very comfortable

* **8. How often have you used the GOOGLE DOCS feature or any other similar file sharing feature?**

◯ Never ◯ Very rarely ◯ Neutral ◯ Often ◯ Very often

* **9. How comfortable do you feel using the GOOGLE DOCS feature or any other similar file sharing feature?**

◯ Very uncomfortable ◯ Uncomfortable ◯ Neutral ◯ Comfortable ◯ Very comfortable

* **10. How well do you type?**

◯ Hunt and pack ◯ Rough or casual typing ◯ good typing ◯ excellent typing (>30 wpm error-free)

* **11. How often have you worked with the other members in your group, BEFORE TODAY?**

◯ Never ◯ Very rarely ◯ Neutral ◯ Often ◯ Very often

You have completed the first part of the experiment. Please click on DONE. Please refer to the instruction sheet for the next step. Thank you.

APPENDIX D – POST-TASK QUESTIONNAIRE

D1 - Without Memory Groups

1. Default Section

* 1. Please enter the userid (not the full email address) that is given to you on your index card (e.g., EN1MEMB1).

* 2. My team members and I are very close to each other (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 3. I understand my team members and who they really are (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 4. I feel this close to my team members in my working relationship (estimate this as an average for all members).

Very distant | Distant | Neutral | Close | Very Close

* 5. In the past I have spent a lot of time with my team members (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 6. My team members influence me in everyday things in my life (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 7. My team members share my overall goals and values (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 8. My team members share are generally honest and truthful in the information provided (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 9. My team members are very competent in the projects in which we interact (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 10. My team members have a shared vision of the team's future achievements (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

2.

* **1. My team members have a clear view to team's directions (estimate this as an average for all members).**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **2. My team members have a shared vision to team's goals (estimate this as an average for all members).**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **3. How do you feel about the process by which your group worked to create the report?**

○ Strongly dissatisfied ○ Dissatisfied ○ Neutral ○ Satisfied ○ Strongly satisfied

* **4. How do you feel about the group's discussion?**

○ Strongly dissatisfied ○ Dissatisfied ○ Neutral ○ Satisfied ○ Strongly satisfied

* **5. How satisfied were you with the outcome (report) of your team's task?**

○ Strongly dissatisfied ○ Dissatisfied ○ Neutral ○ Satisfied ○ Strongly satisfied

* **6. Overall, how satisfied were you with participating in this experiment?**

○ Strongly dissatisfied ○ Dissatisfied ○ Neutral ○ Satisfied ○ Strongly satisfied

* **7. Our group comes up with many new ideas about how a project should be done.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **8. If a novel idea is introduced in class, it often comes from within our group.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **9. There is free and open communication within my group.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **10. Among my friends and colleagues, I will be the first or nearly the first to try out a new idea or method.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

3.

* **1. I solve problems which has caused others great difficulty.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **2. I suggest new and better ways to achieve goals or objectives.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **3. I usually search out new technologies, processes, techniques and/or product ideas.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **4. I have worked often with the other members in my team, before today.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **5. My team works together better than most other teams on which I have worked.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **6. My teammates and I help each other better than most other teams on which I have worked.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **7. My teammates and I get along better than most other teams on which I have worked.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **8. Having access to a chat transcript that showed the group discussion would have been useful for our task.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

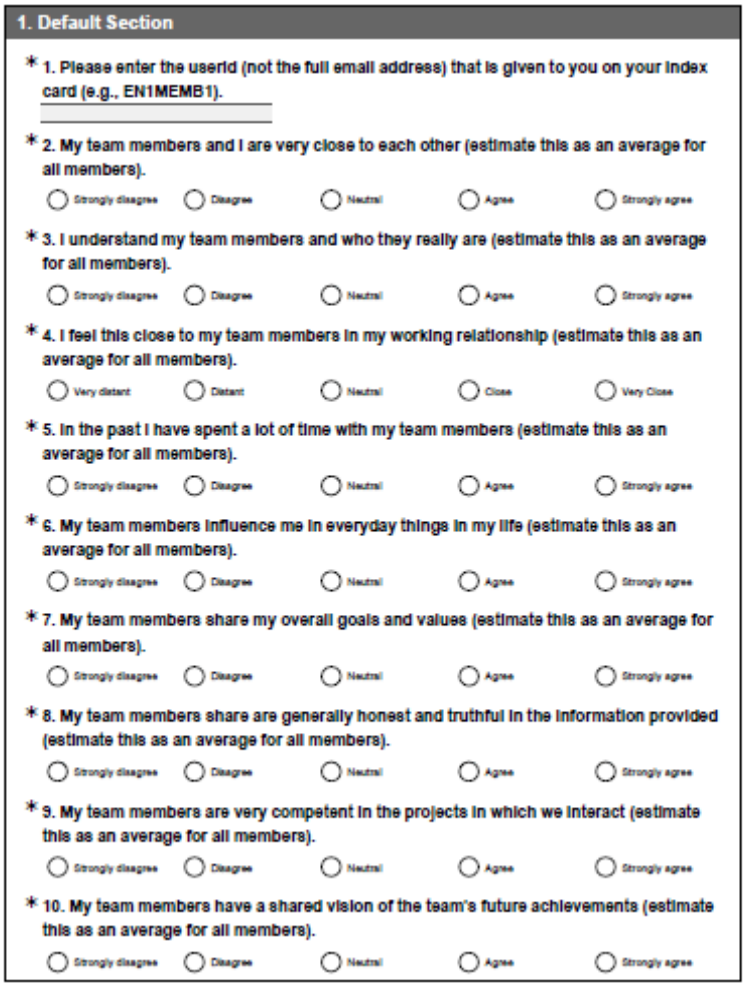
* **9. If we had access to a chat transcript we would have referred to it often.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

