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A COMPARISON OF THE EFFECTS OF EXTRAVERSION AND EXPERTISE ON VIRTUAL TEAM AND FACE-TO-FACE TEAM INTERACTION AND PERFORMANCE

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THESIS

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This dissertation is dedicated to my wife, Doris, without whom it would never have been accomplished.

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JW

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LIST OF ABBREVIATIONS

CMC	Computer Mediated Communications
CMCS	Computer Mediated Communication Systems
FTF	Face-to-Face
GSS	Group Support Systems
IRT	Information Richness Theory
VT	Virtual Team

SUMMARY

The goal of this dissertation is to investigate how a personality trait, and individual expertise affects how teams interact, and how that interaction leads to different levels of team performance (e.g., quality of solution, acceptance of the team's solution) in both face-to-face and computer-supported teams. The increasing importance of teams in organizations and the emergence of a variety of computer mediated communication systems (CMCS) to support these teams have contributed to the growth of virtual work teams. These virtual teams typically are groups of geographically and/or organizationally dispersed co-workers that collaborate using a combination of telecommunication and information technologies to accomplish organizational tasks. The members rarely, if ever, meet in person. The teams are beneficial to their organizations by providing access to scarce human resources, realizing cost savings as a result of reduced travel, and realizing timesavings as evidenced by the ability to move fast in certain decision-making situations.

Groups, in general, have been shown to exhibit constructive, aggressive, or passive interaction styles that affect communication and thus team performance by facilitating or hindering the exchange of information among group members. These styles reflect an aggregation of the behaviors exhibited by individual team members, which are rooted in their individual personalities. The effects of interaction style on team performance have been well established in face-to-face teams. Generally, constructive interaction styles produce positive outcomes whereas passive styles beget negative ones. Aggressive teams produce solutions that are correlated with the expertise of those that have wrestled control of the group. However, there is often little support for those solutions. Recent research has revealed that the interaction styles produced similar results in virtual teams.

SUMMARY (continued)

Personality will be examined because it is an important part of what individuals bring to the group, as in its contribution to interaction styles. Five personality factors have been identified in the research literature. Extraversion has been revealed to be the personality factor that correlates positively with individual performance in tasks involving social interaction. Similarly, previous research has shown that expertise is positively related to team performance. The impact of expertise on performance depends on whether the team interacts in a manner that permits the expertise to be heard, considered, and when possible, improved upon. However, there has been little research on the subject of the levels of extraversion in work teams and its effect on the team's interaction processes in a virtual work environment.

This dissertation will explore how different constellations of extraversion and expertise manifest themselves into group interaction styles and how these styles relate to performance outcomes. Participants will include members of both face-to-face and virtual teams. A series of tasks will be completed by all groups to provide data on performance outcomes. Surveys and questionnaires will be completed to determine the levels of extraversion, and the group's interaction style. The results will be analyzed with the purpose of revealing how the prevalence of extraversion and member expertise is related to team interaction style and the effects of the communication media on this relationship.

I. INTRODUCTION

Many organizations are restructuring their business activities around business teams. Also, companies are often faced with problems associated with the shortage of locally available talent, quality of life issues for employees, and again, competitive pressures to reduce costs. The improvements in computer technology, including faster communications systems, more powerful processors and new software products, have contributed to the growth of virtual teams that interact primarily through computer-supported communication (Townsend, et al. 1998). Townsend et al. (1998) mentions several additional factors that have contributed to this growth. They include the growing popularity of interorganizational alliances combined with a growing tendency towards flatter organizational structures, increased globalization of trade and corporate activity, changes in workers' expectations of organizational participation, and a continued shift from production to service/knowledge work environments.

The study of teams in organizations is important to information technology (IT) professionals and researchers because IT is a key enabler of distributed work arrangements, which has allowed organizations to enter the era of virtual work teams (Townsend, et al. 1998).

Information technology is driving the growth and success of distributed work teams. This technology has its roots in group support systems (GSS). GSS are information technology systems that are used to support group activities. They generally involve personal computers, computers in local area or wide area networks, or computers connected over the Internet, group decision support software and groupware, and support groups engaged in a variety of tasks requiring collaboration and coordination. The group members may interact synchronously or asynchronously, may be either co-located or geographically dispersed, and may be of temporary or long-term duration (Lipnack and Stamps, 1997). Virtual team technologies may include

desktop videoconferencing, collaborative software and Internet/Intranet/Extranet systems. These all converge to forge the foundation of this "new" workplace, which is unrestrained by geography, time, and organizational boundaries (Townsend et al., 1998).

The study of virtual teams is important to the IT practitioner as well as the researcher. From a practical perspective, organizations need to know how to use IT to help maximize team effectiveness in the virtual team environment. From a theoretical and research perspective, we need better insights and explanations regarding the drivers and dynamics of effective team performance in the virtual environment.

Interaction style has been shown to have a great effect on conventional work teams' ability to achieve solution quality and solution acceptance (Hirokawa, 1985; Hirokawa and Gouran, 1989; Cooke and Szumal, 1993; Watson and Michaelsen, 1998). Group interaction styles affect communication and thus team performance by facilitating or hindering the exchange of information among group members. These styles reflect an aggregation of communication traits of individual team members, rooted in their individual personalities. The effects of interaction style on team decision performance outcomes have been well established (as noted above) in face-to-face teams. Recent research by Potter, Balthazard and Cooke (2000) revealed that the interaction styles produced similar results in virtual teams. Among the issues requiring further study is how different constellations of personality types and levels of expertise manifest into team interaction styles. The practical implication of this research is that it may be possible to predict virtual team interaction style from an assessment of the personalities of its individual members. Once the interaction style can be predicted, the effectiveness of the team's performance on certain types of tasks can also be predicted, and managed proactively, if necessary.

The focus of this research is to compare the effects of one of the five personality factors, extraversion, and team member expertise on virtual team and face-to-face team interaction and performance. In a virtual work environment, team members can bring their differing expertise to bear on pressing problems from any geographic location, collaborating via network-supported groupware of various types. While travel and its associated expense and inconvenience can be reduced, it is not clear that virtual teams perform as well as their face-to-face (FTF) counterparts. One approach to improving virtual team performance is to identify characteristics that differentiate low performing FTF teams from high performing FTF teams and then determine if virtual teams also have these characteristics. If they do, and if those characteristics can be properly managed, virtual teams may enjoy increases in performance similar to those realized with FTF teams.

In the next section a definition of virtual teams will be presented, followed by a discussion on communication and interaction styles, expertise, personality, and their manifestations and effects in the FTF and virtual team environments. Previous research relating interaction styles to performance and process outcomes for virtual and conventional teams will also be discussed. After this background information, the present study will be introduced. This study examines the relationship between measures of one of the personality factors (extraversion) that a group's members possess, member expertise, and the interaction style that the group exhibits. The analysis of the data should yield significant insights into the role of communication media, along with that of expertise, extraversion, and interaction styles, on team decision performance and process outcomes.

II. BACKGROUND AND LITERATURE REVIEW

A. Teams

A work group is defined as a group of "individuals who see themselves and who are seen by others as a social entity, who are interdependent because of the tasks they perform as members of a group, who are embedded in one or more larger social systems, and who perform tasks that affect others (Guzzo and Dickson, 1996)". A team is slightly different than a group in that the individual members exhibit a sense of shared commitment (Guzzo and Dickson, 1996). The terms "team" and "group" are used interchangeably in this dissertation, although they are not strictly synonymous. Hollenbeck et al. (1997) consider groups to be configurations of two or more interdependent individuals who interact over time, and teams to be special cases of groups, whose member incorporate skill differentiation and share a common fate (i.e., similar consequences for all members depending on success or failure at the team level). Brannick and Prince (1997) also distinguish teams from groups by their members having distinct and noninterchangeable functions.[1] Individuals that work in teams usually exhibit a sense of shared commitment and often are involved in tasks with the goal of producing high quality decisions.

B. Virtual Teams

The teamwork unit, groupware, and a hyper competitive business environment have been the catalysts for what is being considered a new organizational form – the distributed or "virtual" team (Jarvenpaa and Ives, 1994). These teams, like every team, consist of a group of people who interact through interdependent tasks guided by a common purpose. Lipnack and Stamps (1997) described virtual teams as teams that, unlike conventional teams, transcend distance, time zones,

and organizational boundaries. They are actually specialized forms of teams that use computer mediated communication systems. The teams, via groupware, can interact and collaborate though separated by distance and time, and do so without the expense and inconvenience of travel. This ability gives organizations increased flexibility and responsiveness, permitting them to rapidly assemble dispersed experts into a distributed team that can work on an urgent project. Because of the global business environment that many organizations compete in today, more and more organizations are realizing the benefits of using virtual teams. These team members have distinct complimentary areas of expertise and are geographically and often temporally distributed, possibly anywhere within (and beyond) their parent organization (Duarte and Synder, 1999; Lipnack and Stamps, 1997; Townsend, DeMarie, and Hendrickson, 1998). With virtual teams, companies not only experience savings from reduced travel, but also benefit by having the skills and talents of employees available to the company that would not other wise be available if these employees were away on a business trip.

In the recent literature on virtual teams, most researchers considered a virtual team to be one in which teams were distributed and used CMCS for all of their communications. The type of task and the length of the existence of the teams varied. Some examples of virtual team research, tasks, and length of the research studies are depicted in Table I:

[1] The subjects in this study met most of these definitional requirements of teams, but not others. Consistent with Hollenbeck et al. (1997) our group members were interdependent, had differing levels of skill, and shared a common fate. However, their roles were not distinct and they were interchangeable.

TABLE I: SUMMARY OF RECENT RESEARCH ON VIRTUAL TEAMS

Author	Type of Team	Task Type	Length of Study
Balthazard, Potter & Warren (2002b)	Local virtual teams	1 task Intellectual task	90 minute class session
Jarvenpaa, Knoll & Leidner (1998)	Global virtual teams	3 tasks: 2 team building exercises and a final project	8 weeks
Kayworth & Leidner (2000)	Global virtual teams	Research project	6 weeks
Lind (1999)	Distributed work groups	Internet Project	Academic Semester
Majchrzak, Rice,Malhotra, King & Ba (2000)	Inter-organizational virtual team	Creation of a highly innovative product	10 months
Maznevski and Chudoba (2000)	Global virtual teams	Various organizational tasks	21 months
Tan, Wei, Huang & Ng (2000)	Local Virtual teams	4 tasks	2 weeks
Warkentin, Sayeed & Hightower (1997)	Local Virtual teams	1 task – case study	3 weeks

Virtual teams rarely, if ever, meet in a face-to-face setting (Townsend et al., 1998). Knoll and Jarvenpaa (1998) state that the unique characteristic of virtual teams is that fact that "they do not have a physical instantiation; they do not exist except in digital or electronic form."

There are many types of virtual teams and hence, many different ways to classify them. Lipnack and Stamps (1997) characterize teams, in general, based on their spatial distribution and organizational affiliation. Virtual teams are often geographically distributed, meaning that they are comprised of people who work in different places and sometimes across different time zones. The team members may be part of the same organization or different organizations. Virtual teams can be composed of members in the same organization and in the same geographical location in close physical proximity, or they can be composed of members from the same

organization and geographically (and temporally) distributed. Alternatively, these teams can be composed of members from different organizations and in the same geographical area in close physical proximity to each other, or they can be composed of members from different organizations that are geographically (and temporally) distributed.

Virtual teams can be characterized based on the type of membership and the function of the teams (Duarte and Synder, 1999). Networked teams consist of individuals who collaborate to achieve a common goal or purpose. Membership in these types of teams is diffuse and fluid, with team members rotating on and off the team, as their expertise is needed. Parallel teams consist of members who carry out special assignments, tasks, or functions that the regular organization does not want or is not equipped to perform. A parallel team is different from a networked team because it has a distinct membership (can be distinguished from other parts of the organization). Project or product development teams have fluid memberships, clear boundaries, and a defined customer, technical requirement, and output. Longer-term team task is nonroutine, and the team has decision-making authority. Work or production teams have distinct memberships and clear boundaries. The members perform regular and ongoing work, usually in one functional area. Service teams have distinct memberships and supports ongoing customer, network activity. Management teams have distinct memberships and works on a regular basis to lead corporate activities. Last, action teams deals with immediate action, usually in an emergency situation. Membership may be fluid or distinct.

Spatial characteristics, expected life span, and size are other ways to classify virtual teams. There are local and global virtual teams that may have temporary or permanent life spans, and are either small or relatively large teams.

Global virtual teams are defined by Maznevski and Chudoba (2000) as internationally distributed groups of people with an organizational mandate to make or implement decisions with international components and implications. Their tasks are complex and strategically important, and the team members rarely meet in person, therefore relying on computer technology to perform their collaboration and decision-making tasks. Jarvenpaa et al., (1998) defines a global virtual team as a "temporary, culturally diverse, geographically dispersed, electronically communicating work group." This type of team is usually a temporary team that is assembled on an as-needed basis for the duration of a task, and is staffed by members from the far corners of the world (Jarvenpaa et al., 1998). In these teams, members usually physically remain on different continents and in different countries, interact primarily through the use of computer-mediated communication technologies, and rarely or never see each other in person.

Local virtual teams use computer technology to perform their decision-making tasks but are geographically confined to a specific country or locality. Transient teams are formed for ad-hoc tasks, as in product development teams or project teams, whereas permanent teams work on a regular and more long-term basis. Virtual teams can be small, consisting of 3-7 members, or large, consisting of greater than 7 members.

Previous studies have indicated that there has been little or no demonstrated significant performance gains for computer-mediated-communication (CMC) teams in comparison to face-to-face (FTF) teams, and many of these studies revealed that individuals in the FTF teams experienced higher satisfaction than those in the virtual teams (VTs) (Straus, 1996; Warkentin, Sayeed, & Hightower, 1997). However, we continue to study VTs because the advantages of these work arrangements should contribute to their continued deployment. Cost savings in terms

of time, use of human resources, travel, etc., may outweigh the shortcomings of teams using CMC.

Due to the newness of this organizational form, approaches to effective virtual team management are still emerging. This research focuses on internal and technological issues of virtual team management with the general strategy of determining whether or not characteristics that distinguish high performance FTF teams from low performance FTF teams also exist in the virtual world. These characteristics, such as interaction styles, expertise, and member personality, are discussed next. Also, a discussion is presented on research findings that used a web-based technology, which enabled managers to identify these same characteristics in virtual teams.

C. Interaction, Expertise and Performance in FTF and Virtual Teams

Interactive communication is a fundamental behavior of FTF teams (McIntrye, Salas, Morgan, and Glickman, 1989; Morgan, Blickman, Woodard, Blaiwes and Salas, 1986), but the quality of interaction—and team productivity--can vary. Members of problem-solving teams face two types of pressures in achieving quality solutions and high solution acceptance (Hoffman, 1979; Maier, 1963; 1967;). On the one hand, there is pressure on each member to contribute unique, and possibly controversial, information to maximize the team's resources. On the other hand, members of teams tend to believe that closure to team problem solving and strong solution acceptance are best achieved through conformity of opinions (e.g., Festinger, 1950; Hoffman, 1979; McGrath, 1984). The way in which a team deals with the conflicting "task" and "maintenance" pressures is reflected in the team's interaction style (Cooke and Szumal, 1994). Watson and Michaelson (1988) showed that a team's interaction style affects performance. They identified positive and negative behaviors as components of group interaction

style. Three groups of behaviors (expectations of performance and integration, leadership, and cohesiveness) contributed to team performance on an intellective task while one group of negative behaviors (e.g., noninvolvement, withholding of information) detracted.

Group interaction, in general, is the "way the group members pool their abilities in a collaborative context in order to reach the best decision (Watson and Michaelson, 1988)." Building on the Watson and Michaelsen typology and others (e.g., Hoffman, 1979; Maier 1967;), Cooke and Szumal (1994) showed that group interaction, aggregated from stable personality factors of the individual group members, can be categorized as constructive, passive, and aggressive styles. These styles were identified using the Group Styles Inventory (GSI) survey instrument (Cooke and Lafferty, 1988). This instrument was developed explicitly to measure group interaction styles that are theoretically linked to the quality and acceptance of group solutions. The GSI is a self-report survey designed to assess three distinct yet interrelated group interaction styles, that is, "the ways in which members interact with one another and approach the task to be accomplished" (Cooke & Lafferty 1988, p. 1). It measures group styles from the perspective of the group as a whole. Potter, Balthazard, and Cooke (2000) validated a web-based version of the Cooke and Szumal's (1994) interaction style assessment tool.

A constructive style is descriptive of groups in which members interact and approach the problem in ways that enable them to fulfill both interpersonal and performance-related needs. It is characterized by a balanced concern for personal and group outcomes, cooperation, creativity, free exchange of information, and respect for others' perspectives. Groups exhibiting a passive style behave in ways that promote group harmony and the fulfillment of their people-oriented needs for security and acceptance. The emphasis is on maintenance rather than task considerations and on interactions that are non-threatening and defensive. Affiliation goals and

maintaining harmony in the group are important. There is limited information sharing. The aggressive style is characterized by the promotion of group member status and position and the fulfillment of security needs through task-related behaviors. Greater emphasis is placed on personal achievement needs, with personal ambitions placed above concern for group outcome. This group style is often characterized by competition, criticism, interruptions, and overt impatience.

Group interaction styles are important in teams because they affect team performance (Watson and Michaelson, 1988). They can impede or enhance team members' ability to bring their unique knowledge and skills to bear on the task. They are also important because of the extent to which they develop and consider alternative strategies for approaching the task (Hackman and Morris, 1975). This is particularly critical for groups with heterogeneous levels of expertise, as communication by most expert group members is positively correlated with group performance. Zalesny (1990) found that the most accurate member in interacting groups did not influence performance unless he or she was assertive and confident. Watson and Michaelson (1988) indicated that during group interaction, members may "withhold critical information and the group results will be of low quality; however, the group may develop a level of integration of individual inputs to the point that the outcome will be a synergy that greatly surpasses the best member" (Watson and Michaelson, 1988, p. 496-497). Bottger (1984) also found that amount of communication time and expertise were positively correlated with performance, though only with high-performing groups. In their study of estimation methods for individual/team performance differences, Cooke and Kernaghan (1987) found that average individual scores explain an average of 57% of the variance in team scores. They also noted that the expertise of the best member contributes significantly to the team score, above and beyond the average

individual score, with both factors together explaining an average 69% of the variance in team score performance. That study also documented significant variances in relative performance, with some groups composed of less able individuals showing significant group process gains, and instances of high-potential groups (i.e., with high average individual performance scores) showing minimal gains or even losses due to group processes. Group performance has usually been found to be inferior to that of the best individual, and typically groups perform better than the average of their individual members and worse than their best individual member (Burleson, Levine, and Samter, 1994; Hill, 1982; Libby, Trotman, and Zimmer, 1987; Yetton and Bottger, 1982).

Groups whose interactions are characterized by a dominant style achieve different levels and patterns of effectiveness. Specifically, predominantly constructive groups produce solutions that are superior in quality to those produced by passive groups and superior in acceptance to those produced by either passive or aggressive groups. Predominantly passive teams produce solutions that are inferior in quality to those of constructive (and sometimes aggressive) groups and inferior in acceptance to those of constructive groups. Similarly, groups with predominantly aggressive styles produce solutions that are not as consistently of high quality as those generated by constructive groups but not as consistently of low quality as those produced by passive groups. The solutions produced by aggressive groups generate less overall acceptance than those developed by constructive groups and about the same level of acceptance as those generated by passive groups (Cooke and Szumal, 1994).

Communications quality is also emerging as a key determinant of virtual team performance. Recent studies show that communication characteristics including high frequency, initiation of contact, positive tone, and appropriate feedback style are key to establishing "swift"

trust, and that swift trust has a significant positive effect on team performance (Jarvenpaa et al., 1998; Iacono and Weisband, 1997). Maznevski and Chudoba (2000) found that successful distributed teams developed a rhythm in media choice, using both FTF and CMC meetings when each was deemed appropriate. The successful teams' communication was characterized by higher message frequency, positive tone, and appropriate feedback. Ocker, Fjermestad, Hiltz, and Johnson (1998) also found that teams that used FTF along with synchronous and asynchronous CMC media produced higher quality work and were more satisfied with their solutions. Building on research that examined information exchange in FTF teams (e.g., Stasser and Titus, 1985), Hightower and Sayeed (1996) found information exchange to be positively linked to distributed team performance on an intellective decision task. Tan, Wei, Huang, and Ng (2000) found that information exchange positively related to distributed team performance on a preference task. Warkentin, Sayeed, and Hightower (1997) found that perceptions of shared norms and expectations of task process were types of relational links positively related to a higher level of team cohesion and information exchange in computer-supported distributed teams. Mennecke and Valacich (1998) also found information sharing to be positively related to decision quality for GSS-supported groups whose members had unique information.

The effects of interaction style on team decision performance outcomes have been well established (as noted above) in face-to-face groups. Potter, et al. (2000) revealed that in the virtual setting, the constructive interaction style produced a solution quality that was superior to passive teams and the solutions acceptance was superior to passive and aggressive teams. Passive interaction style produced a solution quality that was inferior to constructive and somewhat inferior to aggressive groups, with a solution acceptance that was inferior to constructive groups. Aggressive interaction style produced a solution quality that was lower than constructive yet

higher than passive groups, with a solution acceptance that was inferior to constructive yet similar to passive groups.

There are relatively few studies that explore the aforementioned phenomena in virtual teams. Potter, Balthazard and Cooke found that the interaction styles produced similar results in virtual teams (Potter, et al., 2000). In that study, a series of experiments with distributed teams showed that team interaction via CMC did not significantly interfere with the expression and perception of individual interaction characteristics. The computer-supported communication medium did not interfere with team members' ability to accurately assess their team's interaction style. The virtual teams used in those studies all exhibited interaction styles, and the effects of those styles on team decision performance and process outcomes were directionally consistent with those commonly found with FTF teams.

In the FTF and VT environment, the overall goal is the successful performance of the team. Although it has been demonstrated that group interaction styles affect team performance (Potter, et al. 2000; Potter, Balthazard, and Cooke, 2001; Balthazard, Potter et al., 2001), the reasons that group members interact in certain ways have not been fully investigated. As noted above, Cooke and Szumal attribute an individual's communication behavior during team interaction to stable personality characteristics. However, those characteristics have not yet been specified. If by looking at the personality traits of team members, we can reveal a relationship between individual personality and group interaction styles, we will be able to make better decisions regarding team composition, which, in turn, will result in improved team performance.

