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Can Information Systems Foster Emotional Intelligence? A Design Theory-Based Approach

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ABSTRACT

Researchers in Information Systems (IS) have conducted extensive research into various kinds of collaboration systems over the last twenty-five years. A parallel stream of inquiry in psychology and management has developed research in organizational Emotional Intelligence, which contributes to the effectiveness of group interactions by increasing cooperation and reducing conflict. Collaboration systems present a special opportunity to introduce soft management functions such as Emotional Intelligence because they are designed as an intelligent channel of interaction between group members. This research used an Information Systems Design Theory approach to guide the integration of Emotional Intelligence functions into collaboration systems. Two artifact systems were constructed based on these designs, and the systems were utilized and compared in a lab exercise that required group interaction. The findings of the research provide validation of the design approach, evaluation of emotional communication effects, and implications for new dimensions of emotion-based subtext and advisory capabilities that enhance Emotional Intelligence.

INTRODUCTION

During the last two decades, IS and CS researchers developed extensive research in the theory and design of collaboration tools, which span a spectrum from e-mail to synchronous group decision environments (Power, 2003), and from wikis to virtual environments such as Second Life. At the same time, behavioral and management researchers developed management concepts known collectively as Emotional Intelligence. Emotional intelligence (EI) can be described as "the ability to monitor one's own and others' feelings, to discriminate among them, and to use that information to guide one's thinking and actions" (Abraham, 1999). EI abilities and skills can be learned, and are claimed to result in improved performance in work environments (Cherniss, 2003). Although there is some controversy about the validity of research into EI (Landy, 2005), there is considerable support for the idea that EI can improve the effectiveness of dyadic and group interactions by increasing cooperation and reducing conflict (see, for example,

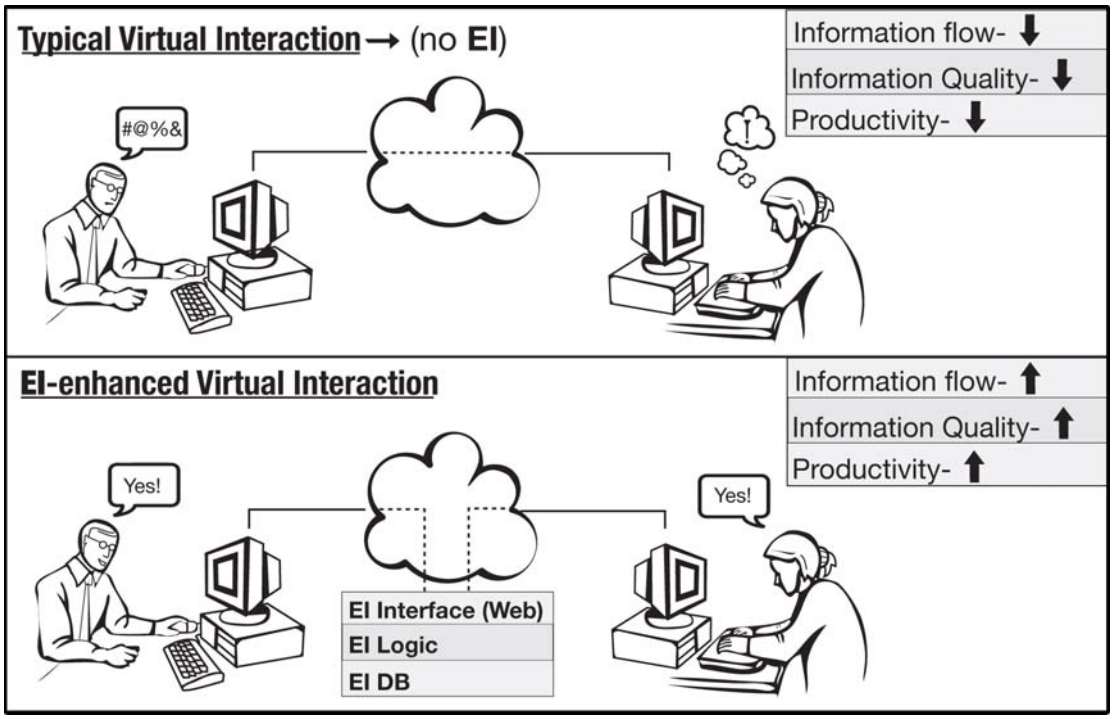
Cherniss, 2003; Cherniss et al., 2006; Chrusciel, 2006; Jordan et al., 2002; Salovey & Mayer, 1990).