* **10. Having access to a chat transcript would add to our task performance.**

○ Strongly disagree ○ Disagree ○ Neutral ○ Agree ○ Strongly agree

D2- With Memory Groups



1. Default Section

* 1. Please enter the userid (not the full email address) that is given to you on your index card (e.g., EN1MEMB1).

* 2. My team members and I are very close to each other (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 3. I understand my team members and who they really are (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 4. I feel this close to my team members in my working relationship (estimate this as an average for all members).
Very distant | Distant | Neutral | Close | Very Close

* 5. In the past I have spent a lot of time with my team members (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

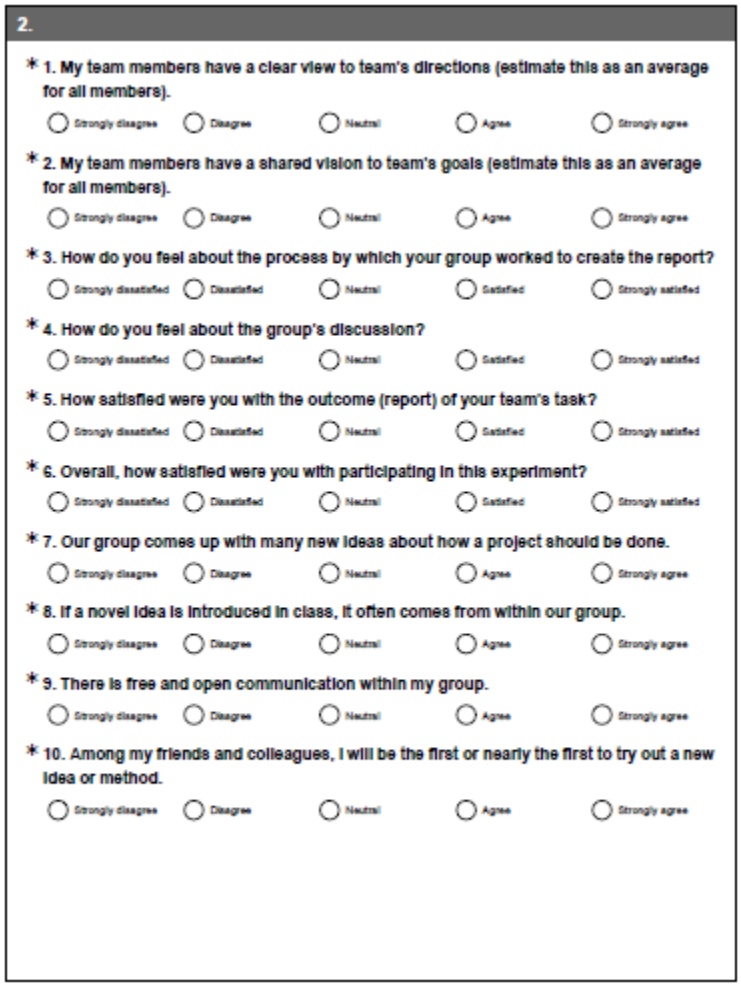
* 6. My team members influence me in everyday things in my life (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 7. My team members share my overall goals and values (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 8. My team members share are generally honest and truthful in the information provided (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 9. My team members are very competent in the projects in which we interact (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 10. My team members have a shared vision of the team's future achievements (estimate this as an average for all members).
Strongly disagree | Disagree | Neutral | Agree | Strongly agree



2.

* 1. My team members have a clear view to team's directions (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 2. My team members have a shared vision to team's goals (estimate this as an average for all members).