D. Personality Factors and Team Performance

Prior to the late 1980's, it was generally assumed that the link between personality and job performance was tenuous at best. Research findings were inconsistent. However, in the last

decade, there have been a series of advances which unequivocally demonstrate that personality, as assessed through standardized instruments, has a predictive relationship with job performance approaching, and in some cases exceeding, that of cognitive ability (Goffin, Rothstein, and Johnston, 1996: Nowack, 1997). The greatest single advance in personality research has been the emergence and broad acceptance of the Five Factor model of personality, commonly referred to as the "Big Five (Digman, 1990; Hogan, 1996). The Big Five are bipolar dimensions of personality that have been found to form the taxonomic (and factorial) core of personality models and also capture laypersons descriptions of personality as found in everyday language (Fiske, 1941; Hogan, 1991; McCrae and John, 1992; Barry and Stewart, 1997). These dimensions/factors are extraversion, agreeableness, conscientiousness, openness and neuroticism. McCrae and John (1992) investigated the history and evolution of the model and concluded that all five factors were shown to have convergent and discriminant validity across instruments and observers.

There are several reasons why personality should be considered when organizing teams. Individuals working in teams each bring something to the team that affects the way that the team interacts. This "something" consists of the personalities exhibited by each team member. Barry and Stewart (1997) suggests, "at the core of the analysis of either the structure or functioning of a group must be an analysis of what individual members bring to the group." Hoyle and Crawford (1994) asserts that the analysis of a group or work team should include what the group member brings to the group. Research indicates that there is a complex and profound relationship between personality and job performance (Barrick and Mount, 1991).

Organizations often attempt to evaluate job candidates' personalities by means of standardized tests (Bell, 1999; Hurwitz and Ippel, 1999). Also, many companies use personality

assessment tools (e.g., Myers – Briggs) to assist in hiring decisions and work assignments of its employees. A survey completed by the AON Consulting/Society for Human Resource Management of its association's 130,000 members showed that 18 percent of U.S. companies use behavioral and personality testing for screening non-management candidates while 22 percent used them for management candidates (Walz, Wynekop and Clark, 2002).

There is also an extensive history of research examining the link between personality characteristics and effective leadership. Personality characteristics have been shown to predict overall leader effectiveness in terms of outcomes, the ability of the leader to build an effective team, subordinate ratings of leader effectiveness, and executive derailment (Barry and Stewart, 1997). Furthermore, personality is also predictive of emergent leadership – that is, early identification of leadership potential (Hogan, Curphy and Hogan, 1994).

Many virtual teams are largely self-managed. Thoms, Moore, and Scott (1996) studied personality factors and how they relate to self-efficacy for participating in self-managed work groups. Virtual teams and self-managed work groups share certain similarities. In these particular work arrangements, the traditional roles (e.g., leadership) may not be the same as those in FTF teams, or may not be pre-assigned roles. These types of teams are also known as self-managed teams, empowered teams, team self-leadership, and semi-autonomous teams (Arnold, Arad, Rhoades, and Drasgow, 2000; Durham, Knight, and Locke, 1997; Manz and Sims 1990; Stewart and Barrick, 2000). Barry and Stewart (1997) note:

> ... personality may be particularly important in self-managed teams ... the role of personality within self-managed teams must be examined from a perspective that allows roles to evolve through interpersonal interactions. One method of determining this effect is to examine how group processes and performance vary with the number or proportion of group members with relatively high scores on personality traits that are theoretically related to group process and performance (p. 65).

There are relatively few studies that address the relationship between personality and team performance. A major reason for this lack of research may be because of the problems in trying to aggregate individual level of analysis to the group level (Barrick, Stewart, Neubert, and Mount, 1998). It is important to choose a theoretically appropriate method of combining individual-level characteristics into a team-level construct. Barrick et al. (1998) suggests, "The appropriateness of any operationalization depends largely on the nature of the task being completed by the team, the research questions being asked, and the specific traits being analyzed (p. 378)." They provide three suggestions for operationalizing team composition: 1) the calculation of a mean score, 2) focus on the variability of individual characteristics (by looking at the proportion of team members possessing a particular trait) and, 3) a focus on the highest or lowest individual-trait score for the team (Barrick, et al. 1998; Heslin, 1964; Williams and Sternberg, 1988).

Barrick et al. (1998) describes a task-based approach to choosing methods of aggregating individual analysis to the group level, based on Steiner's (1978) taxonomy. For *additive* types of tasks where the summing of resources for performance are required (e.g., moving a heavy object), the calculation of a mean score would be appropriate. *Compensatory* tasks require diverse inputs to be averaged together to arrive at a team outcome (e.g., sales forecast for a new product). In this case the mean score alone would not be sufficient. The inclusion of variance among team members would provide a better group measurement. *Conjunctive* tasks are those in which each group member must perform at a minimally acceptable level in order for the team to succeed (e.g., assembly lines). The maximum method (use of the best team member abilities) will provide the best group measurement. Similarly, for *disjunctive* tasks in which only one team

member must perform well in order for the team to succeed (e.g., problem solving), the minimum method would be appropriate.

The predictive utility of personality assessment is enhanced when job type and personality constructs are matched, either based on the findings of previous research, rational analysis, or a thorough personality oriented job analysis (Raymark, Schmit and Guion, 1997). This is to say, different tasks demand different personality profiles (Hogan, 1996). Extraversion, widely agreed to be the first "Big Five" personality factor, appears to be a valid predictor for tasks involving social interaction (Barry and Stewart, 1997; McCrae and Costa, 1989). Barry and Stewart (1997) found that at the individual level of analysis, extraversion was the key personality-based correlate with individual impact on group performance as perceived by other group members. Peabody and Goldberg (1989) revealed that extraversion and agreeableness accounted for most of the variance in studies of the "Big Five" personality factors. Various studies have supported the validity of extraversion and conscientiousness as predictors of general performance in managerial jobs (Barrick and Mount, 1991; 1995; De Jong, 1999; Barrick, Stewart, Neubert and Mount, 1998). However, Barry and Stewart's (1997) findings revealed no direct role for conscientiousness either at the individual or group level. Barrick et al. found that work teams with higher mean levels of extraversion and emotional stability received higher ratings of team viability. Team viability is the team's capability to continue functioning as a unit. This is considered to be a critical measure of team effectiveness (Barrick et al., 1998; Hackman, 1987). As such, extraversion is the most appropriate factor to examine as we deal with interaction styles and performance in teams in this study.

Extraversion refers to the degree to which individuals are gregarious, friendly, complaint, cooperative, nurturing, caring and sympathetic versus introversion, which is characterized by

those who are shy, unassertive, and withdrawn. Conscientiousness describes those who are achievement oriented, well organized, neat, dependable, and hardworking versus those who are disorganized, impulsive, careless, unreliable, and lazy. Openness refers to the degree to which individuals are intelligent, imaginative, curious, original, and creative versus those who are more conservative in their opinions, dull, literal-minded, and set in their ways. Neuroticism can be characterized by individuals that are tense, self-doubting, depressed, irrational thinkers, moody, low in self-esteem, and ineffective in coping versus people that are emotionally stable who exhibit self-confidence, high self-esteem and calmness. Agreeableness describes individuals who are cooperative, warm, tactful and considerate versus those who are independent, cold, rude, harsh and unsympathetic.

E. Extraversion and Team Performance

Barrick and Mount (1991) found that extraversion and conscientiousness were the two of the five traits that consistently related to success in the work place (Barrick and Mount, 1991). They concluded that extraversion correlates positively with individual performance in jobs involving social interaction. Walz, et al. (2002) found higher levels of extraversion to be related to exceptional performance of software developers. Barry and Stewart (1997) revealed that at the individual level, extraversion was the "key" personality correlate with individual impact on group performance. There was a positive relationship between extraversion and impact on group performance at the individual level. At the group level the proportion of high extraversion members in a group was found to be curvilinearly related to group processes and performance (Barry and Stewart, 1997).

Extraversion affects interpersonal relations in that it is an interpersonal trait this is related to the quality of social interactions (Barry and Stewart, 1997; McCrae and Costa, 1989).

Extraverts are usually active participants in group interactions and often have high intragroup popularity (Barry and Stewart, 1997; Mann, 1959).

Straus (1996) investigated the relationship between individual participation in discussions and extraversion to determine if electronic communication promotes participation equalization by reducing member inhibitions. In this study, the relationship between extraversion and participation was analyzed at the individual member level. Extraversion for individuals was measured with an 8-item scale. Group measures of individual participation rates were calculated as the number of words per participant divided by the total number of words in the group. The findings revealed that although individuals exhibiting extraversion personality characteristics dominated in both FTF and CMC groups, members of CMC groups participate more equally in discussions than do FTF groups. This may be due to the ability of individuals to participate simultaneously in the CMC groups. Similarly, in a study involving extraverts and introverts in traditional FTF meetings and a virtual environment, all participants contributed more original solutions in the virtual environment, compared to the FTF environment (Yellen, 1995). Although there were more comments in the FTF setting, overall, the extraverts had more comments in both environments. Therefore, though CMC promotes equality of participation, and introverts may experience a greater impact in the virtual world than in the traditional team setting, extroverts will typically exert their influence in both settings.

F. Extraversion, Group Interaction and Conflict

Two ways in which extraversion could be linked to group interaction are based on the nature of extraverted individuals and their behavior characteristics. Extraverted persons have strong tendencies to be articulate, expressive, and may be able to persuade and influence others (Goldberg, 1990; Watson and Clark, 1997). An important behavioral characteristic of

extraversion is dominance (Trapnell and Wiggins, 1990). House and Howell (1992) describes dominance as a tendency to "take initiative in social settings, to introduce people to each other, and to be socially engaging by being humorous, introducing topics of discussion, and stimulating social interaction"(House and Howell, 1992, p. 85).

The proportion of group members that are high in extraversion may be related to the groups' interaction style, which in turn, relates with group performance. Barry and Stewart (1997) found that the proportion of high-extraversion group members was related curvilinearly to task focus and group performance. Too few extraverts may result in low performance whereas too many extraverts, may lead to a decrease in group performance due to the group's lessened ability to remain focused on task completion (Costa and McCrae, 1992). Two possible reasons are: 1) extraverts may be more concerned with pleasurable social interactions than task completion (Barry and Stewart, 1997) and, 2) too many extraverts may result in intra-team conflict. Recalling that one of the characteristics of extraverts is dominance, conflict can occur when there are too many dominant individuals (Mazur, 1973).

Rahim (1992) defined conflict as an interactive process manifested in incompatibility. Antonini (1998) examined the relationship between the "Big Five" personality factors and conflict management styles. He found that there was a positive relationship between extraversion and integrating styles and dominating styles of managing conflict. Antonini's conflict management styles are based on Rahim's (1992) model which characterizes an integrating style as being a win-win situation in which individuals are assertive, openly exchange information and try to achieve solutions that are acceptable to all parties. In the dominating style, at least one of the parties in conflict is aggressive and is concerned with meeting only their own needs. This results in a win-loss outcome. The integrating style is similar to Cooke and Lafferty's (1988)

constructive style and the dominating style is similar to their aggressive style. This study, however, examined the effect of individual personality on the conflict management styles of the individual, rather than the effect of the group's aggregate personality styles on the interaction of the group.

Bond and Shiu (1997) examined the relationship between the group's personality and the characteristics of its interaction. They examined eight dimensions of personality, indicating that eight, rather than five factors, were used because in the Hong Kong Chinese culture, eight such dimensions have been identified. The results revealed that personality measures were successful in predicting variation in group process measures. The authors, however, compared all of the personality factors to the group processes and did not examine extraversion separately.

In the next section, personality, expertise and group interaction are examined in relation to how they manifest in the electronic context. Relevant theoretical perspectives and research findings are presented to support hypotheses regarding the interplay between communication mode and virtual team performance potential.

G. Computer-Mediated Communication Modalites

Burke and Chidabaram (1999) suggests that the increasing importance of group work and the emergence of a variety of group support systems require modern organizations to evaluate which media (e.g., electronic mail, fax) will best support their team. They further assert that virtual teams should be able to communicate in a variety of temporal configurations. For example, some activities may require communication and information exchange in real time, whereas other activities may require delayed interaction. Kayworth and Leidner (2000) found that the virtual teams that communicated most effectively were those that used a variety of CMCS (e.g., email, web collaboration, chat rooms), rather than those who relied almost

exclusively on only one type (e.g., email). The media and temporal configuration combine to define the communication mode

Information richness theory (IRT) and its application to the VT environment has been widely discussed in the IT literature. Communication media can be characterized as "rich" or "lean." based upon the capacity to convey information (i.e., the amount and types of information they can deliver within comparable time intervals), and to facilitate shared meaning (Daft and Lengel, 1986; Trevino, Daft and Lengel, 1990). Rich media have the highest capacity to allow the simultaneous exchange of more types of information and lean media have the lowest. Face-to-face is the richest medium, followed by the telephone, electronic mail, personal written documents, and impersonal written documents. In short, IRT asserts that the performance of a task performed by a group of people depends on the extent to which the information richness requirement of the task matches the richness of the communication medium.

A rich medium is best for equivocal communications, and a lean medium is appropriate for unequivocality of the message. Initial studies addressed the media as having objective characteristics, which influenced managers' choice of usage (Daft and Lengel, 1986). Subsequent research argued perception of media is more subjective (Lee, 1994; Kinney and Dennis, 1994; Valacich, Mennecke, Wachter, and Wheeler, 1994). For example, viewing e-mail in terms of a series of messages rather than isolated messages can be richer than the telephone because it provides a history of messages and the communications can take place regardless of the time or location of the communication. Barua, Chapella, and Winston (1994, 1996) describe media richness as a reflection of the bandwidth of the communication. For example, a media rich computer-based system for cooperative work should be able to support not only textual material but also pictures, charts, graphics, voice, and video images. Media and usage choice is dependent

on the interplay between media characteristics and organizational context. Our concern here is that the computer media used for virtual teams should be sufficiently rich to permit clear transmission and reception of messages among team members, and not interfere with, diminish, or distort either task oriented or social maintenance oriented communication.

Cooke and Szumal (1993, 1994) developed an instrument that can reliably assess interaction styles of FTF groups. It is a self-report survey that solicits post task feedback from team members on their perceptions of team interaction. For a version of such a tool to function properly in a computer-mediated communication (CMC) environment, the tool and medium must not limit expression of user interaction characteristics to such a degree that other team members cannot perceive them. Potter, Balthazard and Cooke (2000) validated a web-based version of the Cooke and Szumal (1993, 1994) interaction style assessment tool. In a series of experiments with distributed teams, they found that team interaction via CMC did not significantly interfere with the expression and perception of individual interaction characteristics. The computer-supported communication medium did not interfere with team members' ability to accurately assess their team's interaction style. The distributed virtual teams used in those studies all exhibited interaction styles, and the effects of those styles on team decision performance and process outcomes were directionally consistent with those commonly found with FTF teams.

Research on how communication mode effects expressions and perceptions of personality is still a relatively new area. Earlier studies showed that although distributed groups may communicate (via CMC) less frequently, they can compensate in various ways (Hiltz, Johnson, and Turoff, 1986; Hiltz and Turoff, 1993; Siegel, Dubrovsky, Kiesler, and McGuire, 1986). Distributed CMC team members may express opinions more strongly as a compensatory measure or as a response to reduced social presence (Hollingshead, 1996a, 1996b). The degree to

which this occurs likely depends on the task and the team as well as the medium. The computer-mediated communication medium may actually be superior to face-to-face communication for objective and accurate evaluation of others' input into teamwork (Hedlund, Ilgen, and Hollenbeck, 1998; Weisband and Atwater, 1999). There also seems to be no fundamental reduction of the human tendency to promulgate relational or socio-emotional communication (Kahai and Cooper, 1999), nor does extant research suggest that people have difficulty interpreting the emotional tone or other manifestations of personality that are expressed in CMC (Walther, 1992, 1994, 1995, 1996).

More recent studies investigated the effects of personality and expertise on virtual team processes and performance. Balthazard, Potter and Warren (2002a, 2002b) studied 248 members of 63 virtual teams of professional managers to determine the effects of extraversion and expertise on virtual team interaction and performance. Each individual participated in an intellective decision making task using a web-based conferencing tool. Subjects were executive MBA students and mid-level managers that completed the exercise for course or professional credit. The median number of participants per team was four. All participants reported to be highly computer literate with respect to the technologies in use within the computer-mediated exercise (Windows, a browser, e-mail, chat room). The decision making task (The Ethical Decision Challenge) was an exercise with an "expert" solution that was based on the decisions of over 800 Institutional Review Board members who are responsible for reviewing proposals for research involving human subjects. Individual and team solutions were compared to the expert's solution. The average expertise measure represented the average of the absolute difference between individual solutions and the expert's solution and is scored out of 50 points. That is, maximum error would receive a score of 0 and absolute consistency with the expert's ranking

would receive a score of 50. Ideally the team should develop a solution that is of higher quality than the solution developed by the best member working alone. In this study, process loss was indicated when better solutions were developed by members working alone rather than as a group. A team score that was better than the initial score of any of its members was attributed solely to the quality of interaction, communication, and learning within the group.

At the start of this study, individuals completed a 50-statement "five factor" instrument to determine individual and group-level extraversion. The overall levels of extraversion within each team were determined by averaging the scale scores of the individual members. Another group-level extraversion measure captures the difference in extraversion scores for each member (operationalized as the standard deviation of extraversion in each team). Immediately after the exercise, and upon achieving a consensus solution, each member completed the Group Style Inventory™ (Balthazard 1999), a normed a validated instrument that assesses interaction behaviors within a group. Also, within 48 hours of the completion of the session, each member completed a group process questionnaire that assessed satisfaction with the process and "buy-in" into the consensus solution.

The results of this study revealed the level of extraversion to be negatively and significantly correlated with the constructive interaction style. The relationship was also in the negative direction (but not significant) with the aggressive style. Variation in extraversion levels within virtual teams were positively and significantly correlated with a passive interaction style, negatively and significantly correlated with the constructive style, and negatively and significantly correlated with cohesion, solution acceptance and perceived effectiveness. Average level of expertise was negatively and significantly correlated to the constructive interaction style and team errors. Average expertise also correlated highly and positively with the best member's

expertise. In virtual team settings, extraversion was found to be an important personality trait to promote effective team interactions; teams with lower variances in extraversion did best, especially in teams with good knowledge to start off with. In virtual teams, the mix of expertise and personality traits does its work via the group interaction styles it promotes. However, for the most part, group styles, have more predictive power on performance outcomes in virtual teams than individual personality or expertise. Performance was measured by deriving two measures of solution quality. The first, "Team Error," represented the absolute difference between the team's consensus solution and the expert's solution. A low team score represented good solution quality and general agreement with the expert's solution. Second, "Gain over best member," was computed by subtracting the team consensus score from the best member's score. If the team's error score was lower that the best member's error score, the difference represented a gain in quality over the best member's initial solution. If the team's error score was higher than the best member's score, the difference represented a loss in quality. Process loss was indicated when better solutions were developed by members working alone rather than as a group. This occurs when the group interacts and approaches problems in ways that either prevents members from sharing relevant knowledge and information or from recognizing and using relevant knowledge and information when it is offered.

Another study by Balthazard, Potter and Cooke (2001) investigated process and performance in both face-to-face and virtual teams. Both teams completed the same exercise (Ethical Decision Challenge) as mentioned above in their earlier study (Balthazard, et. al. 2001). Measures of expertise and group interaction styles were also the same as in the above-mentioned study. The findings of this study revealed that while mode is both related to group interaction styles and performance, mode may contribute to outcomes only through its effect on interaction

style. In other words, the effect of mode on outcomes tends to dissolve when interaction type is taken into account. The results also showed that the use of technologies including Internet web pages and interactive threaded discussions supported these group communication processes during the decision task without distorting them significantly.

To summarize, in VT communications, the computer media used should be rich enough so that it will not reduce either task oriented or social maintenance oriented communications. Recent research has revealed that team interaction via CMC mode does not significantly interfere with the expressions and perceptions of these important interaction characteristics (Potter, et al., 2000; Balthazard, et al., 2001). Additional research (Balthazard, et al., 2002a; 2002b) revealed that while expertise is positively related to team performance, it will be only so long as the team exhibits an interaction styles that permits the expertise to be heard, considered, and when possible, improved upon. The presence of extraverted team members is conducive to this process only if those members place high value on social rather than task-related processes. As extraverts commonly display dominance both in the FTF and virtual setting, expertise held by non extraverts is likely to be suppressed, yielding lower information sharing, lower performance, and lower satisfaction with process. Even if the expertise is held by extraverts, dominated introverts will likely feel less free to contribute and improve upon the knowledge, yielding lower performance as well as lower satisfaction with the team process.

The present study builds on the previous research by comparing the effects of extraversion and expertise on team interaction and performance in both face-to-face and virtual team environments, thereby explicating the role of mode with these variables. The next section provides a model, which captures the essence of these relationships. Hypotheses based on the model and the proposed relationships are presented, along with rationales for the hypotheses.

III. RESEARCH MODEL

In this dissertation, the effects of extraversion and expertise on team interaction and performance are compared in the traditional face-to-face (FTF) mode and the computer-supported communication (CMC) mode. The former are the face-to-face teams and the latter are the virtual teams.

A. Research Model

The general model is depicted below:

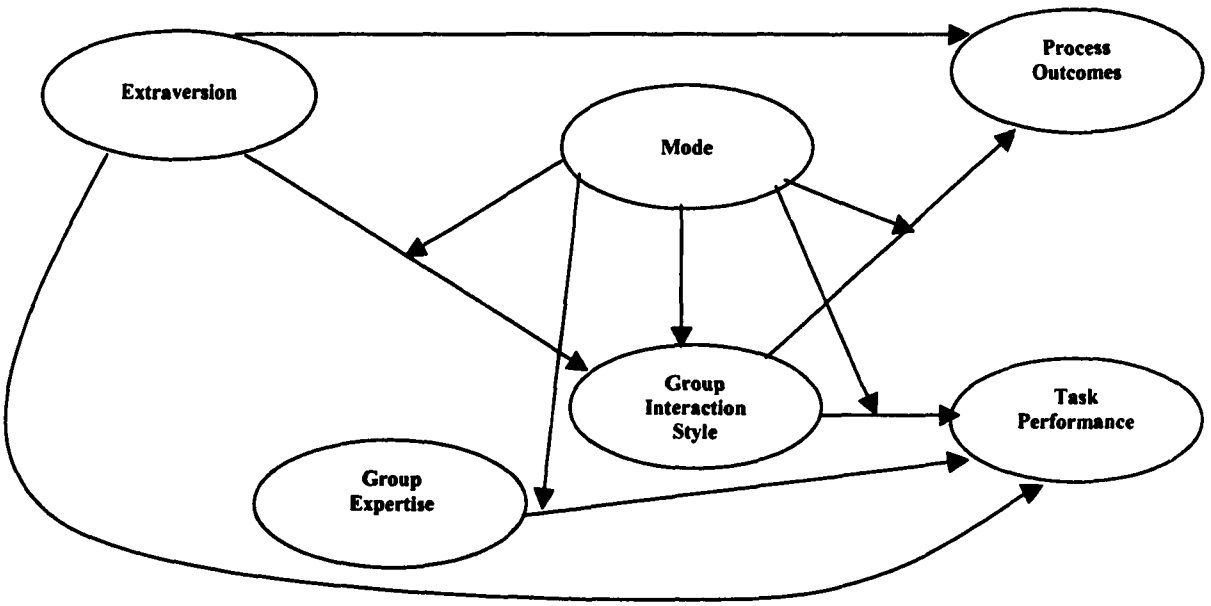

Figure 1. Research model depicting the relationship between expertise, extraversion, group interaction styles, mode, and performance and process outcomes.