Efforts to develop and maintain emotional intelligence have been largely the province of training programs, many of which have been tried in management curricula at universities and large corporations. Typical collaboration applications are not designed to include EI methods.[1] Yet, a fundamental purpose of collaboration applications is to facilitate information flow and group interaction, two factors shown to improve with EI training and application. Collaboration systems are a special opportunity to introduce soft management functions because they are a primary, and sometimes only, channel of interaction between group members in organizations. In addition, online interactions lack many of the cues that can facilitate emotionally intelligent interactions.

Can collaboration systems effectively incorporate Emotional Intelligence techniques? This research explores this question using a design theory-based approach based on extension of prior theory in collaboration systems combined with theoretical elements from IS and other fields in new ways.

The design of information systems in general, and collaboration application in particular, create functions that best operate in a context of rational and uninhibited information flow by users, and commonly-available systems do not address the non-rational or emotional motives and behaviors commonly seen in work environments. New approaches to design theory are needed to understand and develop systems that include EI as an integral part of the collaboration application.

Figure 1: Typical versus EI-enhanced virtual interactions.



To approach this problem, this study drew theoretical guidance from research in collaboration systems, organizational conflict, and Emotional Intelligence, with secondary support from research in expert systems, virtual organization, and Social Presence Theory. The research used an Information Systems Design Theory (ISDT) framework (Walls et al. 1992) to combine theory with models, methods, and instantiation of the application, and to serve as an ongoing framework for the development of applications of this type. A prototype application was developed and tested to help evaluate these objectives.

The next section discusses the basis of the design. This is followed by a summary of an evaluation of this design and its results, along with a discussion of its implications.

INFORMATION SYSTEMS DESIGN THEORY AS A FRAMEWORK FOR DESIGNING EI-ENHANCED SYSTEMS

Information Systems Design Theory (ISDT) was used to structure the design product. ISDT and related terms such as Improvement Research, Design Research and Design Science (Markus et al., 2002; Walls et al., 1992) describe an approach to IS research that "seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts" such as new kinds of IS applications (Hevner et al., 2004). In IS design research, increased understanding of the problem area is expected to result from the activities of building the artifact itself (Rossi & Sein, 2003; Vaishnavi & Kuechler, 2007). The artifact becomes an investigational tool, and the researcher applies circumscriptive methods to develop the knowledge base and generate "understanding that (can) only be gained from the specific act of construction" using the "artifact as experimental apparatus" (Vaishnavi & Kuechler, 2004). The license to use an artifact as an exploratory, experimental tool is useful in areas that have limited or no research precedent, such as in our effort to introduce EI to IS. Functional instantiations of EI in test systems is a practical way to begin integrating EI into an information system such as a collaboration application.

ISDT AS A DESIGN METHODOLOGY

Walls et al. (1992) describe design theories in general, and Information Systems Design Theories in particular, as prescriptive, rather than explanatory or normative. Goals are intrinsic to design theories, but are extrinsic elements in other classes of theory. In addition, ISDTs are composed from kernel, or contributing, theories from natural and social sciences, as well as mathematics. ISDTs provide a unique way to integrate highly diverse theories into a design structure of any scale in a verifiable and traceable way.

Information System Design Theories have four components that cover the design product:

- Meta-requirements: Describes a class of goals to which a theory applies
- Kernel theories: Theories from natural and social sciences governing design requirements
- Meta-design: Describes a class of artifacts hypothesized to meet the meta-requirements
- Testable design product hypotheses: Used to test whether the meta-design satisfies the meta-requirements

Figure 2: The Information Systems Design Theory as defined by Walls et al. (1992).