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 3. How do you feel about the process by which your group worked to create the report?

Strongly dissatisfied | Dissatisfied | Neutral | Satisfied | Strongly satisfied

* 4. How do you feel about the group's discussion?

Strongly dissatisfied | Dissatisfied | Neutral | Satisfied | Strongly satisfied

* 5. How satisfied were you with the outcome (report) of your team's task?

Strongly dissatisfied | Dissatisfied | Neutral | Satisfied | Strongly satisfied

* 6. Overall, how satisfied were you with participating in this experiment?

Strongly dissatisfied | Dissatisfied | Neutral | Satisfied | Strongly satisfied

* 7. Our group comes up with many new ideas about how a project should be done.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 8. If a novel idea is introduced in class, it often comes from within our group.

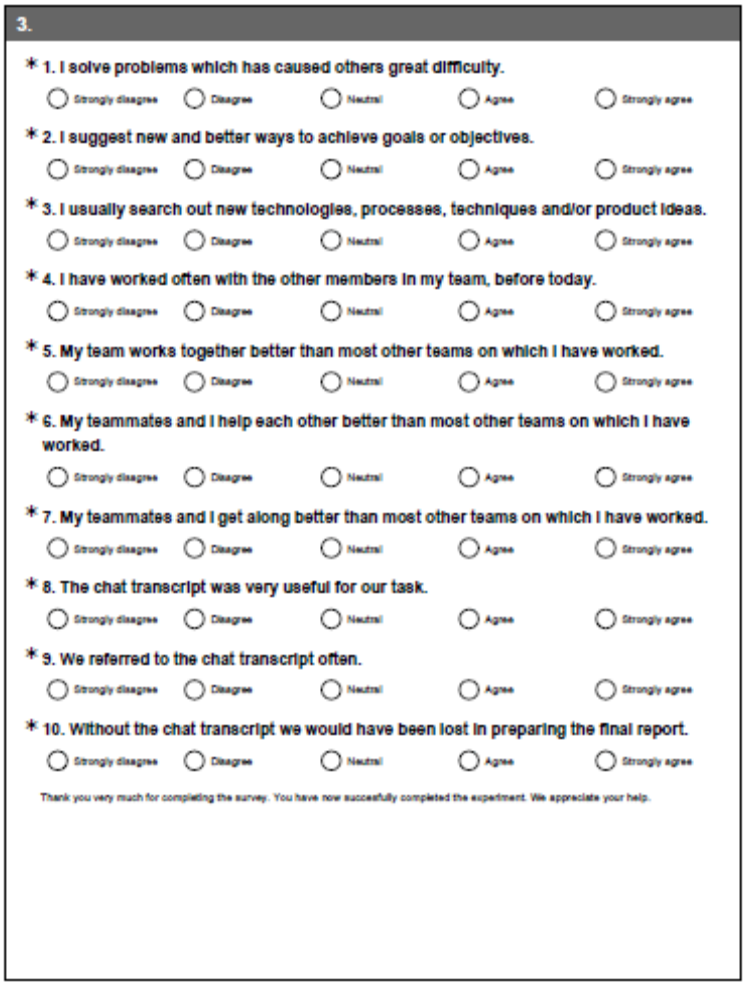
Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 9. There is free and open communication within my group.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 10. Among my friends and colleagues, I will be the first or nearly the first to try out a new idea or method.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree



3.

* 1. I solve problems which has caused others great difficulty.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 2. I suggest new and better ways to achieve goals or objectives.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 3. I usually search out new technologies, processes, techniques and/or product ideas.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 4. I have worked often with the other members in my team, before today.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 5. My team works together better than most other teams on which I have worked.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 6. My teammates and I help each other better than most other teams on which I have worked.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 7. My teammates and I get along better than most other teams on which I have worked.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 8. The chat transcript was very useful for our task.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 9. We referred to the chat transcript often.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

* 10. Without the chat transcript we would have been lost in preparing the final report.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Thank you very much for completing the survey. You have now succesfully completed the experiment. We appreciate your help.

APPENDIX E – CHAT STARTER INSTRUCTIONS

Appendix E1: Chat Starter Instructions - For With History/With Memory Condition

You have been assigned to start your group chat session for your group.

a. Go to the left side of the screen with Inbox etc. You will see "- Chat".

b. You will see the userid of member2 and member3. You will see a green button next to the userid if they are online. If you don't see the green button wait until they get online.

c. Move the mouse over the userid of member2 (e.g., em1memb2).

d. You will see a dialog box with *Email, Chat* and *More*. Click on "Chat".

e. A chat window will open up to the right corner of the screen. You will see three icons. Click on the icon that shows a + sign with a person (as you move your mouse, it should read "Add people to this chat").

f. In the empty box that comes up, type the userid of member 3 (e.g., em1memb3). Click on Invite.