B. Propositions and Hypotheses

Group deliberations with gregarious, friendly, cooperative, and nurturing individuals suggest that there will be active participation. However, extraversion does not necessarily balance both needs for personal achievement and group outcomes. Extraverts with needs for affiliation will create an atmosphere suited for a constructive interaction style. Extraverts with greater task orientation will be perceived to be more aggressive than constructive by their peers. These two behavioral extremes also suggest that there is no linear relationship between extraversion and passive interaction styles.

Virtual teams that exhibited high average levels of extraversion were found to inhibit the development of constructive and aggressive interaction styles (Balthazard et al., 2002b). These teams also did not demonstrate a significant relationship between extraversion and team performance. An explanation for this pattern of correlations might be derived from the work of Barry and Stewart (1997) who noticed that the proportion of high extraversion members in a group relates to the group's focus on task accomplishment and group performance. It may be that having too many highly extraverted members may result in more socializing by the members and less focus on the task at hand. They found a curvilinear relationship between the highly extraverted groups and performance, finding that a clear inverted U relationship emerged for the performance outcome, with groups having 20% - 40% high-extraversion members outperforming groups with either fewer or more such members. Balthazard et.al (2002b) tested this assertion with their dataset by splitting their extraversion data into three subsets: low, medium, and high. They also found a curvilinear relationship between these three levels or extraversion and the process performance measures, thus producing results similar to those of Barry and Stewart's (1997).

In that study and in the present study, the extraversion and expertise measures represents the proportion of individuals in a team that are determined to be highly extraverted or to have high expertise. The 75th percentile was used as the threshold for both measures (the explanation for selecting the 75th percentile is given in the next chapter). In sum, these findings suggest the following:

Proposition 1: The proportion of high-extraversion members in a team will influence the development of group interaction styles, and demonstrate related performance and process outcomes in both face-to-face and CMC modes.

Hypothesis 1(a): Teams with a high proportion of highly extraverted members will be less likely to develop constructive interactions styles.

Hypothesis 1(b): Teams with a high proportion of highly extraverted members will generate lower scores on measures of process outcomes.

Hypothesis 1(c): Teams with a high proportion of highly extraverted members will generate lower scores on measures of task performance.

Intuitively, low amounts of expertise lead to lower team performance and high levels of expertise lead to high team performance. Knowledgeable teams have better quality information shared among several participants. Thus, through straightforward information exchanges (even those with limited or poor group dynamics), teams with high expertise have a greater potential to create a better solution. However, the greater the knowledge in the group, the more difficult it will be to produce a "synergistic" outcome – one with significantly higher scores than the solution proposed by the best individual in the group. Teams with limited expertise will also find

it difficult to outperform the best member since the knowledge does not exist to do so. However, the potential exists for large improvements in performance, that is, the team solution produced being superior to the average quality of that produced by the team's members.

As noted earlier, group interaction is aggregated from stable personality factors of the individual group members (Cooke and Szumal, 1994; Watson and Michaelson, 1988; Hoffman, 1979; Maier, 1967). Teams with high expertise can exhibit any of the three interaction styles. However, expertise is not a personality factor and there has not been any demonstrated linkage between it and group interaction. The interaction styles are based on the personalities of the individuals and not the level of expertise or knowledge that an individual possesses. In addition, prior research does not support significant linkages between expertise and group interaction (Balthazard et. al. 2002a, 2002b). Thus:

Proposition 2: The proportion of high-expertise members in a team will predict task performance outcomes, regardless of mode.

Hypothesis 2(a): Teams with a high proportion of high expertise members will exhibit superior task performance.

Hypothesis 2(b): Teams with a high proportion of high expertise members will demonstrate significantly less gain over best member and gain over average individual score as a result of group interaction.

The knowledge of the best member is, by extension, a component of the group knowledge. Higher levels of knowledge will improve the potential for producing a good solution. However, the greater the score of the best individual in the group, the more difficult it will be for

the group to outperform him/her. Since group interaction style is more a function of personality traits than knowledge, there is no expectation that the best member will influence the development of a predominant group interaction style. The same argument is used with respect to the influence of the best member on process measures—it is not a function of knowledge:

Proposition 3: Expertise from the best member will influence task performance in both face-to-face and CMC modes.

Hypothesis 3: The level of expertise of the best member will be positively related to team performance and negatively related to gain over best member.

Like individuals, teams have distinct "personalities" (styles of interaction) and potential (available expertise). These group interaction styles are a reflection of a complex interaction between participant characteristics at the individual level and process and personality synergies and losses at the group level. Like people's personalities, group styles can be positive and effective, leading to high-quality solutions to which members are committed. Or they can be negative and defeating, leading to solutions of marginal quality and acceptance. Thus:

Proposition 4: The expertise and personalities of individuals are aggregated within the team into a group interaction style to produce performance and process outcomes. The resulting predominant interaction style within the team will be a much greater predictor of group outcomes than either individual member expertise or extraversion, in both face-to-face and CMC interaction modes.

Hypothesis 4(a): Interaction styles will be a more powerful predictor of task than will expertise or extraversion.

Hypothesis 4(b): Interaction styles will be a more powerful predictor of process outcomes than will expertise or extraversion.

A more specific model characterizing the relationships exhibited by hypotheses 1 through 4 is given in figure 2:

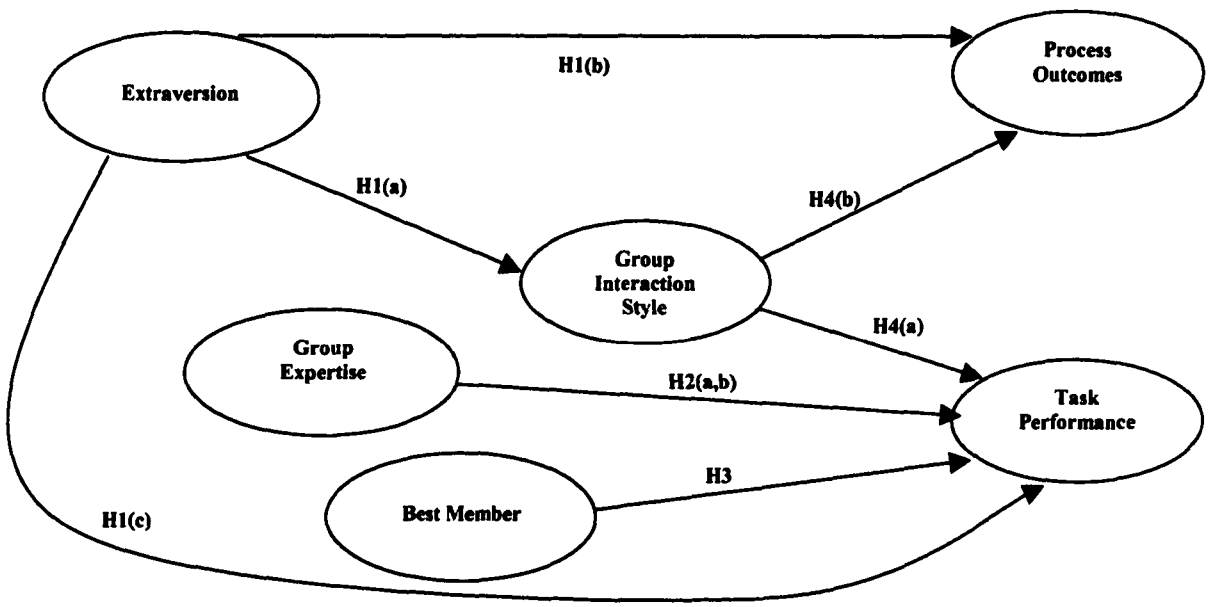

Figure 2. Research model ultimately testing the importance of extraversion, expertise, group interaction style, process outcomes and task performance in teams.

Individual communication behavior—rooted in stable personality characteristics—can be expressed and perceived via some modern forms of computer-supported media. In addition, as with more traditional face-to-face teams, virtual teams exhibit constellations of these behaviors

that can constitute an interaction style. Cognitive indicators such as expertise and personality factors such as extraversion contribute to these styles (Balthazard et al., 2002a; 2002b).

A moderator variable is one that influences the strength of the relationship between two other variables (Baron and Kenny, 1986; Hoyle and Kenney, 1999; Judd and Kenney, 1981). The communication media might be a moderating variable in that it may cause a somewhat differential effect between the level of extraversion in a team and the type of group interaction style that develops. Groups using CMC, as compared to those in the FTF settings, exhibit less inhibited communications, voice more radical opinions, exhibit greater equality in participation, and demonstrate a reduction of status differences between members (Dubovsky, Kiesler, and Sethna, 1991; Kiesler and Sproul, 1992; McGrath and Hollingshead, 1994). If this is correct, then introverts may experience a greater impact in the virtual world than in the traditional team setting. The previous research (Balthazard et al., 2002a; 2002b) revealed significant findings regarding the relationship between extraversion, interaction styles, media and performance in virtual teams. However, the strength of the effects of levels of extraversion on team interaction and performance between FTF and VTs has not been compared. Straus (1996) suggests, "The idea that electronic communication decreases users' inhibitions suggests that communications media moderates stable personality traits."

Previous research indicated that extraversion has a somewhat negative relationship with constructive and aggressive interaction styles (Balthazard, et al. 2002b). The effect of extraversion may be moderated by the mode. One manifestation of extraverted behavior in conventional groups is domination of the dialogue. In the CMC mode, parallel processing of input allows all participants to contribute equally, reducing this dominance. In addition, as noted in previous research, introverts are frequently less inhibited in CMC. Thus:

Proposition 5: The interaction mode will moderate the effects of extraversion on group interaction style.

Hypothesis 5: Teams with a high proportion of highly extraverted members will be less likely to develop constructive interaction styles in both face-to-face teams and virtual teams. However, the relationship between extraversion and constructive styles will not be as strong in the virtual teams as in the face-to-face teams.

Individual expertise will have an impact on team performance only if it is given due consideration by the members of the team. In the CMC mode, experts will not have certain verbal capabilities such as tone and inflection, or nonverbal capabilities such as gestures, posture, etc., that could be used to support their communication. All they have is superiority of argument and literacy, which they also have in the FTF mode. In sum, because the media is richer in the FTF setting and experts may be able to communicate better, they might be more convincing in FTF compared to CMC. Thus, the communication medium may cause a differential effect between the level of expertise in a team and the type of performance that the team achieves. Balthazard, et al. (2001) found a significant relationship between expertise, media and performance in both VTs and FTF teams. However, the strength of the effects of levels of expertise on team interaction and performance between FTF and VTs has not been compared. Thus, the following is proposed:

Proposition 6: Interaction mode will moderate the effects of expertise on task performance.

Hypothesis 6: The effect of team expertise on performance will be lower in the virtual team setting than in the face-to-face setting.

Task performance and process outcomes are driven by interaction styles of groups working in both the traditional FTF mode as well as the virtual team mode (Cooke and Szumal, 1993). An interesting question that arises is whether the interaction mode can to some degree drive the development of the team's interaction style. Social Presence Theory (Short and Christie, 1976) would characterize CMC that is used during virtual team interactions as engendering less social presence than FTF communication. That is, the recipient of a CMC-based message would have a lesser sense of the actual presence of the sender of the message than would the recipient of a FTF message. This lessened social presence can affect the formation of a virtual team's interaction style. For example, during the interactive phase, the CMC technology can undermine the development of a constructive style and promote the development of a passive style. The constructive style encourages participation and increases information exchange. This is accomplished in part in FTF groups via visual cues, (e.g., body language, eye contact). Because a lot of the constructive behaviors are manifested via visual cues, the constructive style will not be fully manifested in the VTs and the passive styles will be more likely to develop. Thus, in the CMC mode, the constructive team member has fewer means to enjoin a passive member to participate. Also because of lessened social presence in this mode, it may be harder for CMC group members to sense the appropriate level of communication frequency and amount of contribution compare to a FTF setting. In that case, passivity may be mistakenly tolerated longer into the collaborative process. As a passive member may be both harder to detect and correct on a timely basis, their interaction style can have relatively greater influence in the CMC

mode and the constructive style can have relatively less influence n the CMC mode compared to the FTF mode. The result is that in virtual teams with both passive and constructive members, the latter will be less able to counteract the effects of the former. This shift in influence effect a similar shift in salience, so that more teams in the CMC mode will characterize themselves as passive, and fewer as constructive, compared to FTF teams. Therefore:

Proposition 7: There is a relationship between the interaction mode and the development of group interaction styles.

Hypothesis 7(a): Virtual teams will be more likely to develop passive interaction styles than FTF teams.

Hypothesis 7(b): Virtual teams will be less likely to develop constructive interaction styles than FTF teams.

Due to its newness, virtual team research has not yet reached a point that supports or refutes performance advantages of virtual teams over their conventional counterparts. Laboratory studies (e.g., Hightower and Sayeed, 1996; Warkentin, Sayeed, and Hightower, 1997) typically show that virtual teams do not perform as well as face-to-face teams and may suffer lower satisfaction with the process. The few field studies that now exist (e.g., Maznevski and Chudoba, 2000) also report a general performance deficit. An antecedent to this research is that on group support systems (GSS). Recent meta-analyses of GSS research by Fjermestad and Hiltz (1999, 2000), as well as earlier meta-analyses (e.g., Hollingshead and McGrath, 1995) that compare the performance of GSS supported groups and conventional groups present very mixed results. In a review of laboratory research, Fjermestad and Hiltz (1999) found that GSS-supported teams

rarely outperformed their conventional counterparts except on idea generation tasks, and that these positive effects are likely only as the group size increases beyond 10 members. They also note that GSS-supported teams have difficult time reaching consensus compared to FTF teams. Hollingshead and McGrath (1995) also found that FTF groups typically outperform computer-assisted groups. Alternatively, in a review of GSS case and field studies, Fjermestad and Hiltz (2000) found that GSS-supported groups reported greater efficiency and effectiveness than FTF groups, as well as higher levels of satisfaction and related process outcomes. Because of H7, which says that there will be more constructive and fewer passive teams in FTF, the accompanying performance and process outcome patterns associated with those styles would indicate that these FTF teams would perform better than those with relatively fewer constructive and relatively more passive teams (that is, the virtual teams).

In sum, the following is expected:

Proposition 8: Face-to-face teams will outperform virtual teams.

Hypothesis 8(a): FTF teams will produce higher scores on task performance measures than virtual teams.

Hypothesis 8(b): FTF teams will generate higher scores on process outcomes measures than virtual teams.

Interaction styles have been demonstrated to have a relatively strong impact on both task and process outcomes (Cooke and Szumal, 1994; Balthazard, et.al., 2002a, 2002b). Groups whose interactions are characterized by a dominant style achieve different levels and patterns of results. As a result, the following is proposed:

Proposition 9: The resulting predominant interaction style within the team will be a much greater predictor of performance than mode.

Hypothesis 9a: Interaction styles will be a more powerful predictor of task performance than mode.

Hypothesis 9b: Interaction styles will be a more powerful predictor of process outcomes than mode.

A more specific model characterizing the relationships exhibited by hypotheses 5 through 9 is given in figure 3:

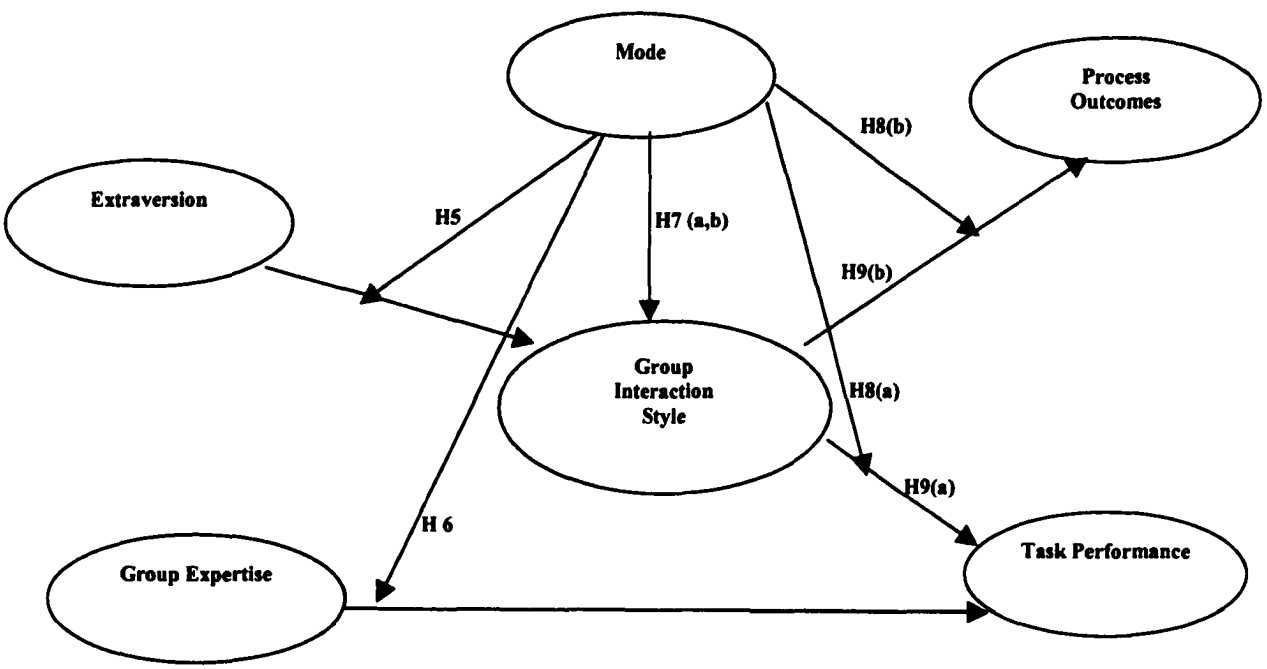

Figure 3. Research model ultimately testing the importance of interaction mode, extraversion, expertise, group interaction style, process outcomes and task performance in teams.

IV. METHODOLOGY

A. Participants

Extraversion, group interaction style, task and contextual performance data were collected from members of 98 virtual teams and 79 face-to-face teams (see Table II) who had completed the "Ethical Decision Challenge" task (Balthazard, 2000; Cooke, 1994). This task is a structured problem-solving exercise used for management development and team building in classroom and corporate settings. Subjects were a combination of undergraduate and graduate level students that completed the exercise for course credit. As noted by Yellen (1995) and others, in studies like the present one that examine personality attributes that are independent of specific decision-making skills or business background, students can serve as surrogates for real world workers. Jarlstrom (2000) also found that the personality attributes of business students are essentially the same as those of business managers. Undergraduates have been effectively used in several recent studies involving virtual teams and CMCS (Hightower and Sayeed, 1996; Kayworth and Leidner, 2000; Lind, 1999; Straus, 1996; Tan et al., 2000; Warkentin et al., 1997; Yellen et al., 1995).

TABLE II
SUMMARY OF TEAMS

Team Size	Face-to-Face	Virtual Teams	Total # of Teams
7 member teams	0	1	1
6 member teams	1	0	1
5 member teams	15	27	42
4 member teams	34	53	87
3 member teams	24	15	39
2 member teams	5	2	7
1 member teams	0	0	0
Total # of teams	79	98	177

There were 703 total participants in the 177 teams. There were actually more participants, but several were dropped from the data set due to non-completion of the exercise and the follow-up surveys. The 98 virtual teams consisted of 403 participants and the 79 face-to-face teams consisted of 300 participants. The mean number of participants per team was four with 7 two-member teams, 39 three-member teams, 87 four-member teams, 42 five-member teams, 1 six-member and 1 seven-member team. Given their backgrounds and/or prior coursework that used web-based communications and software, all subjects were assumed to be highly computer literate, especially with respect to the technologies in use within the exercise (Windows, internet browser, e-mail, chat-room).

B. Task and Procedures

The "Ethical Decision Challenge®" requires participants to rank ten biomedical and behavioral research practices—all of which involve human subjects—in terms of their relative permissibility and acceptability (Balthazard, 2000; Cooke, 1992). It provides participants with an opportunity to practice their skills in both ethical analysis and group decision-making in either a face-to-face or a virtual setting. The reason for using this type of "intellective" task is that it provides an objective measure of performance and expertise, and provides quantitative data for analysis. This type of task was also selected, rather than a business-oriented case, because it does not require background functional knowledge such as accounting, finance, marketing, etc., and therefore isolates the communication aspects of solving the simple task (Warkentin et al., 1997). Participants in the traditional classroom groups completed the paper version of the exercise with a face-to-face discussion while virtual teams completed an Internet version of the exercise with a

computer-supported text-based discussion. The computer mediated communication tool used for the virtual discussions was the virtual classroom feature of the Blackboard® software.

There were three phases of the experiment. In the first phase, during their regular class meeting, all participants were given a 50-statement "five-factor" survey instrument, which was designed to determine the type of individual personality style that the individual possesses. They were then instructed to fill out the survey and return them the following week during their regular class meeting times in order to participate in the experiment for class credit.

In the second phase, participants were randomly assigned to either face-to-face teams or virtual teams. They were then introduced to the "Challenge" during their regularly scheduled 90-minute class meeting. Each team was asked to provide a team name and select a team secretary (a member with a clerical responsibility for providing the group consensus solution with no implied leadership role). The participants were given a first 10-minute block to read the situation and a second 10-minute block to individually rank 10 items (e.g., permissibility and acceptability of 10 behaviors). Those in paper-base (i.e., face-to-face) groups indicated their ranking on an answer sheet provided within the booklet. Those in virtual teams submitted their personal solutions via an interactive Web form. The groups were then given up to 45 minutes to discuss the problem and provide the best possible consensus ranking of the items – a ranking with which all group members could "live with." The face-to-face team discussions were held with participants sitting at the same table in the room. The virtual team discussions were completed exclusively on the Internet.

It is not clear that the majority of laboratory studies on computer-based group support systems (e.g., electronic brainstorming tools) have given sufficient attention to the issue of trial length (Fjermestad and Hiltz, 1999). If the trial is too long, benefits of a particular treatment or

intervention may be exaggerated. If it is too short, the groups may miss out on producing more high quality ideas that generate a better outcome. Although this is was not a brainstorming task, we sought to give sufficient time to allow our teams to do their work (which involves surfacing of perspectives on the problem as well as alternative schemes for its resolution, inherent in many brainstorming tasks). In a previous study using the same task, 45 minutes were allotted to the test and all FTF teams completed the task within 25 minutes and all distributed teams completed the task within 34 minutes. Similarly in this study, all FTF and all virtual teams completed the task well within the allotted time. Thus, all teams completed the task without excessive time pressure and without generating participant fatigue or disinterest.