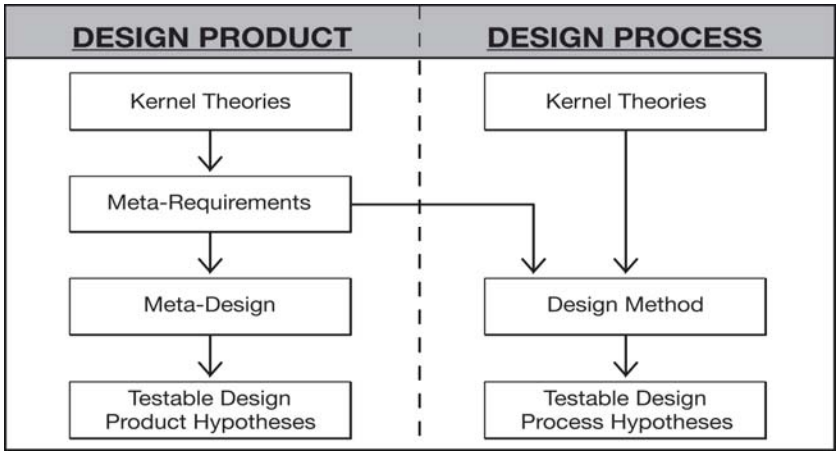
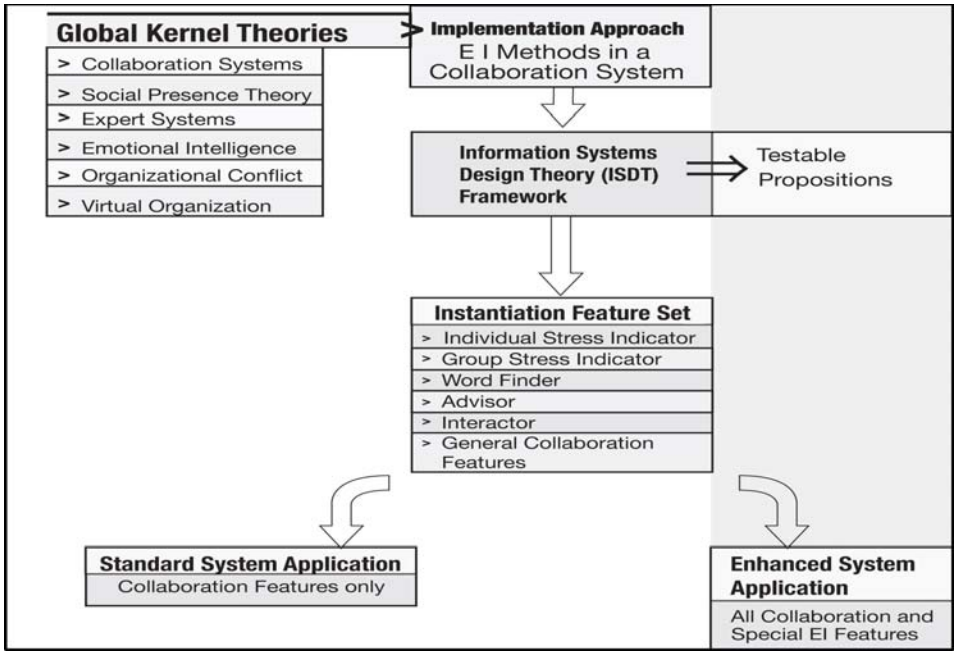


Figure 2 shows the ISDT design approach as defined by Walls, et al., which includes a dual focus on product and process. Although both paths were employed in this study, only the design product path is discussed here.

FROM THEORY TO ARTIFACT

The ISDT-based product design process resulted in two systems that were developed to allow comparison of EI and non-EI implementations: A Standard System that contained only standard collaboration application functions, and an Enhanced System that contained collaboration application functions plus special EI features. Figure 3 presents an overview of the relationship between kernel theories, implementation, and designed artifacts in this study.

Figure 3: Conceptual Overview of Movement from Theory to Artifact.



GLOBAL KERNEL THEORIES THAT CONTRIBUTED TO DESIGN

The first set of theories is focused on organizational elements, and this includes theories and concepts from Emotional Intelligence, Organizational Conflict, and Virtual Organization. The second stream is focused on research related to information systems for group support, and these include research from Collaboration systems, Social Presence Theory, and Expert Systems. These are briefly reviewed below.

ORGANIZATIONAL THEORY AREAS

Emotional Intelligence

Although a number of definitions of exist, organizational Emotional Intelligence can be described as a set of competencies in the areas of self-awareness, social awareness, and the skills for managing relationships based on such awareness (Cherniss & Goleman, 2001; Goleman, 2000). Sufficient research showing a positive relationship between EI and improved managerial effectiveness has justified the addition of EI training into the management programs of several business schools (Cherniss, 2003; Cherniss & Goleman, 2001; Shinn, 2003). The concepts have been applied in many contexts. Technology managers, for example are encouraged to "develop your emotional intelligence, particularly social awareness or empathy, if you are to be a CIO leader (Broadbent & Kitzis, 2005)."

Specific EI skills have four categories: Self-awareness (Including self-observation, self-assessment, and recognizing a feeling, such as resistance to an individual or a group, as it happens); Social Awareness: Including empathy and organizational awareness; Self-Management: Including self-control, initiative and optimism; Relationship Management: Including conflict management, teamwork and collaboration (Chiarrochi & Godsell, 2005; Salovey & Mayer, 1990; Shinn, 2003).