NOTE: Make sure that you invite ONLY YOUR group members.

g. The chat window will read "This is a group chat. EM1MEMB2 has joined. EM1MEMB3 has joined."

a. *Note*: If for any reason any one member does not show up as "joined" in the group chat session repeat steps (c) through (e). All members should show up in the group chat.

h. To maximize the chat window, click on the middle arrow at the top right corner (which reads "pop-out"). You can start your group chat and discuss the task with your group.

i. When the facilitator announces the end of discussion time, refer back to the **GENERAL INSTRUCTIONS** handout for Part II (b) - Report Creation.

Appendix E2: Chat Starter Instructions - For Without History/With Memory Condition

You have been assigned to start your group chat session for your group.

a. Go to the left side of the screen with Inbox etc. You will see "- Chat".

b. You will see the userid of member2 and member3. You will see a green button next to the userid if they are online. If you don't see the green button wait until they get online.

c. Move the mouse over the userid of member2 (e.g., am1memb2).

d. You will see a dialog box with *Email, Chat* and *More*. Click on "Chat."

e. A chat window will open up to the right corner of the screen. You will see three icons. Click on the icon that shows a + sign with a person (as you move your mouse, it should read "Add people to this chat").

f. In the empty box that comes up, type the userid of member 3 (e.g., am1memb3). Click on Invite.

   NOTE: Make sure that you invite ONLY YOUR group members – see the number after "am".

g. The chat window will read "This is a group chat. AM1MEMB2 has joined. AM1MEMB3 has joined."

   Note: If for any reason any one member does not show up as "joined" in the group chat session repeat steps (c) through (e). All members should show up in the group chat.

h. To maximize the chat window, click on the middle arrow at the top right corner (which reads "pop-out"). You can start your group chat and discuss the task with your group.

When the facilitator announces the end of discussion time, refer back to the **GENERAL INSTRUCTIONS** handout for Part II (b) - Report Creation

Appendix E3: Chat Starter Instructions - For With History/Without Memory Condition

As member1, you are assigned to start your group chat session for your group.

a. Go to the left side of the screen with Inbox etc. You will see "- Chat".

b. You will see the userid of member2 and member3. You will see a green button next to the userid if they are online. If you don't see the green button wait until they get online.

c. Move the mouse over the userid of member2 (e.g., en1memb2).

d. You will see a dialog box with Email, Chat and More. Click on "Chat.

e. A chat window will open up to the right corner of the screen. You will see three icons. Click on the icon that shows a + sign with a person (as you move your mouse, it should read "Add people to this chat").

f. In the empty box that comes up, type the userid of member 3 (e.g., en1memb3). Click on Invite.

   NOTE: Make sure that you invite ONLY YOUR group members.

g. The chat window will read "This is a group chat. EN1MEMB2 has joined. EN1MEMB3 has joined."

a. *Note*: If for any reason any one member does not show up as "joined" in the group chat session repeat steps (c) through (e). All members should show up in the group chat.

h. To maximize the chat window, click on the middle arrow at the top right corner (which reads "pop-out"). You can start your group chat and discuss the task with your group.

When the facilitator announces the end of discussion time, refer back to the **GENERAL INSTRUCTIONS** handout for Part II (b) - Report Creation.

Appendix E4: Chat Starter Instructions - For Without History/Without Memory Condition

As member1, you are assigned to start your group chat session for your group.

a. Go to the left side of the screen with Inbox etc. You will see "- Chat".

b. You will see the userid of member2 and member3. You will see a green button next to the userid if they are online. If you don't see the green button wait until they get online.

c. Move the mouse over the userid of member2 (e.g., an1memb2).

d. You will see a dialog box with Email, Chat and More. Click on "Chat".

e. A chat window will open up to the right corner of the screen. You will see three icons. Click on the icon that shows a + sign with a person (as you move your mouse, it should read "Add people to this chat").

f. In the empty box that comes up, type the userid of member 3 (e.g., an1memb3). Click on Invite.

   NOTE: Make sure that you invite ONLY YOUR group members.

g. The chat window will read "This is a group chat. AN1MEMB2 has joined. AN1MEMB3 has joined."

   Note: If for any reason any one member does not show up as "joined" in the group chat session repeat steps (c) through (e). All members should show up in the group chat.

h. To maximize the chat window, click on the middle arrow at the top right corner (which reads "pop-out"). You can start your group chat and discuss the task with your group.

   When the facilitator announces the end of discussion time, refer back to the **GENERAL INSTRUCTIONS** handout for Part II (b) - Report Creation.