The virtual team members were segregated among several dispersed computer laboratories within the large urban campus and were closely observed to eliminate verbal communication and non-verbal cues (with anyone regardless of team membership). Participants were told that any type of communication would disqualify their participation and cause their team members to forfeit credit for the exercise. All of their discussion took place in writing within the "conference" and "chat" features of Blackboard®, a web-based communication tool and course management software used extensively by the participants in other work. Each team was provided with its own private chat room.

Solutions to the "Challenge" for the virtual teams were developed and posted via an active server page (ASP) input form, first on an individual basis and then as a group. In the face-to-face teams, the solutions were written on the paper based instruments. Individual and team solutions were then compared to experts' solutions based on the decisions of over 800 Institutional Review Board (IRB) members who are responsible for reviewing proposals for research involving human subjects. Comparisons between individual solutions and the experts'

solution indicate how well participants are exercising their knowledge, experience, and skills with respect to ethical analysis and complex problem solving. Comparisons between participants' individual scores and their team's score indicate whether they were able to achieve team synergy by fully using and building on their collective knowledge and skills (see Cooke and Kernaghan, 1987). In other words, the team's score should be better than any individual score if team synergy is achieved. Upon achieving a consensus solution, the virtual team's secretary registered the ranking by submitting a Web form, and the face-to-face teams all entered the consensus solution on their paper based instruments and turned them in to the facilitators of the experiment.

In the last phase, each team member completed the Group Style Inventory™ (GSI) questionnaire (Balthazard, 1999; Cooke and Lafferty, 1988), a normed and validated instrument that assesses interaction behaviors within a group. A group process questionnaire that assesses satisfaction with the process and "buy-in" into the consensus solution was answered after the session but within 48 hours of the completion of the session. Both questionnaires were answered after ranking the items as a group but before receiving feedback on the "experts' rank" or the quality of their own or team solution.

In previous work (Balthazard, 1999; Balthazard et al., 2002a; 2002b; Potter et al., 2000; Potter et al., 2001) these tools were shown to effectively measure the variables of interest. In this the use of these tools are extended.

C. Computer-Mediated Communication System

The virtual teams communicated and collaborated using the conference and "chat" features of Blackboard® (The University of Illinois at Chicago) and First Class® (Arizona State

University West). These are secure computer mediated communications systems that are accessible from the World Wide Web. The Blackboard® system resides on a server at the University of Illinois at Chicago and the First Class® systems resides on a web server Arizona State University West. They are both is accessible to anyone with a computer that has a web browser (e.g., Internet Explorer, Netscape Navigator) and that is connected to the Internet. Each virtual team was provided with its own password-protected work area and each member was given a username and password for access to their "virtual" work area.

Blackboard® and First Class® are both relatively easy to use and has a familiar look and feel to users of the World Wide Web. The system permits the team members to answer questions to on-line surveys and questionnaires individually and as a team, while using the chat features (a.k.a. virtual classroom, private chat rooms, instant messaging) and conference features (threaded email discussions) to assist in the team members' collaboration and decision-making efforts. The chat feature allows team members to communicate synchronously. The members were identified by name upon entering the chat room, and the system kept a textual record of the discussions (see Exhibit A for sample discussion logs of the virtual teams). This allows team members to be aware of who enters the chat room and when and if a member leaves the room. The systems' recording and archiving of member comments by member name allows the individual the opportunity to read previous comments that may have been made prior to entering the chat room.

The wide availability and use of the World Wide Web makes Blackboard®, First Class® and other similar web-based CMCS (e.g., WebCT®, Meeting Web ™) accessible to a wide audience. Because the hypertext transfer protocol of the World Wide Web is platform

independent, communication among virtual team members is convenient in that any computer with Internet access and a Web browser will permit access to the system.

D. Measures

1. Mode

Mode is coded as a dichotomous variable where face-to-face teams are coded as 0 and virtual teams as 1. Negative correlation coefficients and negative standardized betas in regressions will occur for phenomena less indicative of computer-mediated virtual teams.

2. Justification for Individual to Group-Level Aggregation

In the description of a task-based approach (Barrick et al., 1998) to choosing methods of aggregating individual analysis to the group level, compensatory tasks are described as those requiring diverse inputs (e.g., personality characteristics of individuals) to be averaged together to arrive at a team outcome. In tasks such as these, the mean score alone would not be sufficient. Therefore, the inclusion of variance among team members would provide a better group measurement. This study includes the variability of individual characteristics by looking at the proportion (Barrick et al., 1998; Heslin, 1964; Williams and Sternberg, 1988) of team members possessing a particular trait. The use of proportions follow conventional practices in scoring personality profiles (Barry and Stewart, 1997; Costa and McCrae, 1992; Steiner, 1972).

3. Expertise

Individual "expertise" represents the absolute difference between individual solutions and the expert's solution and is scored out of 50 points. That is, maximum error would

receive a score of 0 and absolute consistency with the expert's ranking would receive a score of 50. Participants with high initial expertise values were most likely to have considered the implications of their decisions on all the stakeholders within the simulation problem. More generally, individuals with well-honed skills – such as extensive knowledge, experience, or skills in ethical analysis (our task here) and/or complex problem solving – will have the best (higher) expertise values.

At the group level of analysis, the expertise measure represents the proportion of individuals possessing high expertise in a team. In addition to the justification for using proportions stated earlier (e.g., (Barrick et al., 1998; Heslin, 1964; Williams and Sternberg, 1988), proportions are easily understood and can be very useful when discussing results (Eatwell, 1997).

From individual expertise we will derive "Best Member Expertise" group-level measure by selecting the highest individual performance score within a team (prior to interaction). This measure provides another standard or benchmark for analyzing the team's performance. Ideally the team should develop a solution that is of higher quality than the solution developed by the best member working alone.

4. Group –Level Extraversion

At the beginning of the experiment in the phase one period, which was one week prior to the actual exercise, individuals participating in the study completed a 50-statement "Big Five" factor instrument. Respondents judged the accuracy of each sentence as a description of their selves on a 5-point response scale. The scale endpoints were: (1) *Very Inaccurate* and (5) *Very Accurate*. Within the instrument, 10 items are intended to represent each of the five

personality dimensions that comprise the five factor model – extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience (see Goldberg, 1992; Barry and Stewart, 1997; McCrae and Costa, 1989). The answers to the 10 extraversion items were summed to form a single individual measure (see Table III for inter-rater reliability and average variance extracted measures). Sample items include:

(1) Feel comfortable about people.

(2) Am skilled in handling social situations.

(3) Keep in the background (reverse coded).

(4) Know how to captivate people.

Similar to the expertise group measures, the extraversion measure represents the proportion of individuals in a team who are determined to be highly extraverted. There are three well recognized techniques to determine the relative level of a personality trait. The first, used in many studies, provides a cutoff based on ½ or 1 full standard deviation (SD) above and/or below the mean (M). That is, those scoring ½ SD or more above a mean could be said to demonstrate that trait highly versus those with ½ SD or more below would then demonstrate the trait lowly. The second calculates "T" scores which are standardized measures with M=50 and SD = 10. Those with a "T"=55 or above are deemed high in their approach (Barry and Stewart, 1997). This approach is similar to that used by Costa and McCrae (1992). The third technique, which is slightly more conservative than the first two, is a percentile break point. The "T" practice discussed above results in a classification scheme that is nearly identical to choosing individuals scoring in the top third of the distribution of a trait (Barry and Stewart, 1997). In this study, those at the 75^{th} percentile and above are considered to be highly extraverted.

At the group level, the proportion of group members scoring high in extraversion are those that are in the top 25th percentile. This approach is consistent with that of many researchers (Barry and Stewart, 1997; Costa and McCrae, 1992; Hackman and Morris, 1975; Bouchard, 1969).

5. Task Measures of Performance

Three measures of task performance were derived for each team. The first, "Team Performance," represents the absolute difference between the team's consensus solution and the expert's solution. As per the individual recipe, a score of 50 represents absolute consistency with the expert's ranking. Groups with relatively few errors in their solutions are more likely to have considered the implications of their decisions on all the stakeholders within the simulation problem. A solid team performance value can be the result of high-quality group interaction, but it can also be achieved when members have significant task skills and knowledge (as reflected by the individual expertise measure discussed above).

Second, "Gain Over Average" was computed by subtracting the team (consensus) performance from the average performance of the team. That is, the score that the team achieved as a result of the members interacting with each other was subtracted from average of the initial individual member scores for the team. If the team's performance measure is *higher* than average performance of the team, the difference represents a gain in quality over the average performance; if the team's performance is *lower*, the difference represents a loss in quality.

Third, "Gain Over Best Member" was computed by subtracting the team (consensus) performance from the best member's performance. If the team's performance measure is *higher* than the best member's performance measure, the difference represents a gain in quality over the

best member's initial solution; if the team's performance is *lower* than the best member's, the difference represents a loss in quality.

Process loss is indicated when better solutions are developed by members working alone rather than as a group. It occurs when the group interacts and approach problems in ways that either prevents members from sharing relevant knowledge and information or from recognizing and using relevant knowledge and information when it is offered.

In contrast, when groups outperform even their best-scoring members, they have achieved synergy. A team measure that is better than the initial measure of any of its members cannot be explained by initial task ability or knowledge; rather, such performance is due solely to the quality of interaction, communication, and learning within the group.

6. *Group Interaction Styles*

To assess a group's interaction style, participants answered the Group Styles Inventory (GSI) from Human Synergistics International of Plymouth, Michigan. The instrument contains 72 questions that focus on the ways in which members of a group might interact with one another and approach their task during a meeting or specific problem-solving session (see Cooke and Szumal, 1994, for complete list of items and description of the commercial instrument). Specifically, following prior research (see Cooke and Rousseau, 1988; Cooke and Szumal, 1994), constructive, passive/defensive and aggressive/defensive interaction styles were treated as first-order constructs that reflected underlying group behaviors. A constructive interaction style was measured by four subscales (i.e., second-order constructs) composed of six items each, labeled as follows: "self-actualizing, "humanistic/encouraging," "achievement," and "affilliative" constructive behaviors (coded as "Constructive T12, T1, T2, and T11" in Table IV).

Similarly, a passive/defensive interaction style was measured by four subscales comprised of six items each, assessing "approval," "conventional," "dependent," and "avoidance" passive interaction styles (coded as "Defensive T3, T4, T5, AND T6" in Table IV), whereas an aggressive/defensive interaction style was measured by four subscales composed of six items each, assessing "oppositional," "power," "competitive," and "perfectionistic" aggressive interaction styles (coded as "Defensive T7, T8, T9, and T10" in Table IV) (Cooke and Szumal, 1994).

After completing the "Ethical Decision Challenge," participants answered the questionnaire by indicating the extent to which each item described the style of their group using a five-point response scale ranging from (0) *not at all* to (4) *a very great extent.* Responses to the relevant items for each of the four constructive and eight defensive group interaction subscales were summed, and an average score was computed for the respective teams on each subscale. Sample aggressive/defensive items include:

To what extent...

(1) ...did some members seem more interested in "winning the point" than in solving the problem;

(2) ...did the discussion seem to turn into a contest;

(3) ...did the group get "hung up" on details.

Sample Constructive items include:

To what extent...

(1) ...did the group set goals and work toward them;

(2) ...were conflicts and differences used constructively (to generate better ideas);

(3) ...did members actively look to each other for ideas, insights, and opinions.

Sample passive/defensive items include:

To what extent...

(1) ...did some members seem to expect others to run the meeting;

(2) ...were members evasive when decisiveness was needed;

(3) ...did people stay detached (and never fully come together as a team).

The overall levels of aggressive/defensive, constructive, and passive/defensive interaction styles within each team were then computed by averaging the scale scores of individual members. Justification for aggregation of these measures is discussed in the "Level of Analysis" section below.

Factor scores were used instead of scale scores for the group interaction styles in all our analyses to ensure statistical independence of those scores. Because of the complementary nature of the 12 behaviors (second-order constructs) that make up the 3 styles measured by the instrument (first-order constructs), they are all related to some degree to one another; thus, the "raw" scale scores for the three styles that are aggregates of the 12 behaviors are likely to be correlated as well, presenting multicollinearity problems in statistical analyses where group interaction styles are present. Providing independence (at the individual level of analysis) between the constructive, passive/defensive, and aggressive/defensive factor scores is consistent with the varimax rotation used to identify orthogonal group-level measures used in our analyses.

7. Process Outcome Assessment

Three measures of group process outcomes were derived for each team: "Cohesion," "Effectiveness" and "Solution Acceptance." Cohesion was measured by asking participants on the post-task questionnaire to rate nine items that dealt with group atmosphere and satisfaction

with the group. Respondents were asked to indicate their level of agreement with the following:

(1) members appeared to feel that they were really part of the group;

(2) people offering new ideas were likely to get "clobbered" (reverse);

(3) the group members really helped each other out on this task;

(4) some people showed no respect for the others (reverse);

(5) members of the group really stuck together;

(6) there were feelings in the group which tended to pull the group apart (reverse);

(7) group really got along well with one another;

(8) there was constant bickering (reverse);

(9) it appeared that members of the group would look forward to working with one another again.

Items 1, 2, 4, 6, 8, and 9 were taken from the work of Cook (1981); items 3, 5, and 7 came from the work of O'Reilly, Caldwell, and Barnett (1989). Responses to each of these items were rated on a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree.* However, we ultimately retained only items 2, 4, 6, and 8 because the positive coded items loaded on their own dimension and overlapped with either the group interaction styles measure or other contextual measures, weakening the discriminant validity of the cohesion measure in this context. Thus, only the four remaining items for group cohesion were averaged for each team.

Effectiveness was measured by asking participants on the post-task questionnaire to rate two sentences that dealt with behaviors consistent with conscientious groups (specifically completing the EDC). Respondents were asked to indicate to what extent...

(1) ...were the potential risks to research subjects fully considered by the group?

(2) ...was the importance of the research procedures (to investigators, the hospital, and to scientific knowledge) fully considered by the group?

Similar (but more generic) items have been used in the work of Cook (1981), O'Reilly, Caldwell, and Barnett (1989), and Human Synergistics (1993). Responses to each of these items, which ranged from (1) *not at all* to (5) *to a very great extent,* were summed and averaged for each team member. High scores on the two items thus represent a high degree of process effectiveness. The overall level of process effectiveness within each team then was computed by averaging the scale scores of individual members.

Solution Acceptance was measured by five supplementary questions included in the group interaction questionnaire. Respondents were asked to report the extent to which they...

(1) ...were personally committed to the course of action proposed by the team?

(2) ...thought the solution generated by the group was better than the one developed personally?

(3) ...thought the group came up with the best solution possible – given the time available to solve the problem?

(4) ...had reservations about any of the decisions reached by the group?

(5) ...would feel comfortable defending the group's decisions?

The questions were adapted from the work of Cooke and Lafferty (1988). Responses to each of these items, which ranged from (1) *not at all* to (5) *to a very great extent,* were averaged for each team member. High scores on this scale therefore represent a high degree of solution acceptance in the group. Solution Acceptance within each team then was computed by averaging the scale scores of individual members.

8. Level of Analysis

The level of analysis in the present study is the group. To justify the aggregation of the items measuring the various scales to the group level, inter-rater reliability and agreement was assessed for the measures by means of the eta-squared statistic (η^2), a series of one-way analyses of variance (ANOVAs) with group membership as the independent variable and the measure to be aggregated as the dependent variable), and tests based on the multiple-item estimator $r_{wg(j)}$ for scales with moderately skewed distributions (see James, Demaree, and Wolf, 1984, 1993; Lindell and Brandt, 1999; Lindell, Brandt, and Whitney, 1999). The multiple-item estimator $r_{wg(j)}$ was used to assess inter-rater consensus or the interchangeability among different members' responses within each group to the items associated with each scale. As a measure of convergence among a group of raters, this estimator is particularly relevant to instruments designed to measure group- or organizational-level variables on the basis of individual members' reports (Kozlowski and Hattrup, 1992). As depicted in Table III, results of the $r_{wg(j)}$ analyses indicate a minimum average IRC of .70, for all appropriate scales. That is, 71% of the teams on average achieved a $r_{wg(j)}$ value above .70. An inter-rater consensus coefficient (IRC) of .70 for the *majority* of cases is considered sufficient agreement (George, 1990, p.110). In this study, $r_{wg(j)}$ statistics are not appropriate for the process effectiveness or extraversion measures. The effectiveness scale has only 2 items (which can lead to unpredictable results with the r statistic) and the average extraversion measure is an aggregate of self-assessed items with only one rater (self) per individual.

TABLE III
CONSISTENCY, RELIABILITY AND AGGREGATION ASSESSMENTS

	Extraversion	Aggressive/ Defensive	Passive/ Defensive	Cohesion	Solution Acceptance	Process Effectiveness
ICC(3,k)	0.85	0.93	0.89	0.83	0.79	0.71
AVE	.54	.77	.73	.68	.64	.70
η^2	n/a	.40	.38	.58	.40	.37
Anova	n/a	1.51**	1.72**	3.59**	1.86**	1.52**
Mean $r_{WG(j)}$IRC	n/a	0.70	0.73	0.85	0.71	n/a

The η^2 statistics indicate that group membership explained 40% of the variance in individual responses to the aggressive/defensive measure, 38% of the variance for the passive/defensive measure, 35% of the variance for the constructive measure, 58% of the variance for the cohesion measure, 37% of the variance for the process effectiveness measure and 40% of the variance for the solution acceptance measure. Similarly, the *F* ratios in Table II suggest that the variance in responses between groups is significant in relation to the total variance for each. The η^2 and *F* ratios therefore support the proportional consistency of variance (Kozlowski and Hattrup, 1992) among the responses of members within the same group as compared to the responses of members across groups (i.e., inter-rater reliability). Thus, team members' assessments of the team's interaction styles, and team member's assessments of cohesion, solution acceptance, and process effectiveness were aggregated to the group level for each scale.

V. STATISTICAL DESIGN AND RESULTS

The foregoing propositions and hypotheses address the mechanisms through which personal characteristics of individuals are aggregated via group-level dynamics to produce group-level outcomes. In this study the analyses are limited to the group-level. Combinations of group member dispositional characteristics have been presumed conceptually to be associated with group processes since the early days of group dynamics research (e.g., Haythorn, 1953). There is no extant research to suggest that this has changed.

The hypotheses were tested three ways: correlation analysis, regression analysis, and *t*-tests used to compare the mean differences by interaction mode for the outcome measures. First, correlations were computed among the different measures for all teams, followed by separate correlations for the face-to-face and virtual teams. The correlations provide an indication of the direction and magnitude of the relationship between the expertise, extraversion, interaction styles, interaction mode, and task and contextual outcome measures.

Second, two sets of multiple regression analyses were performed to define the relative importance of each measure as a predictor of outcomes. A forward (stepwise) selection procedure was first performed followed by a backward elimination procedure. Forward selection is traditionally the most widely used but least reliable in reaching valid results in multivariate datasets. The backward elimination procedure is more accurate. Therefore, agreement between these two stepwise regression procedures would be enough to provide reliable and valid estimates of the standardized regression coefficients. Unlike the correlations, the standardized betas from a multiple regression equation with independent variables entered simultaneously provide an indication of the unique effects of expertise, extraversion, and group interaction styles when taken together. Best member expertise was excluded in this set of independent variables

because its role in the development of a group interaction style is included within group expertise. Team size was included as a control variable in the regression analysis to rule out team size effects.

Collinearity diagnostics, including variance inflation factors (VIF), are provided with the regression analyses. The VIF are inversely related to tolerance values (amount of variability of a selected independent variable not explained by other independent variables) and indicates the degree of collinearity or multicollinearity among the independent variables. Tolerance values below .10 and corresponding VIF values above 10 are considered large and indicative of significant multicollinearity issues. Finally, the resulting R^2 from a multiple regression equation provides an estimate of the total variance explained in the dependent variable by the set of independent variables. Six sets of regression equations were computed, one set for each outcome measure. The direction of the standardized regression coefficients and their corresponding level of significance (as estimated by the t statistic) were used to further determine whether the hypotheses were supported.

VI. INTERPRETATION OF RESULTS

A. Test of the Measurement Model

The measurement model was tested by examining individual item reliability, internal consistency, convergent validity, and discriminant validity. Individual item reliability of the scales used to measure the constructs in the model was tested by examining the factor loadings of items on constructs (see Table IV).

Principal components analysis (PCA) is a statistical technique that is applied to a set of variables when the researcher is interested in discovering which variables in the set form coherent subsets that are relatively independent of one another. A major use of PCA in psychology is in the development of objective tests for measurement of personality and intelligence (Tabachnick and Fidell 2002). Catell's use of factor analysis underlines its primary usefulness, that is, to take a large number of observable instances to measure an unobservable construct or constructs (George and Mallery, 2000).

PCA with Varimax rotation was performed through SPSS FACTOR on 42 items from surveys completed by 703 members of face-to-face and virtual teams. The rotated sums of squared loadings indicated that there were eight factors with eignevalues greater than 1.0. These factors accounted for over 62% of the variance.

Initial examination of the measurement model revealed that five cohesion items had cross-factor loadings on the interaction style and solution acceptance measures. Close examination of these items revealed that they measured behaviors (e.g., "the group members really helped each other out on this task") that could also be identified with the constructive interaction style. However, the negatively coded items appeared to be consistent with feelings of a lack of cohesiveness (e.g., "there were feelings among members of my group which tended to

pull the group apart"). Accordingly, these five items were dropped from the scale, and four items remained to measure cohesion.

Table IV shows the factor and cross-factor loadings of the measures of the constructs and the scale reliabilities. With few exceptions, items loaded at the .60 level or higher on their respective constructs, as recommended by Barclay, Higgins, and Thompson (1995), and did not cross-load significantly (over .40) on other factors.