Reinforcement of EI is essential to its effectiveness, and collaboration tools may be an ideal platform for reinforcement of EI on an ongoing basis in organizations. Training and reinforcement of EI though collaboration systems may increase productivity. Some research suggests that while simple introduction of an information technology such as groupware may have limited effect on productivity, information technologies can produce real results as "an essential component of a broader system of organizational changes (that) does increase productivity" (Brynjolfsson, 1993). Others suggest that IT can support productivity through important but difficult-to-measure factors such as trust-building and knowledge sharing (Brown & McFarlan, 2003). Trust-building, open knowledge-sharing, and EI-supported organizational change are all potential benefits of an EI-enhanced collaboration application.

Organizational Conflict

Research on organizational conflict offers many concepts that can assist the design of an EI-enhanced collaboration application. Conflict is a wide-ranging and multifaceted phenomenon (Chen et al., 2004) that affects most organizations, and technology management environments may be particularly vulnerable to conflict (Barki & Hartwick, 2001). Organizational conflict is

thought to stem from the growth of opposing interests between individuals or groups, along with the belief or expectation that the opposing party will attempt to assert its interests over those of the primary party (Rahim, 1992). These processes are familiar to organizational participants at all levels.

The specific types of conflict that are seen in organizational teams include relationship-based conflict, task-based conflict, and process-based conflict (Jehn & Mannix, 2001). Relationship conflict, which is comprised of "interpersonal incompatibilities" leading to feelings of tension and friction, can be found in most, if not all, team environments. Task conflict arises from differing orientations to a group task, and process conflict that arises from how task assignments and responsibilities are approached by individuals and subgroups. Conflict develops in the context of processes of team coordination requirements, such as task interdependencies and schedule changes (Hoegl et al., 2004).

Conflict within teams is not always negative. Examples of potential positive outcomes of group conflict include the identification of positive alternative courses of action for a group, the identification and clarification of individual positions with respect to team issues, and increased creativity in pursuit of solutions to team challenges (Rahim, 1992). In this sense, conflict may sometimes be beneficial in that it reveals hidden problematic issues (Baron, 1990).

On the other hand, conflict is often harmful to group performance (see, for example, Jehn & Mannix, 2001), and some researchers have found that conflict is almost always damaging (Barki & Hartwick, 2001). Dysfunctional outcomes include job stress, burnout, inhibited communication, distrust, resistance to change, and decreased commitment, resulting in teams that are breeding grounds for conflict (Rahim, 1992).

Geographically distributed teams, such as those who interact through collaboration application as virtual teams, may be particularly vulnerable to the development of conflict, and both task-related conflict and relationship-based conflict modes have been identified in distributed groups (Hinds & Bailey, 2003). Such groups are increasingly reliant on technology as a mediator, and the impersonal character of technology-mediated interactions tends to create a more conflict-prone environment (Straus & McGrath, 1994).

Virtual Organization

Implicit in the use of collaboration application is the assumption that team members may often be geographically dispersed and virtually organized. Co-workers in virtual organizations interact using a combination of telecommunications and information technologies to accomplish organizational tasks (Townsend et al., 1998). Improvements in connectivity communication technologies increasingly offer workers the option to work from a variety of physical locations (Gray & Markus, 1996), resulting in virtual teams whose members may never meet face-to-face, yet who work on many kinds of activities (for example, Lipnack & Stamps, 2000; Majchrzak et al., 2000). An important aspect of virtual organizations is their ability to modify group roles and relationships, and much of this is made possible by technologies such as groupware (DeSanctis & Monge, 1999). Traditional organizational and geographical boundaries may disappear in the face of increasingly competent information technologies such as collaboration application.

The impact of this trend on organizations may require significant changes in management techniques for many firms. For example, central to both virtual organization and EI is the need to address factors that affect trust between team members in a virtual environment. Virtual organizations and the relationships that form them cannot prosper without trust (Paul & McDaniel, 2004; Sabherwal, 1999) and researchers have suggested the need for managerial actions to foster trust (Lippert & Swiercz, 2007) and communication among virtual team members (Grabowski & Roberts, 1999). The issues of trust-building are basic to the objectives of this research because of the possibility that an EI-enhanced collaboration application can favorably influence interpersonal and group trust among the participants. In addition, considerable dissatisfaction with the shortcomings of technologies of virtual organization has been seen among IS researchers and academics (Burkhard & Horan, 2006), which underscores the potential usefulness of an enhanced collaboration application as a tool for support of virtual organization.