APPENDIX F – GENERAL INSTRUCTIONS (8 versions : F1 through F8)

Appendix F1: General Instructions for Chat Starter – For With History/With Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your Baruch id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout.
Read the Task handout now and then proceed to (a) below.

☐ *(a). Chat session* (20 minutes) – *you & your group will discuss the task.*

- Go to: http://mail.diss1.com
- Login with the userid and password given on your index card.
- You have been assigned to be the chat starter for your group.
- Read the handout called "*Starting the Chat session*" for instructions on starting a group chat.
- Wait for the facilitator to notify completion of chat session (20 minutes).
- Stop the chat and proceed to (b) below.

☐ *(b). Report Creation* (20 minutes) – *you & your group will use google docs to create your group report.*

- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, click on File / Rename. Rename as your userid (e.g., em1memb1).
- (NOTE: this is needed to give credit)
- Close all the windows and log out of the account.
- Proceed to Part III.

Part III: Post-task Survey

☐ Please answer all questions at this site: http://www.surveymonkey.com/s/MXV3PVQ
Enter the userid shown on your index card.
When you are finished, please notify the facilitator. Return all handouts and cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F2: General Instructions for other two members – For With History/With Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your Baruch id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout.
Read the Task handout now and continue to (a).

☐ *(a). Chat session* (20 minutes): - *you & your group will discuss the task.*

- Open Internet Explorer and go to http://mail.diss1.com
- Login with the userid and password given on your index card.
- On the left side of the screen you can see folders such as Inbox and "- Chat" with a box below it.
- Wait for member 1 to start a group chat (if you get a prompt inviting you to chat, click "Yes").
- The group chat window will open up with the words "EM1MEMB1 has joined. EM1MEMB2 has joined."
- Click on the middle arrow at the top right corner (which reads "pop-out") to maximize.
- You can now chat and discuss how you want to create the report mentioned in the task handout.
- DO NOT USING GOOGLE DOCS NOW. ONLY CHAT!
- When the facilitator announces the end of 20 minutes, stop the chat discussion.
- Proceed to (b).

☐ *(b). Report Creation* (20 minutes) - *you & your group will use google docs to create your group report.*

- At the top left corner of the screen, you will see Mail, Calender etc. Click on "*Documents*."
- Click on the file "*Group Report*" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, your member 1 should rename the report for the group (he/she has instructions).
- Confirm that the report is renamed (click view/reload)
- Close all windows. Log out of the account.
- Proceed to Part III.

Part III: Post-task Survey (10 minutes)

☐ Go to http://www.surveymonkey.com/s/MXV3PVQ and answer all questions.
Use your userid shown in the index card.
When done, close all the windows. Return all handouts and index cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F3: General Instructions for Chat Starter – For Without History/With Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your Baruch id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout.
Read the Task handout now and then proceed to (a) below.

☐ *(a). Chat session* (20 minutes) – *you & your group will discuss the task.*

- Go to: http://mail.diss2.com
- Login with the userid and password given on your index card.
- You have been assigned to be the chat starter for your group.
- Read the handout called "*Starting the Chat session*" for instructions on starting a group chat.
- Wait for the facilitator to notify completion of chat session (20 minutes).
- Stop the chat and proceed to (b) below.

☐ *(b). Report Creation* (20 minutes) – *you & your group will use google docs to create your group report.*

- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, click on File / Rename. Rename as your userid (*e.g., am1memb1*).
  (NOTE: this is needed to give credit)
- Close all the windows and log out of the account.
- Proceed to Part III.

Part III: Post-task Survey

☐ Please answer all questions at this site: http://www.surveymonkey.com/s/MXV3PVQ
Enter the userid shown on your index card.
When you are finished, please notify the facilitator. Return all handouts and cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F4: General Instructions for other two members – For Without History/With Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your Baruch id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout.
Read the Task handout now and continue to (a).

☐ *(a). Chat session* (20 minutes): - *you & your group will discuss the task.*

- Go to http://mail.diss2.com
- Login with the userid and password given on your index card.
- On the left side of the screen you can see folders such as Inbox and "- Chat" with a box below it.
- Wait for member 1 to start a group chat.
- The group chat window will open up with the words "AM1MEMB1 has joined. AM1MEMB2 has joined."
- Click on the middle arrow at the top right corner (which reads "pop-out") to maximize.
- You can now chat and discuss how you want to create the report mentioned in the task handout.
- DO NOT USING GOOGLE DOCS NOW. ONLY CHAT!
- When the facilitator announces the end of 20 minutes, stop the chat discussion.
- Proceed to (b).