TABLE IV
FACTOR AND CROSS-FACTOR LOADINGS

	Defensive	Extraversion	Constructive	Cohesion	Solution Acceptance	Process Effectiveness
Defensive T8	**0.89**	-0.02	-0.12	-0.15	-0.12	0.04
Defensive T9	**0.87**	-0.02	-0.11	-0.15	-0.10	0.03
Defensive T3	**0.85**	0.00	-0.09	-0.04	-0.04	-0.15
Defensive T6	**0.83**	0.05	-0.13	-0.02	-0.07	-0.06
Defensive T5	**0.83**	0.05	-0.17	-0.06	-0.06	-0.12
Defensive T10	**0.83**	0.04	0.04	-0.16	-0.11	0.05
Defensive T7	**0.81**	-0.01	0.05	-0.19	-0.08	0.10
Defensive T4	**0.79**	0.01	0.10	0.01	0.08	-0.12
Extraversion B12	0.04	**0.72**	-0.11	-0.05	0.03	0.10
Extraversion B40	-0.01	**0.71**	0.01	0.00	-0.08	0.08
Extraversion B48	-0.11	**0.71**	0.00	0.03	-0.06	-0.09
Extraversion NEG44	0.04	**0.71**	-0.05	-0.02	-0.05	0.01
Extraversion B27	0.01	**0.69**	-0.03	0.05	0.02	-0.02
Extraversion NEG07	0.08	**0.63**	-0.02	-0.04	-0.02	0.08
Extraversion B02	0.06	**0.60**	-0.16	-0.11	0.16	-0.12
Extraversion NEG17	0.04	**0.59**	-0.04	-0.02	0.02	-0.14
Extraversion NEG33	-0.05	**0.52**	0.07	0.02	-0.06	-0.39
Extraversion NEG23	0.03	**0.43**	0.11	-0.02	-0.20	0.01
Constructive T12	-0.04	-0.05	**0.89**	0.05	0.11	0.10
Constructive T1	-0.09	-0.09	**0.88**	0.08	0.16	0.14
Constructive T2	-0.11	-0.04	**0.85**	0.17	0.18	0.07
Constructive T11	0.03	-0.08	**0.82**	0.06	0.18	0.22
Cohesion NEGN	-0.11	-0.04	0.08	**0.82**	0.04	0.05
Cohesion NEGR	-0.13	0.00	0.08	**0.82**	0.03	-0.01
Cohesion NEGL	-0.20	0.00	0.11	**0.80**	-0.05	0.03
Cohesion NEGP	-0.14	-0.05	0.06	**0.76**	0.12	0.03
Sol. Accept. F2	-0.06	0.00	0.26	0.08	**0.72**	0.20
Sol. Accept. F3	-0.19	-0.04	0.36	0.03	**0.67**	0.23
Sol. Accept. F6	-0.26	-0.06	**0.48**	0.05	**0.59**	-0.01
Sol. Accept. F7	-0.32	0.02	**0.44**	0.11	**0.49**	-0.03
Effectiveness D	-0.07	-0.08	0.31	0.10	0.19	**0.74**
Effectiveness C	-0.16	0.01	0.32	0.03	0.15	**0.73**

Table III shows measures of consistency, reliability, and aggregation. Scale reliability was evaluated using Fornell and Larcker's (1981) internal consistency measure, denoted ICC(3,k), a two-way mixed effects model average reliability measure. Internal consistency is interpreted in the same way as Cronbach's alpha, but it takes into account individual item weightings (whereas Cronbach's alpha is based on the assumption that each item contributes equally to the construct). Internal consistency reliabilities for the constructs examined in this study ranged from .71 to .93 which exceed Nunnally's (1978) guideline of .70. Convergent validity was evaluated by calculating the average variance extracted (AVE) for each construct. This was determined by calculating the average of the communalities for each factor. When the AVE exceeds .50, the interpretation is that the variance shared between the construct and its measures is greater than unexplained error (Fornell and Larcker, 1981). The AVE ranged from .54 to .82 for all constructs.

The loading of the passive/defensive (people and security oriented) and aggressive/defensive (task and security oriented) constructs on a single "defensive" factor is to be expected in a discriminant analysis. The task-people distinction is definitely secondary in magnitude and importance to the security-satisfaction distinction and, when other variables are considered in the same analysis, the two constructs converge. That is, they are distinct but become relatively similar when analyzed along with outcomes like solution acceptance and cohesion. However, consistent with prior research (e.g., Cooke and Lafferty, 1988; Cooke and Szumal, 1994), analysis in a downward hierarchical manner produced distinct sub-factors corresponding to the constructive, passive/defensive, and aggressive/defensive styles. Since it was postulated that passive and aggressive styles differentially impact outcomes (consistent with

prior research – e.g., Balthazard et al., 2002a; 2002b; Cooke and Szumal, 1994), the distinct factor scores of the sub-analysis were retained and used in my analyses.

The intercorrelations presented in Table V provide further evidence to support the convergent and discriminant validity of the measures examined in the current study. In all cases, the average correlation among the measures of each construct, as shown by the boldfaced elements on the diagonal of the correlation matrix (where appropriate), was greater than that construct's relationship with any other construct tested in the network of constructs. Yet, there was also some overlap in the constructs being measured, as expected based on our discussion of prior literature. In particular, the cohesion measure is strongly related to the constructive and aggressive (defensive) measures. However, examination of Table V indicates that the cohesion items have much higher loadings on its construct than on any other construct, thereby providing further support for the discriminant validity of this measure.

B. Correlation Analysis

The results of the correlation analysis for all teams are presented in Table V. Hypothesis 1(a) postulates that teams with a high proportion of highly extraverted members will be less likely to develop aggressive and constructive interaction styles. In support of H1(a), the correlation analysis demonstrates that extraversion is negatively and significantly correlated ($r = -.14$, $p < .10$) with the constructive interaction style and is in the negative direction with the aggressive style ($r = -.08$, ns). Contrary to Hypotheses 1(b) and 1(c), which proposed a negative relationship between extraversion and the performance measures, there was no significant relationship between teams with a high proportion of extraverts and either the process outcome

TABLE V
GROUP-LEVEL MEANS, STANDARD DEVIATIONS, AND CORRELATIONS[a]
ALL TEAMS

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Mode	0.56	0.50	**n/a**												
2. Constructive[c]	0.02	0.62	-0.36**	**0.91**[b]											
3. Passive	-0.03	0.64	0.09	-0.14+	**0.85**										
4. Aggressive	0.00	0.65	0.03	-0.12	-0.05	**0.88**									
5. Solution Acceptance	3.56	0.51	-0.15+	0.64**	-0.35**	-0.33**	**0.80**								
6. Cohesion	4.30	0.67	-0.25**	0.24**	-0.02	-0.36**	0.23**	**0.82**							
7. Process Effectiveness	3.40	0.63	-0.33**	0.51**	-0.30**	-0.10	0.46**	0.19*	**0.84**						
8. Best Member Expertise	37.86	4.84	0.15+	-0.11	-0.08	0.10	-0.05	-0.11	-0.08	**n/a**					
9. Expertise	0.25	0.23	0.08	-0.13+	-0.11	0.02	0.04	-0.06	-0.04	0.72**	**n/a**				
10. Extraversion	0.28	0.21	-0.12	-0.14+	0.02	-0.08	-0.01	-0.01	0.00	0.04	0.01	**0.74**			
11. Team Performance	34.50	4.95	-0.03	-0.05	-0.08	-0.08	0.07	-0.08	0.05	0.49**	0.42**	0.07	**n/a**		
12. Gain Over Average.	3.49	4.55	-0.12	0.10	0.05	-0.09	0.10	0.04	0.04	-0.08	-0.16*	-0.01	0.65**	**n/a**	
13. Gain Over Best Member	-3.37	4.95	-0.17*	0.06	0.00	-0.18*	0.12	0.02	0.13+	-0.49**	-0.28**	0.03	0.52**	0.73**	**n/a**

a. N = 176 teams.

b. Where appropriate, diagonal elements in boldface represent the square root of the average of variance extracted. For adequate discriminant validity, the diagonal elements should be greater than the corresponding off-diagonal correlations.

c. Factor scores used for interaction styles (for independence of measures).

*p<.05; ** p<.01; + p<.10.

or the task performance measures. Hypothesis 2(a) proposed that teams with a high proportion of high expertise members would exhibit superior task performance. In support of hypothesis 2(a), teams with a high proportion of experts scored higher on team performance ($r = .42$, $p < .01$). In support of hypothesis 2 (b), there was a negative relationship between teams with a high proportion of high expertise members and both gain over average ($r = -.16$, $p < .05$) and gain over best member ($r = -.28$, $p < .01$).

There is strong support for hypothesis 3 which postulates that expertise of the best member is positively and significantly related to team performance ($r = .49$, $p < .01$) but

negatively and significantly related to gain over best member ($r = -.49$, $p < .01$). A careful examination of the correlation columns representing team expertise and the expertise of its most expert member demonstrates that the special abilities of a single individual do not translate into any predominant interaction style although they contribute to the team solution.

In addition, the correlation analysis provides information about the group interaction styles. Hypotheses 4(a) and 4(b) postulate that interaction styles as a predictor of task performance and process outcomes will be significantly more important than specific estimates of expertise and/or extraversion. First, the styles inter-correlations are negligible at the group level of analysis and provide further support for the use of aggregated factor scores in our analyses. Second, each interaction style provides a different pattern of relationship with task performance and process outcome measures. An aggressive style correlates negatively with gain over best member ($r = -.18$, $p < .05$) but does not relate significantly to task performance. Neither constructive nor passive styles seem to relate to task performance measures.

The relationships are clear pertaining to the process outcomes. Constructive styles promote healthy group outcomes whereas passive and aggressive styles do not. There is a strong and positive relationship between the constructive style and solution acceptance ($r = .64$, $p < .01$), cohesion ($r = 24$, $p < .01$), and process effectiveness ($r = .51$, $p < .01$). The passive style correlated negatively with solution acceptance ($r = -.35$, $p < .01$) and process effectiveness ($r = -.30$, $p < .01$). The aggressive style correlated negatively with solution acceptance ($r = -.33$, $p < .01$) and cohesion ($r = -.36$, $p < .01$).

Correlation analyses were conducted separately on the face-to-face teams and the virtual teams. The results are reported in Table VI. Hypothesis 5 stated that teams with a high proportion of highly extraverted members will be less likely to develop aggressive and

constructive interaction styles in both face-to-face and virtual team settings. Contrary to H5, there was no significant difference in the effects of extraversion on group interaction styles. In support of hypothesis 6, the effect of expertise on task performance in virtual teams ($r = .34$, $p < .01$) was lower than that of face-to-face teams ($r = .55$, $p < .01$).

TABLE VI
GROUP-LEVEL MEANS, STANDARD DEVIATIONS, AND CORRELATIONS[a] COMPARISON BETWEEN FTF AND VTS

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. Constructive[c] - FTF	0.25	0.54	**0.91**[b]											
1. Constructive - VT	-0.17	0.62												
2. Passive - FTF	-0.09	0.68	-0.25*	**0.85**										
2. Passive - VT	0.02	0.61	-0.01											
3. Aggressive - FTF	-0.02	0.70	-0.16	0.01	**0.88**									
3. Aggressive - VT	0.02	0.62	-0.09	-0.12										
4. Solution Acceptance - FTF	3.64	0.50	0.66**	-0.46**	-0.37**									
4. Solution Acceptance - VT	3.49	0.50	0.62**	-0.24*	-0.30**	**0.80**								
5. Cohesion - FTF	4.49	0.40	0.45**	-0.27*	-0.51**	0.51**								
5. Cohesion - VT	4.15	0.80	0.07	0.12	-0.34**	0.10	**0.82**							
6. Process Effectiveness - FTF	3.63	0.58	0.35**	-0.38**	-0.09	0.47**	0.05	**0.84**						
6. Process Effectiveness - VT	3.22	0.60	0.51**	-0.22*	-0.11	0.43**	0.15							
7. Best Member Expertise - FTF	37.08	5.45	-0.04	-0.15	0.13	-0.02	-0.11	-0.08	**n/a**					
7. Best Member Expertise - VT	38.51	4.21	-0.09	-0.03	0.07	-0.04	-0.07	0.01						
8. Expertise - FTF	0.23	0.23	-0.09	-0.14	0.07	-0.03	-0.07	-0.05	0.81**	**n/a**				
8. Expertise - VT	0.27	0.23	-0.14	-0.11	-0.03	0.11	-0.04	0.01	0.64**					
9. Extraversion - FTF	0.30	0.23	-0.19+	0.05	0.00	-0.05	-0.19+	-0.05	0.09	0.07	**0.74**			
9. Extraversion - VT	0.25	0.19	-0.20*	0.01	-0.15	0.00	0.03	-0.04	0.02	-0.02				
10. Team Performance - FTF	34.64	4.63	0.04	-0.09	-0.14	0.06	0.07	0.03	0.61**	0.55**	0.08	**n/a**		
10. Team Performance - VT	34.38	5.21	-0.13	-0.07	-0.03	0.07	-0.15	0.05	0.41**	0.34**	0.05			
11. Gain Over Average - FTF	4.08	3.64	0.17	0.08	-0.16	0.10	0.15	-0.01	-0.19	-0.23*	-0.10	0.41**	**n/a**	
11. Gain Over Average - VT	3.00	5.14	0.02	0.05	-0.04	0.09	-0.02	0.01	0.03	-0.10	0.02	0.78**		
12. Gain Over Best - FTF	-2.44	4.51	0.09	0.09	-0.30**	0.09	0.21+	0.13	-0.58**	-0.41**	-0.02	0.29**	0.66*	**n/a**
12. Gain Over Best - VT	-4.13	5.18	-0.05	-0.05	-0.09	0.10	-0.10	0.05	-0.40**	-0.18+	0.04	0.67**	0.77**	

a. N = 176 teams.

b. Where appropriate, diagonal elements in boldface represent the square root of the average of variance extracted. For adequate discriminant validity, the diagonal elements should be greater than the corresponding off-diagonal correlations.

c. Factor scores used for interaction styles (for independence of measures).

*p<.05; ** p<.01; + p<.10.

C. *t*-Test Analyses

Hypothesis 8(a) postulated that FTF teams would produce better scores on task performance measures than virtual teams. Hypothesis 8(b) stated that FTF teams would generate higher scores on process outcome measures than virtual teams. These two hypotheses were tested using *t*-tests to compare the mean differences by media type in team performance, gain over average, team synergy, solution acceptance, cohesion, and process effectiveness. Means, standard deviations, and *t*-values are presented in Table VII, and are graphically illustrated in figures 4 and 5. Face-to-face teams produced significantly better gain over best member, gain over average (H8a), solution acceptance, cohesion, and process effectiveness than the virtual teams (H8b). Team performance was also slightly better, but not significantly so (H8a). This is not unexpected given the nature of the Ethical Decision challenge, which deals with a set of slightly differentiated behaviors from an ethical viewpoint, and the professionally untrained perspective of the participants. Since even untrained participants have deeply held beliefs about ethics that are often based in culture, religion, and "family values," a better test of the success of a team may lie instead in the gain over best member, gain over average, and process outcomes it attains. Interaction mode was expected to influence the development of group interaction styles (H7) but the t-tests only partially supports this hypothesis. Although hypothesis 7(a) postulated that virtual teams would be more likely to develop passive interaction styles than FTF teams, there was no significant difference between the two groups in the development of either passive or aggressive styles. However, in support of hypothesis 7(b) which postulated that virtual teams would be less likely to develop constructive interaction styles than FTF teams, the FTF teams were significantly more constructive than virtual teams, This pattern of result can also be observed in the correlation analysis in Table V.

TABLE VII
T-TEST FOR EQUALITY OF MEANS BETWEEN FTF AND VIRTUAL TEAMS[a]

	Face-to-Face		Virtual		
Outcome	Mean	S.D.	Mean	S.D.	*t*
Team Performance	34.64	4.63	34.38	5.21	0.35
Gain Over Average Team.	4.08	3.64	3.00	5.14	1.57+
Gain Over Best Member	-2.44	4.51	-4.13	5.18	1.63*
Solution Acceptance	3.64	0.50	3.49	0.50	1.95*
Cohesion	4.49	0.41	4.15	0.80	3.68**
Process Effectiveness	3.63	0.58	3.22	0.60	4.52**
Constructive Style	.25	.55	-.17	.62	4.69**
Passive Style	-.09	.68	.03	.61	-1.20
Aggressive Style	-.02	.70	.02	.62	-.38

a. N = 175 teams; 78 FTF teams and 97 virtual teams.

*p<.05; ** p<.01; + p<.10.

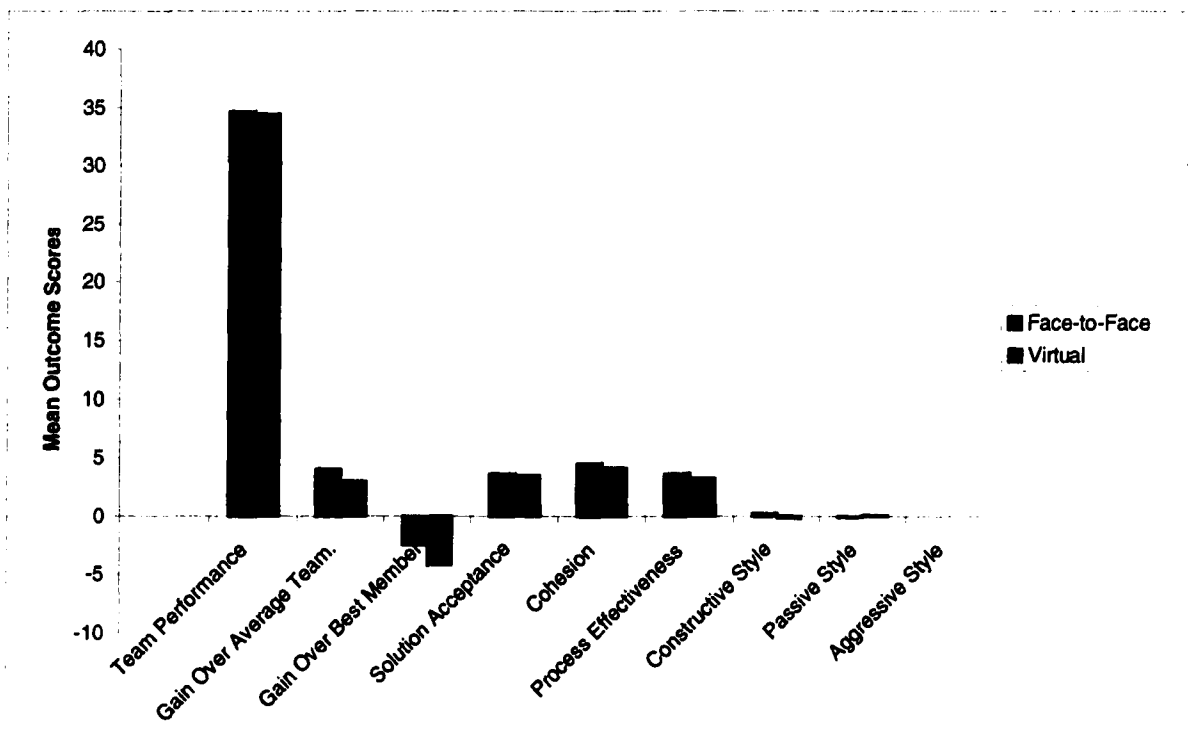

Figure 4. Performance outcomes by communication mode.

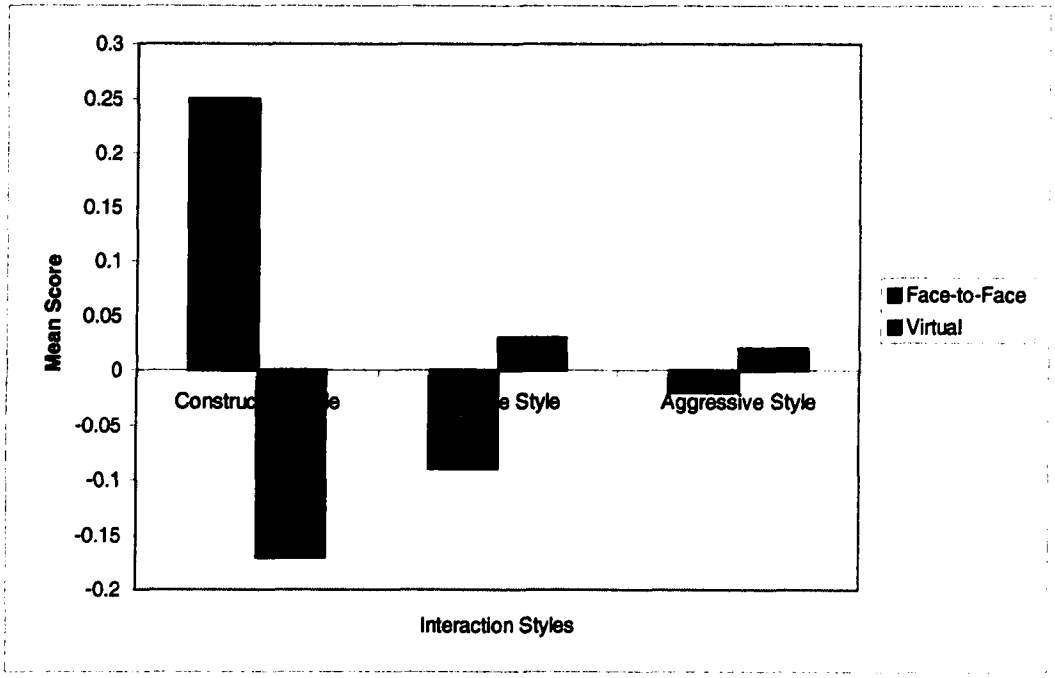

Figure 5. Interaction styles exhibited by teams by communication mode.

D. Multiple Regressions

The stepwise multiple-regression analysis results, pertaining to hypothesis H4, are shown in Table VIII. The values have been confirmed by replicating the analysis using a backward elimination procedure without significant changes in the standardized coefficients reported here. Six sets of equations were run; one for each task performance and one for each process outcome measure. In all of the regression models, mode, expertise, extraversion, and the three group interaction styles were included. Team size was included as a control variable in the regression analysis to rule out team size effects. Mode represented the two interaction modes – the face-to-face team environment and the virtual team environment with face-to-face = 0 and virtual teams = 1.The variance inflation factors, all relatively close to 1.0, support the factor and cross-factor loadings of Table IV and our management of the multicollinearity issue.

TABLE VIII
CONTRIBUTION TO OUTCOMES:
STEPWISE REGRESSION AND COLLINEARITY DIAGNOSTICS[a]

		Group Interaction Style[b]							
Outcome	Team Size (Control)	Mode	Expertise	Extraversion	Constructive	Aggressive	Passive	F	Adjusted R^2
Team Performance	.07	-0.06[c]	0.43**	0.06	0.01	-0.09	-0.04	38.86**	0.18
Gain Over Average	.06	-0.11	-0.16*	-0.01	0.09	-0.09	0.04	4.28*	0.02
Gain Over Best Member	-.07	-0.14+	-0.27**	0.01	0.00	-0.18*	-0.04	10.37**	0.10
Cohesion	-.02	-0.25**	-0.04	-0.07	0.13+	-0.35**	-0.02	19.95**	0.18
Solution Acceptance	-.08	0.09	0.09+	0.06	0.57**	-0.28**	-0.29**	70.90**	0.55
Process Effectiveness	-.06	-0.16*	0.00	0.05	0.42**	-0.06	-0.23**	29.06**	0.33
Avg. VIF =	1.04	1.05	1.01	1.02	1.07	1.01	1.02		

a. N = 176.

b. Interaction styles are aggregated factor scores (for independence of style measures).

c. Standardized regression coefficients.

*p<.05; ** p<.01; + p<.10.