☐ *(b). Report Creation* (20 minutes) - *you & your group will use google docs to create your group report.*

- At the top left corner of the screen, you will see Mail, Calender etc. Click on "*Documents*."
- Click on the file "*Group Report*" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, your member 1 should rename the report for the group (he/she has instructions).
- Confirm that the report is renamed (click view/reload)
- Close all windows. Log out of the account.
- Proceed to Part III.

Part III: Post-task Survey

☐ Go to http://www.surveymonkey.com/s/MXV3PVQ and answer all questions.
Use your userid shown in the index card.
When you are finished, please notify the facilitator. Close all the windows.
Return all handouts and cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F5: General Instructions for Chat Starter – For With History/Without Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your *Baruch id* and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
In the survey, please enter the userid that is shown on your first index card (e.g., en1memb1). Now, continue to Part II.

PART II: Task - Chat Session and Report Creation

You are part of a *3-member* group. Read the Task handout to see the details of the task you will work on, with your group. You will first chat about the task and then will use google docs to create the report.
Proceed now to (a) below.

☐ *(a). Chat session* (20 minutes) - *you & your group will discuss the task*

- Open Internet Explorer and go to: http://mail.nextcenturysystems2.com
- Login with the userid and password given on your first index card.
- You have been assigned to be the chat starter for your group.
- Now, read the handout called "*Starting the Chat session*" for instructions on starting a group chat.
- Wait for the facilitator to notify completion of chat session (20 minutes).
- Sign out of your current account. Proceed to (b) below.

☐ *(b). Report Creation* (20 minutes)

- Open Internet Explorer (not Firefox) and go to: http://mail.diss4.com
- Log in with the userid/password on the *second* index card.
- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- When the facilitator announces the end of the session, click on File / Rename. Rename as your userid (e.g., en1memb1.doc).
- Close all the windows and log out of the account.
- Proceed to Part III.

Part III: Post-task Survey (10 minutes)

☐ Please answer all questions at this site: http://www.surveymonkey.com/s/MXKJZC7
Enter the userid that was shown on the first index card.
When you are finished, please notify the facilitator. Return all handouts and cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F6: General Instructions for the other two members – For With History/Without Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

First, log on to the computer using your Baruch student id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
In the survey, please enter the userid that is shown on your index card (e.g., en1memb2). Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. Read the Task handout to see the details of the task you will work on, with your group. You will first chat about the task and then will use google docs to create the report. Proceed now to (a) below.

☐ *(a). Chat session* (20 minutes): - *you & your group will discuss the task.*

- Open Internet Explorer and go to http://mail.nextcenturysystems2.com
- Login with the userid and password given on your ***first*** index card.
- On the left side of the screen you can see folders such as Inbox and "- Chat" with a box below it.
- Wait for member 1 to open the group chat window.
- The group chat window will open up with the words "EN1MEMB1 has joined. EN1MEMB2 has joined."
- Click on the middle arrow at the top right corner (which reads "pop-out") to maximize.
- You can now chat and discuss how you want to create the report mentioned in the task handout.
- DO NOT USE GOOGLE DOCS NOW. ONLY CHAT!
- When the facilitator announces the end of 20 minutes:
  - close the group chat and other windows.
  - sign out of your current account.
- Proceed to Report Creation below.

☐ *(b). Report Creation* (20 minutes) - *you & your group will use google docs to create your group report.*

- Open Internet Explorer (not Firefox) and go to: http://mail.diss4.com
- Log in with the userid/password on the ***second*** index card.
- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Each time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, your member-1 should rename the report for the group (he/she has instructions).
- Confirm that the report is renamed (click view/reload).
- Close all windows. Log out of the account.
- Proceed to Part III.

Part III: Post-task Survey (10 minutes)

☐ In Internet explorer, go to http://www.surveymonkey.com/s/MXKJZC7
Use your userid in the ***second*** index card.
When done, close all the windows. Log off. Return all handouts and index cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F7: General Instructions for the Chat Starter – For Without History/Without Memory

There are three parts to this experiment. For full credit, all parts will have to be completed.

Log on to the computer using your Baruch id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout. Read the Task handout now and then proceed to (a) below.

☐ *(a). Chat session* (20 minutes):

- Open Internet Explorer and go to: http://mail.diss3.com
- Login with the userid and password given on your first index card.
- You have been assigned to be the chat starter for your group.
- Read the handout called "*Starting the Chat session*" for instructions on starting a group chat.
- Wait for the facilitator to notify completion of chat session (20 minutes).
- Sign out of your current account. Proceed to (b) below.

☐ *(b). Report Creation* (20 minutes)

- Open Internet Explorer (not Firefox) and go to: http://mail.diss5.com
- Log in with the userid/password on the *second* index card.
- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Any time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, click on File / Rename. Rename as your userid (e.g., an1memb1).
- Close all the windows and log out of the account.
- Proceed to Part III.

Part III: Post-task Survey (10 minutes)

☐ Please answer all questions at this site: http://www.surveymonkey.com/s/MXKJZC7
Enter the userid that is shown on the second index card.
When you are finished, please notify the facilitator. Return all handouts and cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix F8: General Instructions for the other two members – For Without History/Without Memory

There are three parts to this experiment. This handout explains step-by-step what you need to do.
Direct any questions to the facilitator. Check off the associated box as you complete each part.

First, log into the computer using your student id and password.

PART I: Pre-task Survey (5 minutes)

☐ Go to http://www.surveymonkey.com/s/3KK8TKM and answer the survey questions.
Use the userid that is shown on your first index card. Now, continue to Part II.

PART II: Chat Session and Report Creation

You are part of a *3-member* group. You must work as a group on the task described in the *Task* handout.
Read the Task handout now and continue to (a).

☐ *(a). Chat session* (20 minutes): - *you & your group will discuss the task.*

- Open Internet Explorer and go to http://mail.diss3.com
- Login with the userid and password given on your ***first*** index card.
- On the left side of the screen you can see folders such as Inbox and "- Chat" with a box below it.
- Wait for member 1 to open the group chat window.
- The group chat window will open up with the words "AN1MEMB1 has joined. AN1MEMB2 has joined."
- Click on the middle arrow at the top right corner (which reads "pop-out") to maximize.
- You can now chat and discuss how you want to create the report mentioned in the task handout.
- DO NOT USING GOOGLE DOCS NOW. ONLY CHAT!
- When the facilitator announces the end of 20 minutes:
  - close the group chat and other windows.
  - sign out of your current account.
- Proceed to Report Creation below.

☐ *(b). Report Creation* (20 minutes) - *you & your group will use google docs to create your group report.*

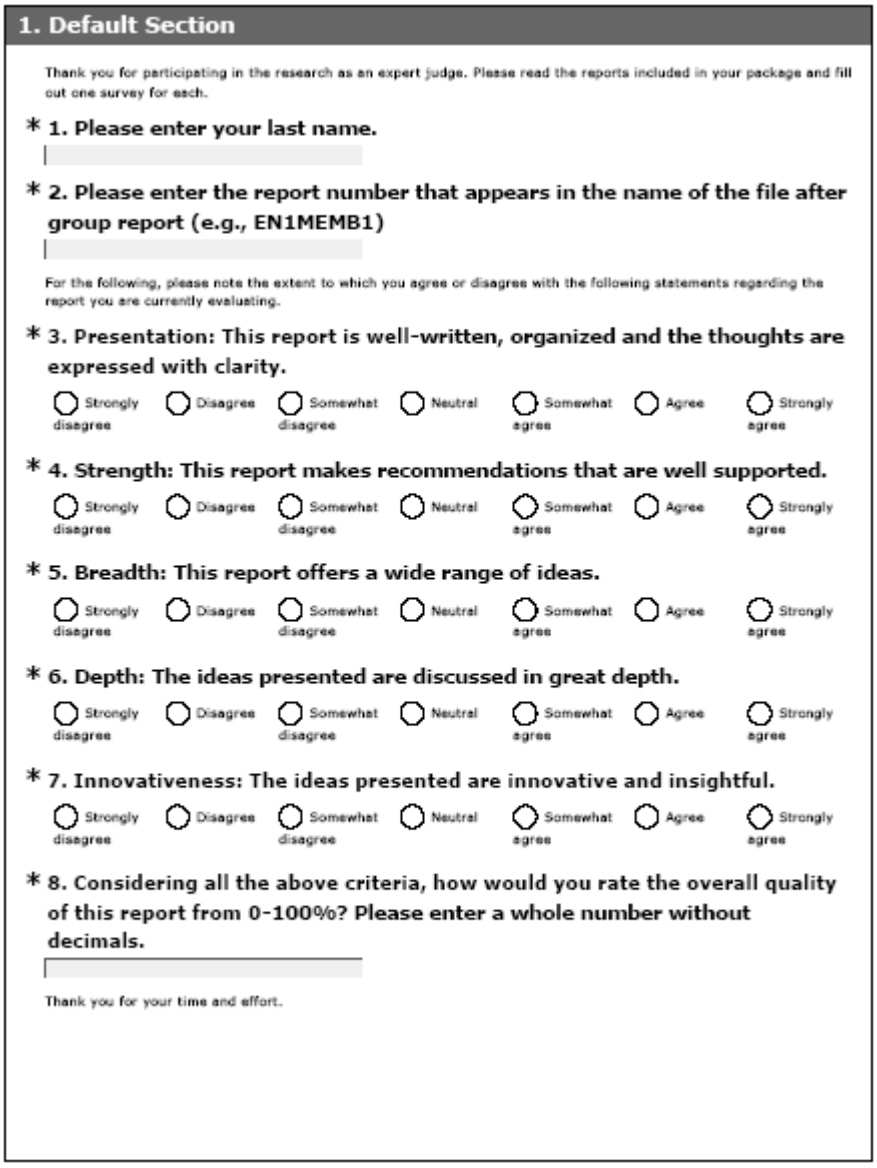
- Open Internet Explorer and go to: http://mail.diss5.com
- Log in with the userid/password on the ***second*** index card.
- At the top left corner of the screen, you will see Mail, Calender etc. Click on "Documents."
- Click on the file "Group Report" to open it. Start typing into the report.
- Each time you enter info in the report, click on "Save" icon so the other members can see it.
- At the end of 20 min, your member-1 should rename the report for the group (he/she has instructions).
- Close all the windows and log out of your account.
- Proceed to Part III.