Not surprisingly, expertise was found to be the most powerful predictor of team performance ($\beta = .43$, $p < .01$). That is, in "content full" tasks like the Ethical Decision Challenge, the quality of the team solution is related to the amount of expertise available in the team (e.g., greater expertise will increase team performance). The significant F value (e.g., $F = 38.56$, $p < .01$) and the adjusted R^2 indicates that our model is adequate to explain a significant amount of variance in the team performance measure. Expertise also significantly (negatively) predicts gain over average ($\beta = -.16$, $p < .05$) and team synergy ($\beta = -.27$, $p < .01$). The regression models also explain a significant amount of variance in the cohesion, solution acceptance, and process effectiveness measures.

Extraversion was of limited importance in the model. These findings are consistent with the correlation analyses in tables IV and V. However, this does not mean that extraversion does not play an important role in team interaction and performance. Note that in the regression model, the mode is negative and significant for cohesion, which indicates that FTF teams are more cohesive than VTs. Also, in the correlation analysis, the relationship between extraversion and cohesion was negative and significant for the FTF teams only. This implies that the effect of extraversion as it relates to cohesion is reduced by the information technology that was used in this study. So why were the FTF teams more cohesive than the VTs? The reason may be that because the FTF teams were significantly more constructive, the interaction styles (particularly constructive) mediated the effects of extraversion on cohesion in the FTF teams.

The constructive style promotes cohesion ($\beta = .13$, $p < .10$), which is inhibited by aggressive behaviors ($\beta = -.35$, $p < .01$). It also promotes solution acceptance ($\beta = .57$, $p < .01$), again inhibited by aggressive ($\beta = -.28$, $p < .01$) and passive behaviors ($\beta = -.29$, $p < .01$). Finally, constructive behaviors promote process effectiveness ($\beta = .42$, $p <. 01$) and passive behaviors inhibit process effectiveness ($\beta = -.23$, $p < .01$). The number of members in a team (team size) had no significant effect on any of the team performance or process outcome measures.

Overall, the regression analysis provided only partial support for hypothesis 4. Interaction styles significantly predicted process outcomes (H4b) but did not predict task performance (H4a). The analysis also revealed that team performance, gain over average, and gain over best member are best predicted by the available expertise in the group.

The next section tests hypotheses 9(a) and 9(b) using mediation analysis. Hypothesis 9(a) postulates that interaction styles will be a more powerful predictor of task performance than

mode. Hypothesis 9(b) postulates that interaction styles will be a more powerful predictor of process outcomes than mode.

E. Mediation Analysis

The multiple regressions are an integral component of the formal procedure that tests for mediation effects (Baron and Kenny, 1986; Judd and Kenny, 1981, Cohen & Cohen, 1983). The procedure involves testing for mediation with a series of regression equations. Four steps (Baron and Kenny, 1986; Judd and Kenny, 1981) in establishing mediation are: (1) show that the initial variable is correlated with the outcome by regressing the predictor variable on the criterion variable, (2) show that the initial variable is correlated with the mediator by regressing the mediator on the criterion variable, (3) show that the mediator affects the outcome variable by regressing the predictor variable on both the criterion variable and the mediator variable, and (4) to establish that the mediator completely mediates the criterion-predictor relationship, the effect of the criterion on the predictor, controlling for the mediator, should be zero.

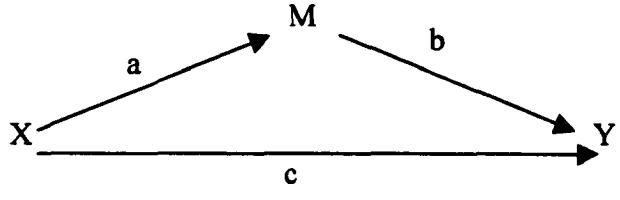

Figure 6. General mediation model.

In figure 6, X is the criterion variable, M is the mediator, and Y is the predictor variable. Paths "a" and "b" reflects the indirect effects (the IV through the mediator) and path "c" reflects

the direct effect (IV directly on the DV). In our analysis, to demonstrate a mediation effect, we want path "a" to be significant, path "b" to be significant, and path "c" to be non-significant when paths "a" and "b" are controlled (meaning no or little effect for path "c" when compared to paths "a" and "b"; no or little effect when the indirect effect is taken into account.

The regression analysis demonstrated that interaction styles predict process outcomes but not task performance. Hence, H9 (a) is not supported.

A mediation analysis was conducted to test H9 (b). Nine models consisting of three regression equations each were composed, resulting in a total of twenty-seven regression equations. These models were designed to test each one of the group interaction styles (GIS) to determine if they were mediating variables between the interaction mode and the process outcomes measure variables. As illustrated in figure 7, the interaction mode (Mode) is the criterion variable and the process outcome variables are the predictor variables. The series of equations are given below:

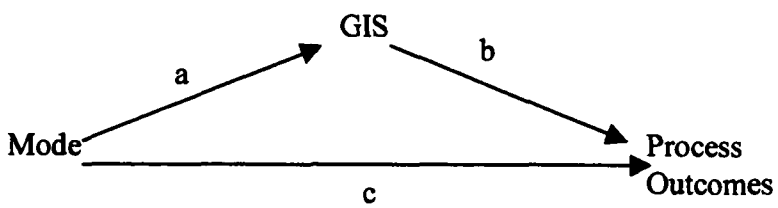

Figure 7. Model depicting mode as the criterion variable, GIS as the mediator, and process outcomes as the predictor variable.

Model 1:

Equation 1: Mode → Solution Acceptance

$F(1, 174) = 3.80$, $p < .10$ Mode ($\beta = -.15$, $p < .10$).

Equation 2: Mode → Constructive Style

$F(1, 174) = 21.96$, $p < .01$ Mode ($\beta = -.34$, $p < .01$).

Equation 3: Mode, Constructive Style → Solution Acceptance

$F(1, 174) = 60.73$, $p < .01$ Constructive ($\beta = .66$, $p < .01$), Mode ($\beta = .08$, ns).

We can make a case for full mediation.

Model 2:

Equation 1: Mode → Solution Acceptance

$F(1, 174) = 3.80$, $p < .10$ Mode ($\beta = -.15$, $p < .10$).

Equation 2: Mode → Aggressive Style *ns.*

Equation 3: Mode, Aggressive Style → Solution Acceptance

Not significant – rule out mediation.

Model 3:

Equation 1: Mode → Solution Acceptance

$F(1, 174) = 3.80$, $p < .10$ Mode ($\beta = -.15$, $p < .10$).

Equation 1: Mode → Passive Style *ns.*

Equation 3: Mode, Passive Style → Solution Acceptance

Not significant – rule out mediation.

Model 4:

Equation 1: Mode → Cohesion

$F(1, 173) = 11.90, p < .01$ Mode ($\beta = -.25, p < .01$).

Equation 2: Mode → Constructive Style

$F(1, 174) = 21.96, p < .01$ Mode ($\beta = -.34, p < .01$).

Equation 3: Mode, Constructive Style → Cohesion

$F(2, 172) = 8.54, p < .01$, Constructive ($\beta = .17, p < .05$), Mode ($\beta = -.20, p < .05$)

The IV is still significant, although the beta of the mode is smaller than the previous equation.

We can make a case for partial mediation.

Model 5:

Equation 1: Mode → Cohesion

$F(1, 173) = 11.90, p < .01$ Mode ($\beta = -.25, p < .01$).

Equation 2: Mode → Aggressive Style *ns.*

Equation 3: Mode, Aggressive Style → Cohesion

2nd equation not significant – rule out mediation.

Model 6:

Equation 1: Mode → Cohesion

$F(1, 173) = 11.90, p < .01$ Mode ($\beta = -.25, p < .01$).

Equation 1: Mode → Passive Style *ns.*

Equation 3: Mode, Passive Style → Cohesion

2nd equation not significant – rule out mediation.

Model 7:

Equation 1: Mode → Process Effectiveness

$F(1, 173) = 20.45, p < .01$ Mode ($\beta = -.33, p < .01$).

Equation 2: Mode → Constructive Style

$F(1, 174) = 21.96, p < .01$ Mode ($\beta = -.34, p < .01$).

Equation 3: Mode, Constructive Style → Process Effectiveness

$F(2, 172) = 34.47, p < .01$, Constructive ($\beta = .45, p < .01$), Mode ($\beta = -.17, p < .05$)

The IV is still significant, although the beta of the mode is smaller than the previous equation.

We can make a case for partial mediation.

Model 8:

Equation 1: Mode → Process Effectiveness

$F(1, 173) = 20.45, p < .01$ Mode ($\beta = -.33, p < .01$).

Equation 2: Mode → Aggressive Style *ns.*

Equation 3: Mode, Aggressive Style → Process Effectiveness

2nd equation not significant – rule out mediation.

Model 9:

Equation 1: Mode → Process Effectiveness

$F(1, 173) = 20.45, p < .01$ Mode ($\beta = -.33, p < .01$).

Equation 2: Mode → Passive Style *ns.*

Equation 3: Mode, Passive Style → Process Effectiveness

2nd equation not significant – rule out mediation.

A summary of the mediation analysis is given in Table IX:

TABLE IX
MEDIATION ANALYSIS

	Predictor	β	F (sig.)
Step 1: Mode as a Predictor of Process Outcomes:			
Criterion			
Solution Acceptance	Mode	-.15+	3.80+
Process Effectiveness	Mode	-.33**	20.45**
Cohesion	Mode	-.25**	11.90**
Step 2: Mode as a Predictor of GIS:			
Criterion			
Constructive	Mode	-.34**	21.96**
Passive	Mode	.09	1.44
Aggressive	Mode	.03	.14
Step 3: Mode and Constructive Style as a Predictor of Process Outcomes:			
Criterion			
Solution Acceptance	Mode	.08	60.73**
	Constructive	.66**	
Process Effectiveness	Mode	-.20*	8.54**
	Constructive	.17*	
Cohesion	Mode	-.17*	34.47**
	Constructive	.45**	

*p<.05; ** p<.01; + p<.10.

In partial support of H9(b), the above analysis indicates that partial mediational effects on mode were found for constructive styles for all process outcome measures. The passive and aggressive styles could not mediate the process outcome measures because the mode failed step two of the mediation validation. Interaction styles do (partially) mediate the effect of mode on process outcome measures. The important thing is that in general, behavior mediates process outcomes.

VII. DISCUSSION, SUMMARY AND CONCLUSIONS

A. Discussion

The results of this study offer a number of important insights into virtual teams. First, individual communication behavior—rooted in stable personality characteristics—can be expressed and perceived via some modern forms of computer-supported media. In addition, as with more traditional face-to-face teams, virtual teams exhibit constellations of these behaviors that can constitute an interaction style.

This study proposed that cognitive indicators such as expertise and personality factors such as extraversion contribute to these styles. The correlation and regression analyses did reveal that highly extraverted teams can inhibit the development of constructive styles and that teams with a high proportion of experts can also inhibit the development of constructive styles. However, there was no significant relationship between extraversion nor expertise and the development of passive and aggressive styles.

Further, the correlations could not detect a significant relationship between extraversion and performance measures. A potential explanation to this pattern of correlations might be derived from the work of Barry and Stewart (1997) who noticed that the proportion of high extraversion members in a group has a curvilinear relationship to group processes and performance. Balthazard et al. (2002b) tested this assertion in their dataset, by splitting the extraversion data into three sub-groups. The "low" grouping was made up of teams with extraversion scores at least one standard deviation below the mean. The "high" grouping was made up of teams with extraversion scores at least one standard deviation above the mean. Remaining groups were deemed "medium." They plotted the relationship between the three levels of extraversion and process outcome measures and ran ANOVA and post hoc t-test

analyses comparing the three groups. Their results were consistent with Barry and Stewart's (1997) findings regarding the curvilinear relationship that extraversion has with performance measures. This lack of a direct relationship between extraversion and performance indicates that extraversion only indirectly affects performance through its ability to influence the emergence of a particular interaction style. It is the interaction style that likely has the direct effect on performance. This is also what is seen with mode.

The present study found that expertise progressively improves performance on the task at hand but provides relatively little help to the on-going group process. Also, as the expertise of the best expert increases, it becomes increasingly difficult (but not impossible) for the team to outperform its most expert member.

Perhaps most importantly, the present study indicates that it is mostly group interaction styles, not individual personality or the expertise of one individual, that have predictive power on process outcomes in teams. Of particular interest is the finding that constructive styles perform well regardless of the interaction mode.

How a team interacts determines its ability to make quality decisions and to achieve a shared satisfaction with the decision and the group's processes. As one might expect from these three predominant interaction styles, the teams with a constructive interaction style have members whose communication behaviors support intra-group communication. Relevant knowledge held by any group member is contributed, respected, and distributed to the other group members. Better decisions are made because all knowledge resources are brought to bear on the problem. Decisions have much greater support because of a greater sense of substantive contribution and perceived equity of group processes. Conversely, it is also possible for groups to be defensive in nature. In passive interaction style teams, there may be disinterest, free riding,

and "groupthink" type conformity. Opinions are often suppressed and knowledge is often ignored, discounted, or not shared. In aggressive interaction style teams, dominators in these teams may also make it hard for others to contribute, and overemphasis on the task (and under-emphasis on people's feelings and process fairness) makes for a very unsatisfying group experience.

In the introduction section of this dissertation it was stated that the practical implication of this research is that it may be possible to predict virtual team interaction style from an assessment of the personalities of its individual members. Once the interaction style can be predicted, the effectiveness of the team's performance on certain types of tasks can also be predicted, and managed proactively, if necessary. The implications of this research extend farther than just the recognition and management of teams that exhibit a certain style. These results are provocative for organizations adopting either face-to-face or virtual teams in that they imply that steps can be taken to help personnel adopt constructive interaction styles before they embark on team tasks. In other words, if we can teach teams how to be more constructive, we should be able to improve the performance outcomes of the teams. In the case of virtual teams, some have suggested that initial face-to-face meetings are warranted before the virtual team proceeds. It may also be rational that team-building exercises should precede team performance tasks. In fact, Weisband (2000) has found that groups that meet face-to-face prior to working in a distributed way do have better group outcomes than those who do not have initial face-to face meetings. Although these are valid observations, many virtual teams do not have the luxury of a co-located beginning.

As a more prescriptive approach, this study provides the first step in a framework to evaluate interpersonal skills for teamwork where no model classification system currently exists.

Traditionally, practitioners adopt one-dimensional definitions of performance as equal to task performance only, which overshadows the importance of personality and interpersonal skills and accentuates the importance of intelligence over process. Here, performance is separated into two parts: task performance and process outcomes. Task performance is the traditional notion of ability: for instance, how well participants perform and complete the Ethical Decision Challenge. Process outcomes measures aspects of performance that may be unrelated to specific tasks — putting in extra effort, cooperating, following rules and procedures, keeping everyone "on their toes"— but are equally important to overall team performance.

It seems that, without any intervention, it is harder for virtual teams than it is for face-to-face teams to develop the more effective constructive interaction style. However, even with a constructive interaction style, it is very difficult to develop cohesion in virtual teams as compared with face-to-face teams (see Table VI). A purely technological solution will not succeed unless it acknowledges the softer side of virtual team performance. Although much work remains, these insights support a methodology that managers can use to assess interaction styles in their face-to-face and virtual teams, and proactively manage any interaction-based challenges that could threaten team performance.

B. Limitations And Conclusion

In face-to-face and virtual teams, the mix of expertise and personality traits does its work via the group interaction style it promotes. Organizations often collect personality data on their members and this information should be scrutinized when assembling a virtual team. Distributed expertise is only valuable when it can be brought to bear. Combined with an inappropriate level and distribution of individual extraversion, it may promote a non-constructive interaction style

that prevents a team from reaching synergy and robs them of satisfaction with the team process. As many academics as well as practitioners can profess, expertise and extraversion is not an uncommon combination, and one that can often make team work less productive and pleasant than it can be.

The results of the present study are preliminary. Although our subjects interacted with each other for an entire semester, they were formed into interdependent teams for only the relatively brief duration of our task. However, beyond the convenience of conducting the study as we did, research suggests that many of the initial ways in which members interact and approach group problems become normative (Feldman, 1984). These behavioral patterns continue to be evident until group process interventions are implemented (Hackman and Morris, 1975) or until members perceive that such behavioral patterns will interfere with their ability to reach their goals (Gersick, 1988).

A second related limitation concerning generalizability of our findings to real life teams is whether the present study is a laboratory study or a field study. This study contains positive and negative elements of both types of research. Although there were not motivational factors in place that might occur in a strict field study of virtual team decision-making, time limits were enforced and participation was encouraged with significant course credit linked to the successful completion of the study. Also, although the technical convenience of a computer-supported lab was available for this study, subjects participated during the trials using a standard browser interface. This is how many virtual teams operate (we are aware that such teams have other communication modes available and may use them as deemed appropriate).

A concern that bridges both of these limitations is that of the use of the term "virtual" to describe the computer-mediated teams. It is acknowledged that these are more so CMC

supported teams than "true" virtual teams. However, virtual teams are an example of and a subset of CMC teams.

The literature on virtual teams identifies three key dimensions to characterize the "virtualness" of virtual teams: relative permanence of the team, team dispersion, and technological enablement. Several researchers have suggested a limited life span, dependent on transient organizational needs, as the significant feature of virtual teams (Jarvenpaa et al., 1998; Townsend et al.1998). Although the subjects in this study interacted as teams during a one-time exercise, they were zero history subjects, analogous to VTs in their initial stages. As noted above, researchers have found that behavioral norms form very early in the life spans of teams (Gersick, 1988; Feldman, 1984). Thus, in this study we are looking at teams in their early stage of development and considering that if these teams continued working together, they would be working in a virtual setting.

Team dispersion has been defined in terms of geographical and temporal space. Technological enablement —that is, the availability and use of a broad range of communication technology— has been identified as a mediator of the effects of physical distance between team members (Griffith and Neale, 2000; Mittleman and Briggs, 1999). Using a composite of the taxonomies defined by these researchers, our virtual teams would be precisely defined as having ad hoc team membership, a (very) transient life span, "same time - different place" dispersion (simulated geographical dispersion), and enabled by a semi-synchronous text-based communication system (e.g., e-mail, chat room). Although synthetic and atypically short in duration, our virtual teams appear to be consistent with the theoretical boundaries of "virtualness." The most important reason that we use the term "virtual team," however, is that the task and measurement instruments used here were developed and are used for team building.

Originally developed through research at the University of Michigan's Institute for Social Research, several million of these types of instruments have been used by organization development consultants around the world and remain recognized as the industry standard. So although one might take issue with the use of the term "virtual team" for the teams in this study, the present research is squarely relevant to the assessment and development of teams, virtual or otherwise.

The technology used did not include real-time audio such as conference calling that real virtual teams sometimes use. It is not clear precisely how adding this feature to would affect the results, although we can speculate that this type of channel may permit greater expression of extraversion if it is manifested as domination of a verbal dialogue. In addition, this type of channel may permit more clear expression and/or perception of expertise, but that would probably depend in large part on the verbal skills of the participants, and of course, on the interaction style of the team (which may or may not support such expression). As noted earlier, previous research (Potter, Balthazard, and Cooke, 2000) validated the instrument used for determining group interaction style in the text-based virtual channel, showing it to perform slightly better than its traditional paper-based counterpart used in face-to-face groups. Adding a real-time audio channel to the present technology is not likely to alter that instrument's ability to identify the interaction styles. Also, this study was intentionally designed to use a text-based messaging system as a baseline for the VT communications and interactions. This type of technology is very common and readily available to anyone with access to the Internet and a standard browser software interface. As a result, the lack of the use of real time audio is not considered to be a weakness of the research. The baseline measure that was used is considered to be one of the strengths of this study because it is the technology that is most readily available.

Clearly, though, additional studies should be carried out to determine if our results regarding extraversion and expertise generalize to groups that can be more convincingly considered real virtual teams.

Although the team performance and synergy (gain over average, gain over best member) findings are directionally consistent with those found in earlier studies using different tasks, they are not at a generally acceptable level of significance in our study (Cooke and Kernaghan, 1987; Cooke and Szumal, 1994; Libby, Trotman, and Zimmer, 1987; Yetton and Bottger, 1982). One reason may be due to issues of motivation. In this study the participants were told that they would receive the extra credit in total if they merely completed the tasks. Thus, credit was not based on how well they did, but only on the completion of the task. However, if the credit had been given in proportion to the team's performance, and had this been communicated prior to the exercise, the findings may have been at a more acceptable level of significance. Another explanation may be due to the nature of the Ethical Decision Challenge task. That is, the different issues and situations presented would be considered very similar by ethics professionals who have a number of objective methods to use in their process. On the other hand, rather than using objective ethical analysis, untrained participants attempt the task using their idiosyncratic but deeply held beliefs derived from culture, religion, and personal experiences. Nonprofessionals represent a potentially tremendously diverse set of perspectives, which members may mistake for expertise. As such any challenges or benefits afforded by the predominance of a behavioral style are not likely to have significant effect given the typical amount of difference in quality between professional and nonprofessional processes and solutions. A more informative test of the success of a team, then, may lie in the process

outcomes it attains, as they are (in this case) more accurate indicators of the quality of the team consensus achieved (regardless of expertise).

Finally, it is recognized that there are "common methods" problem that potentially exists when correlating interaction style measures with our process outcomes measures of performance. Specifically, all of these measures were obtained from a common source (i.e., the participants) after the completion of their group activities. Thus, this issue was addressed in part via the design of the task protocol and by post hoc statistical analysis. First, process measures were collected in two distinct time periods. So, although still a common source, the participants answered a subset of the questions with a different "mindset" and perspective. The data was also re-analyzed by randomly selecting from each team's data a subset of team members for performance measures and a distinct subset for the group interaction styles. Although the findings are essentially the same, the increase in variability / decrease in power and the presence of several three-member teams that cannot be split into two multi-member subsets have forced the acceptance of the common method as a limited threat to the findings of this study. Ultimately, most of the relationships hypothesized in this study (e.g., involving extraversion and expertise) were not affected by potential common method problems.

In summary, the present study offers a methodology that can be used to assess individual personalities, expertise, and the interaction styles of virtual teams. Practitioners can use this methodology to determine how their potential virtual team lineups are going to perform. With a virtual team that—due to personality and/or expertise issues—interacts with a passive/defensive or aggressive/defensive style, an investment in improving these negative dynamics (i.e., teach teams how to be more constructive) before the team is released to its actual task is likely to pay great dividends.

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Appendix A

THE UIC TEAM CHALLENGE

Welcome UIC!

The *UIC Team Challenge* will analyze your team using feedback from extensively researched and widely respected developmental and training materials. These include diagnostic tools that assess **leadership, team effectiveness,** and an **experiential exercise** that focuses on lateral ("out-of-the-box") thinking strategies and skills.

What You Will Learn

The task to be completed is an interactive team exercise that can be used to teach the basics of teamwork while educating participants about proper group behaviors and building participants' consensus decision-making skills. The exercise challenges participants to sequence, first individually and then as a team, 10 business activities — given evaluation criteria. By comparing individual and team solutions to the recommended solution, teams will learn about strategies for improving their group's effectiveness, as well as gain insight into problem solving ability and impact on group decision making.

By completing the *UIC Challenge*, teams should learn about[1]:

- Kicking off a team process
- Evaluating current team practices and procedures
- Create a team environment that encourages innovation and the sharing of ideas
- Sharpen the analytic skills of team members
- Develop the consensus decision making and problem solving skills of individual contributors
- Improve decision quality
- Problem solving and decision making
- Time management
- Identifying more effective and efficient ways for managing teamwork

The Challenge Activities

There are three sets of activities involved in the *Challenge*. The first set is to be **completed before** your team meets to complete the task (Actually, it should have been completed by you before coming to class today!). It involves collecting identification and

Appendix A (continued)

biographical information about you and defining some of your values, perceptions, and attitudes. The second set is the task itself to be done in class (today) from groups that will be announced.

Once presented with the problem, you must provide your initial solution before you discuss the problem with teammates. You should also prepare your thoughts for a group discussion. Your team will be able to discuss (virtually, through a Web chat system like Blackboard) for 45 minutes (approximately – your instructor will be more specific) or until you create a consensus decision (whichever comes first!). Then **all team members** must register their understanding of the consensus decision and must provide their own personal final individual solution (independent from the group solution). We will also ask you to provide us with some information about how your team performed (after consensus is reached).

The UIC Team Challenge: The Activities...

Your participation is important and appreciated. You will be receiving course credit as defined by your course outline. The tasks are all WWW-based and your presence will be monitored comprehensively by our Internet server software. For instance, the server "tags" all inputs with identification information including date and time... it is important that you complete the tasks in the appropriate sequence. A formal participation report will be used for grading purposes.

TO BE DONE BEFORE THE EXERCISE (Before Today!)

1. Answer the V.P.A. Profile questions
2. Answer the D.I.S.C. questions
3. Register your participation

   Note: These web pages ask for your name, team name, and section.

THE ACTUAL EXERCISE (TODAY!)

4. Group Task ← follow the 4 steps in sequence. Discuss with your group using a chat system like Blackboard.

   Note: ALL group members must participate and answer assessment questions for the team to receive credit for assignment (and get valid results).

Appendix A (continued)

TO BE DONE AFTER THE EXERCISE (preferably within 24 hours after team consensus)

5. Answer Supplemental Group Process Questions
6. Answer Group Styles Inventory™
7. Answer the 360 degree D.I.S.C.™ questions

> **Note:** These feedback questions must be (preferably) answered **within 24 hours of completion of the group** exercise (and never before the task). Respondents should not answer these questions in the presence of other team members. ALL group members must complete the preceding tasks for the assessment to be valid and to receive credit for participation.

SHORT NOTE ABOUT NORMS, RELIABILITY, AND VALIDITY

The questionnaires used in the *UIC Challenge* have been designed and tested to meet the standards for measurement established by such organizations as the American Psychological Association and the American Educational Research Association. These standards specify that surveys of this type should be normed, reliable, and valid. Information about the questionnaires and the group task can be directed to Dr. Pierre Balthazard (Arizona State University, (602) 543-6120, pb@asu.edu).

IMPORTANT NOTE ABOUT PRIVACY

All data collected in the *Challenge* are completely confidential and will only be provided in aggregated form.

Multi-rater feedback is becoming increasingly popular in business as a technique for personal and team development. The premise behind using multi-rater feedback with teams is that individuals do not always receive sufficient feedback from other team members about their behavior and how it impacts other team members and overall team effectiveness. The lack of honest feedback stems from the discomfort some feel in providing negative (or even positive) feedback, the desire to maintain harmonious relationships, or perhaps insufficient opportunity.

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[1] The *UIC Challenge* is a "content-full" simulation – it focuses on a problem that is likely to be relevant to participants and their work. Simulations that focus on business-related problems and issues, such as conducting meetings, managing projects, negotiating agreements, developing plans, and handling customer complaints, are usually content-full. They are designed to teach participants how to handle the particular work-related problem or issue presented in the simulation. Though it is not appropriate to define the nature of the problem to be examined here, it should be noted that participants will also learn from the content of the simulation.

Appendix B

Sample Discussion Logs From Virtual Teams

Browse Classroom Archives

Archive for F2 on Apr 5, 2002

Ayca (37) **Gokcen** has entered. [12:52:16 PM]
Megan Gaughan has entered. [12:52:18 PM]
Jama **Fabry** has entered. [12:52:21 PM]
Daniel (48) Hruska has entered. [12:52:37 PM]
Erica **Espino** has entered. [12:52:43 PM]
Daniel (48) Hruska > i am not the score keeper
Megan Gaughan > hellllllllllllooooooooooo
Megan Gaughan > i decline the position also
Jama Fabry > ;-)
Ayca (37) Gokcen > whaaaaaaaaaaa
Ayca (37) Gokcen > damnit
Erica Espino > me too
Ayca (37) Gokcen > jama?
Jama Fabry > i don't really want to do it either
Ayca (37) Gokcen > i don't wanna do it either :)
Ayca (37) Gokcen > haha
Jama Fabry > what up Ayca
Daniel (48) Hruska > ayca r u tino's friend??
Ayca (37) Gokcen > nothin biotch
Ayca (37) Gokcen > yes
Ayca (37) Gokcen > who's this?
Jama Fabry > jama
Megan Gaughan > sdlkjfsiejgng
Erica Espino > lol
Jama Fabry > what's up with the 37?
Ayca (37) Gokcen > no who is the person that just asked if i was tino's friend
Daniel (48) Hruska > look behind you
Ayca (37) Gokcen > haha
Ayca (37) Gokcen > oooooooooookkkkkkkkkk
Ayca (37) Gokcen > the (37) is my stupid accounting number
Jama Fabry > alright, wtf are we doin?
Ayca (37) Gokcen > alright.
Ayca (37) Gokcen > discussing what numbers we put?
Megan Gaughan > ok
Ayca (37) Gokcen > what did everyone put for A?
Megan Gaughan > 6
Jama Fabry > who's the score keeper
Erica Espino > 1
Daniel (48) Hruska > 1
Jama Fabry > 1
Daniel (48) Hruska > you
Megan Gaughan > nota me
Ayca (37) Gokcen > haha. 3. i'm the oddball
Ayca (37) Gokcen > megan? what'd u put
Megan Gaughan > 6

Appendix B (continued)

Ayca (37) Gokcen > jeez
Jama Fabry > one sounds like a pretty good answer
Megan Gaughan > so i guess i am
Ayca (37) Gokcen > yes you are
Megan Gaughan > yeah 1's fien w/me
Jama Fabry > but what's the reasoning for not putting one
Ayca (37) Gokcen > because i put 1 for H
Jama Fabry > why?
Jama Fabry > what was H
Ayca (37) Gokcen > because i wanted to =)
Megan Gaughan > i honestly don't know what one was
Ayca (37) Gokcen > i don't remember!
Jama Fabry > paying people for their participation
Jama Fabry > let's put that as the score
Ayca (37) Gokcen > ok.
Megan Gaughan > okay,
Jama Fabry > i can do it if no one else wants to
Ayca (37) Gokcen > how bout B?
Ayca (37) Gokcen > YAY
Ayca (37) Gokcen > do it do it
Megan Gaughan > sounds good
Megan Gaughan > 4 for 2
Megan Gaughan > i mean b
Ayca (37) Gokcen > me too
Daniel (48) Hruska > 3
Ayca (37) Gokcen > grrrr....
Daniel (48) Hruska > movin' on to c
Ayca (37) Gokcen > jama what'd u put
Ayca (37) Gokcen > and you too erica
Jama Fabry > i put 5
Ayca (37) Gokcen > ERICA QUIT TALKING
Jama Fabry > but i'm retarded
Ayca (37) Gokcen > true
Ayca (37) Gokcen > this is fun!
Erica Espino browsed to http:// so .com/
Jama Fabry > it was the one about paying by the risk
Erica Espino > oh sorry
Jama Fabry > totally
Jama Fabry > so what are we putting cuz i'm on the page
Ayca (37) Gokcen > um, did anyone else just get http:// so .com/ on the pic above?
Daniel (48) Hruska browsed to http://consensus.west.asu.edu/ethics/initial.htm
Erica Espino > what number are we on?
Daniel (48) Hruska browsed to http://consensus.west.asu.edu/ethics/ethics.htm#step1
Megan Gaughan > i think 3 or 4 is good
Jama Fabry > yeah, WTF
Ayca (37) Gokcen > what the....
Daniel (48) Hruska has left. [12:58:41 PM]
Ayca (37) Gokcen > go w/ 4.
Jama Fabry > 3, ok
Erica Espino > ???
Megan Gaughan > ok
Ayca (37) Gokcen > haha.... daniel's a retard
Megan Gaughan > on to c

Appendix B (continued)

Jama Fabry > 4 and why did daniel leave
Daniel (48) Hruska has entered. [12:58:59 PM]
Ayca (37) Gokcen > i dunno
Ayca (37) Gokcen > there we go
Jama Fabry > welcome back!
Ayca (37) Gokcen > way to go #48
Jama Fabry > i'm putting four
Ayca (37) Gokcen > i put 5 for C
Megan Gaughan > 8 for c
Daniel (48) Hruska has left. [12:59:32 PM]
Ayca (37) Gokcen > megan who are you?
Jama Fabry > *i put seven, but i love when people pay me for stuff*
Megan Gaughan > i am bright yellow
Jama Fabry > so what sounds good?
Ayca (37) Gokcen > what?
Ayca (37) Gokcen > confusion
Ayca (37) Gokcen > um
Megan Gaughan > was that like you
Ayca (37) Gokcen > what'd the other three people put for C?
Erica Espino > i'm so confuseddddddddd
Daniel (48) Hruska has entered. [01:00:22 PM]
Erica Espino > i put 2
Ayca (37) Gokcen > daniel quit freaking leaving
Jama Fabry > how bout 5
Jama Fabry > ?
Ayca (37) Gokcen > ok
Jama Fabry > D- i put 6
Daniel (48) Hruska browsed to
Megan Gaughan > ok
Ayca (37) Gokcen > ok
Megan Gaughan > ok
Megan Gaughan > 2 for d
Erica Espino > d is 7
Ayca (37) Gokcen > 10?
Daniel (48) Hruska has left. [01:01:17 PM]
Daniel (48) Hruska has entered. [01:01:33 PM]
Jama Fabry > it really is a very informative way to study people
Ayca (37) Gokcen > jama you crack me up
Jama Fabry > they don't know what's goin on, so they're really truthful
Daniel (48) Hruska has left. [01:01:54 PM]
Ayca (37) Gokcen > the only person i dont know in this group is megan
Jama Fabry > i know
Megan Gaughan > hmmmmmmmm
Jama Fabry > !!!! ;-)
Megan Gaughan > who is she
Daniel (48) Hruska has entered. [01:02:11 PM]
Ayca (37) Gokcen > you.
Megan Gaughan > ah ha
Ayca (37) Gokcen > ack. anyway
Ayca (37) Gokcen > E
Megan Gaughan > 99999999
Jama Fabry > how bout 6, awright
Daniel (48) Hruska has left. [01:02:26 PM]

Appendix B (continued)

Ayca (37) Gokcen > i put 7
Ayca (37) Gokcen > 6 for D?
Jama Fabry > yes
Ayca (37) Gokcen > that's fine
Jama Fabry > E is evil, i put 10
Ayca (37) Gokcen > wait what'd u put for C
Megan Gaughan > e = 9
Erica Espino > for E i out 9
Jama Fabry > 1, 4, 5, 6
Erica Espino > YAY Megan
Jama Fabry > so far
Erica Espino > lol
Ayca (37) Gokcen > erica do u still have that maxim magazine
Erica Espino > no elena has it
Ayca (37) Gokcen > ok
Ayca (37) Gokcen > she just wanted that ck 13
Jama Fabry > i think people should know if they're gonna die from some stupid experiment
Ayca (37) Gokcen > ;)
Ayca (37) Gokcen > yes i do too
Erica Espino > yup
Daniel (48) Hruska has entered. [01:03:47 PM]
Daniel (48) Hruska > i am back
Ayca (37) Gokcen > why do u keep leaving
Megan Gaughan > i suppose they should
Jama Fabry > so is ten alright, or is there one that's worse
Ayca (37) Gokcen > that's fine.
Jama Fabry > hey danny boy, what up
Erica Espino > yeah i guess
Daniel (48) Hruska > my cpu wouldn't let me type anything in]
Ayca (37) Gokcen > sure....
Megan Gaughan > you r typing now
Ayca (37) Gokcen > alright. F=9 for me
Megan Gaughan > 3
Megan Gaughan > what was it
Daniel (48) Hruska > yeah, i logged out and back in again
Megan Gaughan > ahhh
Ayca (37) Gokcen > don't remember
Erica Espino > oops i put 4
Jama Fabry > is ten cool for the one about negligible
Ayca (37) Gokcen > why the "oops".
Ayca (37) Gokcen > ten was E
Ayca (37) Gokcen > yes.... fine with me
Jama Fabry > awesome
Daniel (48) Hruska > what letter are we on
Ayca (37) Gokcen > F
Jama Fabry > f
Erica Espino > 4
Jama Fabry > i put 2
Daniel (48) Hruska > f is 8
Erica Espino > for F
Jama Fabry > i like that one
Ayca (37) Gokcen > lol....
Megan Gaughan > ok

Appendix B (continued)

Jama Fabry > how bout three then
Ayca (37) Gokcen > jama i want to know what you put for all these in the end.
Ayca (37) Gokcen > 3???? that's so random
Jama Fabry > since it doesn't seem like there's any particular harm, and doctor's know what's best
Ayca (37) Gokcen > but the patient should know
Daniel (48) Hruska > the doctor one is one of the worst
Jama Fabry > (it's the one about withholding info with doctor consent)
Jama Fabry > ya think so?
Daniel (48) Hruska > yeah
Ayca (37) Gokcen > yes.
Erica Espino > ok
Jama Fabry > what should be two then?
Daniel (48) Hruska > c
Ayca (37) Gokcen > either H or I
Jama Fabry > apparently you care too much about people.... hehehe
Jama Fabry > H, definately
Ayca (37) Gokcen > let's move on to G....
Ayca (37) Gokcen > ok
Megan Gaughan > yeah sounds good
Daniel (48) Hruska > 58
Daniel (48) Hruska > 5
Ayca (37) Gokcen > 6
Jama Fabry > H is now #2
Daniel (48) Hruska > ok
Jama Fabry > G i put 8, too
Daniel (48) Hruska > we gotta hurry up
Jama Fabry > poor little kiddies shouldn't be subjected to that crap
Ayca (37) Gokcen > we do?
Erica Espino > i put 10 for G
Ayca (37) Gokcen > do you have an 8?
Ayca (37) Gokcen > jama
Daniel (48) Hruska > he just said we should be finishing up
Jama Fabry > i put 8
Ayca (37) Gokcen > ok good
Daniel (48) Hruska > alsdjf
Ayca (37) Gokcen > now for H. is 2
Ayca (37) Gokcen > then I
Erica Espino > i think G should be 10
Ayca (37) Gokcen > i put 2 for I
Jama Fabry > we need something for three
Daniel (48) Hruska > 7 is h
Ayca (37) Gokcen > erica we're past G
Ayca (37) Gokcen > 3 for I then?
Daniel (48) Hruska > g is 5
Erica Espino browsed to http:// .com/
Erica Espino > oh
Daniel (48) Hruska > i is 4
Jama Fabry > alright, 2 for I otay with everyone?
Megan Gaughan > sorry i am not contributing but i think i am lost
Megan Gaughan > sure
Ayca (37) Gokcen > i thought u put that for H?
Jama Fabry > shit
Jama Fabry > i did

Appendix B (continued)

Ayca (37) Gokcen > then put 3
Ayca (37) Gokcen > for I
Jama Fabry > awesome
Ayca (37) Gokcen > good deal
Ayca (37) Gokcen > now what number do u have left
Ayca (37) Gokcen > 9?
Erica Espino > EEEEEEE
Ayca (37) Gokcen > or 8.
Jama Fabry > how about 7 and 8
Ayca (37) Gokcen > 7 and 8 for WHAT
Daniel (48) Hruska > go with it
Erica Espino > huh?
Jama Fabry > we have the one about the doctor and giving away names without consent
Megan Gaughan > that's bad
Ayca (37) Gokcen > oh
Ayca (37) Gokcen > 8 for that
Ayca (37) Gokcen > then 7 for what....
Jama Fabry > for J?
Daniel (48) Hruska > sorry, i just like adding stupid comments
Jama Fabry > i put (
Ayca (37) Gokcen > yes. 8 for J
Jama Fabry > damnit, 9
Daniel (48) Hruska > like j is 6
Erica Espino > 8 for J
Daniel (48) Hruska > and i is 4
Ayca (37) Gokcen > yeah
Jama Fabry > and 9 for F?!?!??!
Ayca (37) Gokcen > yup
Daniel (48) Hruska > nooooooooooooooo
Ayca (37) Gokcen > yesssssssssssssssssssssssssss
Jama Fabry > hey daniel, we have 7 and 9 left
Jama Fabry > which is worse
Erica Espino > 4 for F
Ayca (37) Gokcen > it's cold outside =(
Jama Fabry > you are fuggin hilarious
Daniel (48) Hruska > yeah, it is
Jama Fabry > what's up with the snow in April
Ayca (37) Gokcen > "fuggin".... oh my
Jama Fabry > ???
Ayca (37) Gokcen > yeah i know
Ayca (37) Gokcen > so which two are you debating between jama?
Jama Fabry > happy friggin spring
Daniel (48) Hruska > is this like aol, will we get kicked off for bad words
Ayca (37) Gokcen > i dunno
Megan Gaughan > if i report you
Ayca (37) Gokcen > i imagine they check out what we're talking about
Megan Gaughan > he
Megan Gaughan > he
Megan Gaughan > he
Ayca (37) Gokcen > meanie
Ayca (37) Gokcen > so anyway
Ayca (37) Gokcen > jama.
Ayca (37) Gokcen > what two are you confused between

Appendix B (continued)

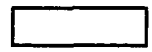
Jama Fabry > that's it, i'm putting F, 7 and J, 9
Ayca (37) Gokcen > sweet action
Daniel (48) Hruska > just pick something already
Jama Fabry > final answer
Ayca (37) Gokcen > she did
Daniel (48) Hruska > ok then
Ayca (37) Gokcen > we done?
Ayca (37) Gokcen > jama
Daniel (48) Hruska > yes
Ayca (37) Gokcen > what happened to that boy. the one you took to honors ball ;)
Ayca (37) Gokcen > sorry, just felt like teasing!
Ayca (37) Gokcen > did you send in that final answers?
Ayca (37) Gokcen > now what
Jama Fabry > you gossip! hehe
Ayca (37) Gokcen > yes?
Daniel (48) Hruska > well, he ditched me for another woman
Jama Fabry > this thing is in da bag
Ayca (37) Gokcen > ok
Jama Fabry > i got this locked down
Ayca (37) Gokcen > daniel!
Ayca (37) Gokcen > i didn't know
Ayca (37) Gokcen > ok so what do we do now
Jama Fabry > hey, ayca, i'm actually goin to see him tonite, we're goin to Eastern
Ayca (37) Gokcen > nice
Jama Fabry > just chill
Jama Fabry > schweet
Ayca (37) Gokcen > nice
Jama Fabry > so is anybody partying this weekend?
Daniel (48) Hruska > i am
Ayca (37) Gokcen > i'm going to some comedy thing this saturday
Ayca (37) Gokcen > it's from 10pm to 6am!
Daniel (48) Hruska > i just don't know where yet
Ayca (37) Gokcen > but i'm definately not staying the whole time
Ayca (37) Gokcen > and i'm stayin at my sisters' tonight because my dad is coming in town today.... w/ my doggie :)
Daniel (48) Hruska > hopefully someplace w/ lots of girls
Ayca (37) Gokcen > so i get to sleep with my doggie
Megan Gaughan has left. [01:15:54 PM]
Ayca (37) Gokcen > i think megan got tired of us
Daniel (48) Hruska > yeah
Ayca (37) Gokcen > erica too
Ayca (37) Gokcen > i'm freezing
Jama Fabry > how do i send my pix?
Ayca (37) Gokcen has left. [01:17:06 PM]
Jama Fabry > put on your coat weinies
Daniel (48) Hruska has left. [01:17:27 PM]
Jama Fabry has entered. [01:18:50 PM]
Jama Fabry has left. [01:19:06 PM]
Erica Espino has left. [01:19:39 PM]
Jama Fabry > do y'all like whoady?
Daniel (48) Hruska has entered. [01:21:02 PM]
Ayca (37) Gokcen has entered. [01:21:09 PM]
Ayca (37) Gokcen > yes?

Appendix B (continued)

Ayca (37) Gokcen > very much so
Jama Fabry > i knew u would
Jama Fabry > u draw something
Ayca (37) Gokcen > you know my type.
Ayca (37) Gokcen > HOW?
Ayca (37) Gokcen > oh geez i'm dumb
Ayca (37) Gokcen > nevermind
Jama Fabry > butthead
Ayca (37) Gokcen > haha
Ayca (37) Gokcen > ERASE IT ALL
Megan Gaughan has entered. [01:22:41 PM]
Jama Fabry > fine!
Ayca (37) Gokcen > there
Ayca (37) Gokcen > that was Jama and that "dude"
Megan Gaughan > i thought we could go home, sorry guys
Jama Fabry > hmmmm, you're so abstract!
Jama Fabry > hehe
Ayca (37) Gokcen > i know
Ayca (37) Gokcen > i could make it so much better if grrrrrrrrrrrrrrrrrrrrrrrrrr
Ayca (37) Gokcen > NOOOOOOOOOOOOOO
Daniel (48) Hruska > whats happening to my sun
Ayca (37) Gokcen > i added the "n"
Jama Fabry > i erased it!!
Ayca (37) Gokcen > ooooooooooo talented
Daniel (48) Hruska > where r u jama
Jama Fabry > how do i get rid of that stuff in the background
Ayca (37) Gokcen > jama's three rows in front of you
Ayca (37) Gokcen > she's HOT
Ayca (37) Gokcen > short brown hair
Jama Fabry > in da front row
Ayca (37) Gokcen > yes
Jama Fabry > thanks baby
Ayca (37) Gokcen > farthest one on the left
Ayca (37) Gokcen > NO PROBLEM
Ayca (37) Gokcen > what are YOUUUUUUUUUUU doing tonight?
Jama Fabry > how u doin?
Jama Fabry > u
Jama Fabry > hehehe
Ayca (37) Gokcen > stayin at my sisters
Ayca (37) Gokcen > w/ my doggie
Ayca (37) Gokcen > sister is goin to a concert
Jama Fabry > awwwww
Jama Fabry > dont tell me- NSYNC right
Jama Fabry > bye, bye, bye
Ayca (37) Gokcen > hell no
Ayca (37) Gokcen > she's not in to that
Ayca (37) Gokcen > she's 24 too
Jama Fabry > sure
Ayca (37) Gokcen > nsync is in town?
Ayca (37) Gokcen > hehe
Jama Fabry has left. [01:26:36 PM]
Ayca (37) Gokcen > i love you all
Ayca (37) Gokcen > this is cheesy.