Part III: Post-task Survey (10 minutes)

☐ Open IE and go to http://www.surveymonkey.com/s/MXKJZC7
Use your userid in the ***second*** index card.
When done, close all the windows. Log off. Return all handouts and index cards.

THANK YOU FOR YOUR PARTICIPATION!

Appendix G – Judges Report Rating Form



1. Default Section

Thank you for participating in the research as an expert judge. Please read the reports included in your package and fill out one survey for each.

* **1. Please enter your last name.**

* **2. Please enter the report number that appears in the name of the file after group report (e.g., EN1MEMB1)**

For the following, please note the extent to which you agree or disagree with the following statements regarding the report you are currently evaluating.

* **3. Presentation: This report is well-written, organized and the thoughts are expressed with clarity.**

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

* **4. Strength: This report makes recommendations that are well supported.**

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

* **5. Breadth: This report offers a wide range of ideas.**

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

* **6. Depth: The ideas presented are discussed in great depth.**

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

* **7. Innovativeness: The ideas presented are innovative and insightful.**

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

* **8. Considering all the above criteria, how would you rate the overall quality of this report from 0-100%? Please enter a whole number without decimals.**

Thank you for your time and effort.

Appendix H – Index Items

Index/Variable Name	Survey Items
Relational Closeness	➢ My team members and I are very close to each other (estimate this as an average for all members). ➢ I understand my team members and who they really are (estimate this as an average for all members). ➢ I feel this close to my team members in my working relationship (estimate this as an average for all members). ➢ In the past I have spent a lot of time with my team members (estimate this as an average for all members). ➢ My team members share my overall goals and values. ➢ I have worked often with the other members in my team, before today. ➢ My team members influence me in everyday things in my life (estimate this as an average for all members).
Relational Trust and Shared Goals	➢ My team members are generally honest and truthful in the information provided (estimate this as an average for all members). ➢ My team members are very competent in the projects in which we interact (estimate this as an average for all members). ➢ My team members have a shared vision of the team's future achievements (estimate this as an average for all members). ➢ My teams members have a clear view to team's directions (estimate this as an average for all members). ➢ My team members have a shared vision to team's goals (estimate this as an average for all members).
Perceived Performance	➢ How do you feel about the process by which your group worked to create the report? ➢ How do you feel about the group's discussion? ➢ How satisfied were you with the outcome (report) of your team's task? ➢ Overall, how satisfied were you with participating in this experiment? ➢ Our group comes up with many new ideas about how a project should be done ➢ If a novel idea is introduced in class, it often comes from within our group. ➢ There is free and open communication within my group.
Group History	➢ My team works together better than most other teams on which I have worked. ➢ My teammates and I help each other better than most other teams on which I have worked ➢ My teammates and I get along better than most other teams on which I have worked.
Group Memory	➢ The chat transcript was very useful for our task (Memory groups). ➢ Having access to a chat transcript that showed the group discussion would have been useful for our task (No memory groups). ➢ We referred to the chat transcript often (Memory groups). ➢ If we had access to a chat transcript we would have referred to it often (No memory groups). ➢ Without the chat transcript, we would have been lost in preparing our final report (Memory groups). ➢ Having access to a chat transcript would have added to our task performance (No memory groups).

Appendix I – Alternate Assignment for Non-Participants

Please write a one to two page essay on whether synchronous communication (via chat software) and access to memory of group interactions (for example, chat transcript on gmail) can be beneficial for team productivity in small groups where the task requires a creative solution. Please include your last and first names and class.

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