Appendix B (continued)

Ayca (37) Gokcen > i love you all
Ayca (37) Gokcen has left. [01:29:34 PM]
Daniel (48) Hruska has left. [01:30:42 PM]



Appendix B (continued)

Browse Classroom Archives

Archive for W2 on Apr 3, 2002

Gregory Grier has entered. [09:58:21 AM]
Stephanie (27) Diliberto has entered. [09:58:30 AM]
Stephanie (27) Diliberto > hi
Gregory Grier > hey
Stephanie (27) Diliberto > ok so we have to rank these again
Gregory Grier > yep
Stephanie (27) Diliberto > what should be 1
Stephanie (27) Diliberto > i say H
Gregory Grier > where is everyone else at
Archana Patel has entered. [10:01:53 AM]
Stephanie (27) Diliberto > i don' know
Bogdan Ortega-Lempicki has entered. [10:02:16 AM]
Archana Patel > i think that 1 should be the one where you get paid
John Warren has entered. [10:02:26 AM]
Stephanie (27) Diliberto > which one
Archana Patel > hold on im trying to find it
Stephanie (27) Diliberto > anyone else have an opinion
Archana Patel > how about c
Gregory Grier > I think that E should be # 10
Stephanie (27) Diliberto > i agree
Gregory Grier > does anyone object, and why
John Warren has left. [10:05:49 AM]
Stephanie (27) Diliberto > i think J should be 9
Archana Patel > i agree with that one
Bogdan Ortega-Lempicki > which one should be 1 again
Bogdan Ortega-Lempicki > I think H should be
Stephanie (27) Diliberto > i agree with H for 1
Stephanie (27) Diliberto > anyone else?
Archana Patel > i think either c or h it done matter
Archana Patel > dont
Gregory Grier > I'll agree with both of your choices, but what about F
Archana Patel > i think
Bogdan Ortega-Lempicki > F is interesting but I dont exactly know what they mean about withholding info for the patients best interest
Archana Patel > F should be 2 or 3 because they are withholding infor
Stephanie (27) Diliberto > so maybe H should be 1
Stephanie (27) Diliberto > C #2
Stephanie (27) Diliberto > and F #3
Archana Patel > i agree
Archana Patel > and 10 is E right
Gregory Grier > yes
Gregory Grier > I agree
Stephanie (27) Diliberto > A #4?
Archana Patel > i agree with #4 also
Bogdan Ortega-Lempicki > that is good
Gregory Grier > i agree
Archana Patel > B#5?
Stephanie (27) Diliberto > ok

Appendix B (continued)

Stephanie (27) Diliberto > G #6
Gregory Grier > yes
Archana Patel > i thought that G should be 8 because they are involving childern
Archana Patel > i mean why involve them at all
Stephanie (27) Diliberto > what do you think for 6
Bogdan Ortega-Lempicki > well these questions are tricky
Archana Patel > how about D#6
Gregory Grier > I said H for 6, or did we pick H already
Bogdan Ortega-Lempicki > yup
Stephanie (27) Diliberto > we used H
Archana Patel > i thought H was #1
Bogdan Ortega-Lempicki > it was
Archana Patel > okie
Stephanie (27) Diliberto > i think I should be before D
Gregory Grier > I agree
Archana Patel > agree also
Stephanie (27) Diliberto > so should I be 6?
Archana Patel > so;I#6 and D#7?
Bogdan Ortega-Lempicki > sorry about the line but i want to see who is on my team
Stephanie (27) Diliberto > G #8?
Gregory Grier > Nice drawing
Bogdan Ortega-Lempicki > a work of art
Archana Patel > yeah so we got 1-8 right?
Gregory Grier > I don't know
Bogdan Ortega-Lempicki > ok someone write our results because I am confused
Archana Patel > i will do it
Stephanie (27) Diliberto > i have A-J : 4,5,2,7,10,3,8,1,6,9
Stephanie (27) Diliberto > so we're done right
Archana Patel > yeap.. thats what i got
Archana Patel > yeap
Bogdan Ortega-Lempicki > does everyone agree with stephanie
Archana Patel > so should i go ahead and submit it or is someone else doing it
Archana Patel > yes i do
Stephanie (27) Diliberto > go ahead
Archana Patel > okie dokie
Archana Patel > alright its done
Bogdan Ortega-Lempicki > perfect
Gregory Grier has left. [10:21:43 AM]
Bogdan Ortega-Lempicki has left. [10:21:43 AM]
Archana Patel > beybeyey
Stephanie (27) Diliberto has left. [10:21:45 AM]
Archana Patel has left. [10:21:47 AM]

Bogdan Ortega-Lempicki has entered. [10:21:54 AM]
Bogdan Ortega-Lempicki has left. [10:21:56 AM]

Appendix B (continued)

Browse Classroom Archives

Archive for R10 on Apr 4, 2002

Anna (62) Koch has entered. [04:49:33 PM]
Edlira (43) Haxhagaj has entered. [04:49:37 PM]
Anas Ihmoud has entered. [04:49:41 PM]
Olivia Jedlicki has entered. [04:49:42 PM]
Samreen Khan has entered. [04:49:48 PM]
Anas Ihmoud > ANAS IHMOUD
Olivia Jedlicki > hi
Anna (62) Koch > hi
Anas Ihmoud > HOWDY
Edlira (43) Haxhagaj browsed to http:// .com/
Edlira (43) Haxhagaj > hello
Samreen Khan > who is keeping track of what he said?
Edlira (43) Haxhagaj > not me?
Anas Ihmoud > WHAT R WE DOING?
Anna (62) Koch > i'm confused... what are we doing?
Samreen Khan > don't ask me
Anna (62) Koch > are we just talking about what our responses were?
Olivia Jedlicki > we need to decide on an order of that stuff
Anas Ihmoud > HIS HEAD IS REALLY SHINEY
Anna (62) Koch > hehe, yeah it is
Anna (62) Koch > i wonder if he's going to read that
Samreen Khan > wait he is going to read the screen
Anas Ihmoud > OOPS
Anna (62) Koch > okay, did you guys write down the order of what you said?
Samreen Khan > forget it
Olivia Jedlicki > maybe someone should jusr enter what they put and then we don't have to talk about it
Samreen Khan > 1-2-8-10-5-9-6-4-7-3
Olivia Jedlicki > ok then
Edlira (43) Haxhagaj > I think G should be #1
Samreen Khan > ok, yo uwon that
Anas Ihmoud > 3-4-5-9-10-8-7-1-2-5
Anna (62) Koch > why?
Edlira (43) Haxhagaj > next???
Edlira (43) Haxhagaj browsed to http:// .com/
Edlira (43) Haxhagaj > becuse it said that children would be subject to testing
Anas Ihmoud has entered. [04:54:46 PM]
Samreen Khan > then that should be 10--least acceptable
Samreen Khan > switch my 10 and 3
Edlira (43) Haxhagaj browsed to http:// .com/
Anna (62) Koch > i don't think it's the best or worst thing on there... i don't think it should be #1, though
Edlira (43) Haxhagaj > oh, i took it the other way,
Edlira (43) Haxhagaj > ok fine
Anas Ihmoud > E=10
Anna (62) Koch > i thought number I was a good one
Samreen Khan > 10 should be J b/c why give out names w/o consent?
Samreen Khan > I didn't really read it in great detail
Anas Ihmoud has entered. [04:56:37 PM]
Anna (62) Koch > so what's our #1?

Appendix B (continued)

Edlira (43) Haxhagaj > yeah , but you don't really want kids to be subject of experimenting...
Anas Ihmoud > in E, they didnt even know they were subjects
Anas Ihmoud has left. [04:57:36 PM]
Anna (62) Koch > I thought E was #10 because they didn't know what was going on and there was risk involved
Anas Ihmoud has entered. [04:57:43 PM]
Edlira (43) Haxhagaj > ok, didn't read carfully
Edlira (43) Haxhagaj > you win
Samreen Khan > D is important
Anas Ihmoud has entered. [04:58:01 PM]
Anna (62) Koch > do you think D is good or bad?
Anna (62) Koch > I put D as 2
Olivia Jedlicki > what did d say
Samreen Khan > it is important for research so either 2 or 1
Anna (62) Koch > D. Withholding from subjects information about the design or purpose of the study when such information might influence their behavior or responses (and distort the measures or research results).
Anas Ihmoud has left. [04:58:45 PM]
Anas Ihmoud has left. [04:58:51 PM]
Anas Ihmoud has left. [04:58:54 PM]
Anas Ihmoud > oops
Anna (62) Koch > does everyone agree that D is 1?
Anas Ihmoud > Can u guys read me?
Olivia Jedlicki > yes
Edlira (43) Haxhagaj > ok, it's setled, D is our # 1
Samreen Khan > d is 1 and G is 10?
Anna (62) Koch > woohoo, onto #2
Olivia Jedlicki > yup
Edlira (43) Haxhagaj > what's our #2
Anna (62) Koch > I think I is pretty permissible
Anna (62) Koch > I. A researcher's giving a data set he or she gathered to a second researcher when the data do not include anything that reveals the identity of subjects
Anas Ihmoud has entered. [05:00:18 PM]
Olivia Jedlicki > 2 sounds ok for that one
Samreen Khan > so what is 2?
Edlira (43) Haxhagaj > that's my #2 also
Samreen Khan > I am marking it on the screen
Olivia Jedlicki > i is 2 right?
Anna (62) Koch > yes
Edlira (43) Haxhagaj browsed to
Anna (62) Koch > onto number 3?
Samreen Khan > ok, done
Anna (62) Koch > what do you have for 3?
Olivia Jedlicki > a
Samreen Khan > f is screwed up, it should be important
Samreen Khan > or that too
Olivia Jedlicki > so which one
Anas Ihmoud > samree, put your hand up
Anas Ihmoud > samreen
Samreen Khan > A
Anna (62) Koch > does everyone agree on A?
Olivia Jedlicki > yup
Samreen Khan > why?

Appendix B (continued)

Edlira (43) Haxhagaj > yep
Anna (62) Koch > okay, number 4
Edlira (43) Haxhagaj > lets go to #4
Samreen Khan > Ihave a purple coat
Samreen Khan > H for 4
Anna (62) Koch > I agree
Olivia Jedlicki > same
Anas Ihmoud > I am wearing nothing
Edlira (43) Haxhagaj > close
Samreen Khan > H is 4?
Olivia Jedlicki > yes
Anas Ihmoud > yes
Samreen Khan > done
Edlira (43) Haxhagaj > cool
Edlira (43) Haxhagaj > 5
Edlira (43) Haxhagaj > ?
Olivia Jedlicki > b
Anas Ihmoud > j?
Samreen Khan > E
Anna (62) Koch > b
Samreen Khan > 2 against 1= B for 5
Anna (62) Koch > I thought E was kind of bad...
Anna (62) Koch > okay
Olivia Jedlicki > b for 5 then
Edlira (43) Haxhagaj > ok
Olivia Jedlicki > 6?
Anna (62) Koch > yeah
Samreen Khan > 9 is E then?
Olivia Jedlicki > yes
Anas Ihmoud > 9=e
Anna (62) Koch > what are we putting for 10?
Olivia Jedlicki > g
Samreen Khan > 10 is G already
Anas Ihmoud > 10=g
Samreen Khan > wait 9 is F and 8 is E
Edlira (43) Haxhagaj > 6, 7, 8?
Anna (62) Koch > E sounds worse than G
Samreen Khan > true
Edlira (43) Haxhagaj > f is 9
Samreen Khan > switch E and G
Samreen Khan > yes?
Olivia Jedlicki > sure
Anna (62) Koch > okay... so 9 is E and 10 is G
Anna (62) Koch > 8 is F?
Anas Ihmoud > e is worse than g/ if g had risk, then it would be different
Anna (62) Koch > I agree
Anas Ihmoud > me too
Edlira (43) Haxhagaj > me too
Samreen Khan > E is 10
Anna (62) Koch > okay, so 6 and 7
Anas Ihmoud > anna, put your hand up
Samreen Khan > C and J are left
Anna (62) Koch > okay which one goes where?

Anna (62) Koch > c sounds better than J
Samreen Khan > ok C is 6?
Anas Ihmoud > whats f and h?
Olivia Jedlicki > c=6
Anna (62) Koch > f is 8 and j is 7
Anas Ihmoud > thanks
Anna (62) Koch > h is 4
Samreen Khan > F is 9
Olivia Jedlicki > what is the list
Edlira (43) Haxhagaj > ?????????????
Edlira (43) Haxhagaj > now i'm confused
Olivia Jedlicki > a through j
Samreen Khan > 3-5-6-1-10-9-8-4-2-7
Olivia Jedlicki > ok
Samreen Khan > yes?
Olivia Jedlicki > yes
Anna (62) Koch > Samreen, are you going to type this in?
Samreen Khan > where is that page?
Samreen Khan > yes, I will
Anna (62) Koch > okay, thanks
Olivia Jedlicki > ok
Anas Ihmoud > whos the scorer?
Anas Ihmoud > ok
Olivia Jedlicki has left. [05:12:58 PM]
Anas Ihmoud has entered. [05:13:14 PM]
Olivia Jedlicki has entered. [05:13:55 PM]
Olivia Jedlicki has left. [05:14:24 PM]
Edlira (43) Haxhagaj > now what?
Anas Ihmoud > ?
Samreen Khan > I put our info. in
Anas Ihmoud > thanks
Edlira (43) Haxhagaj > cool
Anas Ihmoud > we can leave the chat room now
Anas Ihmoud has left. [05:19:56 PM]
Samreen Khan has left. [05:21:03 PM]
Edlira (43) Haxhagaj has left. [05:24:50 PM]
Anna (62) Koch has left. [05:39:08 PM]
Anas Ihmoud has left. [05:45:31 PM]
Anas Ihmoud has left. [05:45:31 PM]

Appendix C

UNIVERSITY OF ILLINOIS
AT CHICAGO

Office for the Protection of Research Subjects (OPRS) (MC 672)
Office of the Vice Chancellor for Research
203 Administrative Office Building
1737 West Polk Street
Chicago, Illinois 60612-7342

Exemption Determination

February 13, 2002

John Warren, PhD Candidate
Graduate Student, Department of Information and Decision Sciences
601 S. Morgan St. M/C 294
Ph: 312-355-1263

Faculty Sponsor:
Richard Potter, PhD
601 S. Morgan St., M/C 294
Ph: 312-996-5360
Fax: 312-413-0385

RE: Research Protocol #2001-0737
"A Comparison of the Effects of Extraversion and Expertise on Virtual Team and Face-to-Face Team Interaction and Performance"

Dear Mr. Warren:

Members of Institutional Review Board (IRB) #2 initially reviewed your research protocol on November 15, 2001 and requested modifications. Your January 29, 2002 response was reviewed on February 5, 2002 and was found to be acceptable. It was determined that it meets the criteria for exemption as defined in the U. S. Department of Health and Human Services Regulations for the Protection of Human Subjects (45 CFR 46). You may now begin your research.

The specific exemption category under 45 CFR 46.101(b) is:

> (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Appendix C (continued)

You are reminded that investigators whose research involving human subjects is determined to be exempt from the federal regulations for the protection of human subjects still have responsibilities for the ethical conduct of the research under state law and UIC policy. Please be aware of the following UIC policies and responsibilities for investigators:

1. Amendments: You are responsible for reporting any amendments to your research protocol that may affect the determination of the exemption and may result in your research no longer being eligible for the exemption that has been granted.

2. Record Keeping: You are responsible for maintaining a copy of all questionnaires, survey instruments, interview questions and/or data collection instruments associated with this research protocol in your research files in the event future verification is necessary.

3. Final Report: When you have completed work on your research protocol, you should submit a final report to the Office for Protection of Research Subjects (OPRS).

4. Information for Human Subjects: UIC Policy requires investigators to provide information about the research protocol to subjects and obtain their permission prior to participating in the research. The information about the research protocol should be presented in the form of written description given to subjects or orally from a written script. When appropriate, the following information must be provided to all research subjects participating in exempt studies:

   a. That the researchers are affiliated with UIC and/or WSVA.
   b. The purpose of the research.
   c. The extent of the subject's involvement and an explanation of the procedures to be followed.
   d. If the information being collected will be used for any purposes other than the proposed research.
   e. A description of the provisions that have been made to protect the privacy of subjects and the confidentiality of the research data.
   f. Description of any risks.
   g. Description of anticipated benefit.
   h. That their participation is voluntary and that the subject can refuse to participate or can stop at any time.
   i. That the researcher is available to answer any questions the subject may have and provide the name and phone number of the investigator(s).
   j. That the UIC IRB/OPRS or WSVA patient advocate office is available regarding questions pertaining to subjects rights. Include phone numbers.

Please be sure to:

→ Use your research protocol number (2001-0737) on any documents or correspondence with the IRB concerning your research protocol.

Appendix C (continued)

We wish you the best as you conduct your research. If you have any questions or need further help, please contact me at 312-355-2908 or the OPRS staff at 312-996-1711. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Charles Hoehne, B.S.
Assistant Director, IRB #2
Office for the Protection of Research Subjects

cc: John McDonald, Ph.D., Associate Dean, MBA, CBA M/C 075

jhl

VITA

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PRIMARY TEACHING/RESEARCH INTEREST

1. Management of IS

SPECIFIC RESEARCH INTERESTS

1. Virtual Team Interaction and Performance
2. IT Adoption and Implementation
3. Online Education

SPECIFIC TEACHING INTERESTS

1. Database Design and Management
2. System Analysis and Design
3. Programming Languages

EDUCATION

Doctor of Philosophy (Business Administration – MIS), expected Fall 2002
The University of Illinois at Chicago, Chicago, IL
Dissertation Title: A Comparison of the Effects of Extraversion and Expertise on Virtual Team and Face-to-Face Team Interaction and Performance
Dissertation Advisor: Dr. Richard E. Potter

Master of Business Administration
Governors State University, University Park, IL, 1994

Business Student, MBA Program
University of Chicago, Chicago, IL, 1991

Bachelor of Arts (Anthropology/Sociology)
Knox College, Galesburg, IL, 1976

WORK EXPERIENCE

2001-present, Teaching Associate, Department of Information and Decision Sciences, The University of Illinois at Chicago

2000 – 2001, Teaching Assistant, Department of Information and Decision Sciences, The University of Illinois at Chicago

1994 – 1998, Owner: SIROD, Inc., Frankfort, IL

- Provided computer applications training, instructional design of training materials, Microsoft Access database design and implementation, and software configuration to clients.
- Worked as a vendor to South Suburban College teaching various software application programs on behalf of the college to their business clients.

1989 – 1994, President, J & D Communications, Inc., Frankfort, IL

- Organized and operated this computerized private pay telephone company.
- Successfully secured vendor capital financing.
- Sold company for a profit in 1994.

1993 – 2001, Adjunct Faculty, Olivet Nazarene University, Kankakee, IL

1989 – 1991, Division Trainer/Sales Representative, Bristol-Myers Squibb, Inc., Princeton, NJ

1986 – 1989, Marketing Representative, Ntron Electronics, San Rafael, CA

1982 – 1986, Professional Sales Representative, DuPont Pharmaceuticals, Wilmington, DE

1979 – 1982, Professional Sales Representative, Pfizer Laboratories, Inc., New York, New York

COURSES TAUGHT

At the University of Illinois at Chicago:

IDS 410, Database Technology, 3 Semesters
IDS 100, Introduction to Management Information Systems (Lab sections), 5 Semesters
[*Received Dean's Commendation for Excellence in Teaching*]

At Olivet Nazarene University:

CIS 105, Introduction to Online Computing
BSNS 625, Managerial Statistics
BSNS 610, Computer Applications in Business

BSNS 629, Managerial Economics
BSNS 129, Foundations of Economics
BSNS 132, Spreadsheets
BSNS 131, Word Processing

PUBLICATIONS

"Expertise, Extraversion and Group Interaction as Task and Contextual Performance Indicators in Virtual Teams," with Pierre Balthazard and Richard Potter, *Database*, currently targeted for vol. 32, no. 4, December 2002, conditionally accepted (with revisions).

"Do Investments in Telecommunications Infrastructure Improve Teledensity in Developing Countries?" with Victor Mbarika, Peter Meso and Phillip Musa, "*Journal of Information Systems in Developing Countries*, conditionally accepted (with revisions).

CONFERENCE PRESENTATIONS

1. "The Effects of Expertise and Extraversion on Virtual Team Interaction and Performance," with Richard Potter and Pierre Balthazard, Hawaii International Conference on System Sciences, 2002.

2. " Teledensity Technological Growth Strategy for Africa's LDCs: 'Viagra' Development Strategy or Sustainable Development Strategy? —The African Telecommunications Stakeholders Speak," with Victor W. Mbarika, and Patrick R. McMullen, Hawaii International Conference on System Sciences, 2001.

CONFERENCE PARTICIPATION (Attendance)

1. Hawaii International Conference on Systems Sciences, 2002.
2. Americas Conference on Information Systems, 1998 – 2001.
3. PhD Project, Information Systems Doctoral Students Association, 1998 – 2001.
4. Illinois Consortium for Educational Opportunity Program, 2000 – 2001.
5. Committee on Institutional Cooperation, 1998.

SPECIAL AWARDS and HONORS

1. Dean's Commendation for Excellence in Teaching, College of Business Administration, University of Illinois at Chicago.
2. AMCIS Doctoral Consortium, 2001.
3. KPMG Ph.D. Project Fellowship, 1998 – 2002.
5. Illinois Consortium for Educational Opportunity Program Fellowship, 2000 – 2002.
6. Committee on Institutional Cooperation Fellowship, 1998 – 2000.
7. Who's Who in American Colleges and Universities, 1993.

LEADERSHIP AND SERVICE ACTIVITIES

Reviewer, Hawaii International Conference on System Sciences, 2003.
Reviewer, International Conference on Information Systems, 2002.
Reviewer, Hawaii International Conference on System Sciences, 2002.
Participant, Study Abroad Research Program, London, England, Great Cities Research Program, Summer, 1999.
Member, Association for Information Systems.
Member, Association for Information Technology Professionals.
Member, Ph.D. Project Information Systems Doctoral Students Association, 1998 – present.

COMPUTER SKILLS

Web Courseware: Blackboard, WebCT, FirstClass, Groove.
Databases: Microsoft Access, db2, Oracle8i.
Software/Development Tools: SPSS, C++, Visual Basic, VBA, HTML, Active Server Pages, Microsoft Office Professional and various other application programs.