COLLABORATION SYSTEMS THEORY AREAS

Collaboration Systems

Collaboration platforms provide a theoretical and practical foundation for any potential enhancement offered by EI. Information system applications for group support originally included decision support systems (DSS), group support systems (GSS), executive information systems (EIS), collaboration information systems (CIS) (Nunamaker et al., 2001; Power, 2003) and more recently wikis and virtual environments such as Second Life. These systems have benefited from over two decades of research and development and have been deployed and evaluated in a wide variety of organizational contexts. Users can take advantage of various mechanisms to communicate, share work information, and collaborate on group decision making tasks (Hung et al., 2008).

In spite of the important research and development support for collaboration systems, they have met with mixed experimental success and somewhat limited adoption (Gopal & Prasad, 2000; Nunamaker et al., 2001). The reason for these uncertain outcomes may be that early collaboration system designs were typically confined to pragmatic group communication and decision facilitation, including such functions as ranking and voting, and they tended to focus on fairly narrow communication, data, documents, or decision models (Power, 2003). The utility of early commercial collaboration application applications is comparable to what might be accomplished by a co-located team equipped with whiteboards, note-taking devices, and spreadsheets, but with the benefits of greater efficiency and distributed, asynchronous communication.

Most collaboration systems appear to have assumed rational and uninhibited information flow by group participants, and they were not explicitly designed to address the non-rational or emotional motives and behaviors commonly seen in work environments. Reactions by users of these tools may be “difficult to capture using conventional (groupware) methodological assumptions” (Gopal & Prasad, 2000).

Some collaboration system researchers have called for an expansion of collaboration application scope to address non-rational elements that extend beyond basic efficiencies. One pioneering decision support system researcher argues that broadly defined, future group decision support tools should address "individual characteristics such as personality type, risk aversion, gender, background (Alter, 2003)" on collaboration processes in individuals and teams. Notably absent from collaboration application designs are functions specifically designed to assist groups in the management aspects of cooperation, group harmony, and open knowledge sharing, which are essential benefits of EI-enhanced group interactions.

Social Presence Theory

Social Presence Theory is relevant to the design of EI-enhanced groupware because it attempts to understand "the degree to which a person is perceived as 'real' in a (computer) mediated environment" (Gunawardena & Zittle, 1997). Diminished social presence resulting from information technology has been examined since at least the 1970s (Tu, 2002). A high degree of interpersonal social presence should facilitate EI, since EI is based in part on enhanced awareness of the counterpart in the interaction (Rourke, 2004), and simple EI-enhancing social context cues may improve collaboration in a dedicated application. Studies of communication volume and understanding have shown that both are diminished in computer-mediated communications because of the lack of social context cues provided in face-to-face interaction (DeSanctis & Monge, 1998). More challenging objectives for increasing social presence in collaboration application may include stimulating behavioral engagement (Biocca et al., 2001), and addressing possible gender-based differences in presence (Baskin & Henderson, 2005) as well as cultural differences (Nath & Murthy, 2004). Methods designed into a collaboration application that can enhance social presence can increase the potential of the collaboration application to facilitate EI.

Expert Systems

A collaboration application can provide intelligent advice to facilitate EI, and it this way it could function as a form of expert system, or "a computer program that is able to give some sort of reasoned guidance on a fairly tightly delineated problem" (Speigelhalter et al., 1993). Expert systems applications may include any of a variety of functions, including acquisition of data through goal-oriented questioning of the user, constructing inferences, and the ability to justify conclusions to the user (Gallant, 1988). Often such systems are based on rules or heuristics and are designed to provide "expert-level consultative advice in scientific . . . problem solving" (Clancey, 1981)

Following this approach, systems with EI can provide advisory functions that implement EI analysis in unique ways. Researchers have speculated that expert systems can contribute to groupware by helping to improve overall group synergy (Aiken et al., 1991). Such a system can be designed with expert functions that can derive themes from analysis of textual communication and provide specific advice to assist the user in implementing EI. A typical approach to applying expert technologies in such systems is to base the design on normative, predictive user models (Carroll & McKendree, 1987) that would recommend particular actions, such as communication patterns based on EI.

In practical terms, the reasoning in a collaboration application with EI can take the form of EI rule-based analysis and recommendation, which can "codify the problem-solving know-how of human experts" (Hayes-Roth, 1985, pg. 921). These can be designed as three-step processes that have the potential for application in a collaboration application environment: An alert, or flagging filter that identifies interactions that may be useful in an EI context; a rule-based analysis filter, that applies the EI-based analytical rules to the textual interactions in the system; and a result filter that classifies the results of the rule-based analysis according to the possible recommendations for the user (Anderson et al., 1995).

The six kernel theories relate to the organizational context and dynamics in which a collaboration application is used, as well as to increasing the effectiveness of technology-based interactions. Both categories of kernel theories underscore the need to begin design with the understanding of broader dynamics of team work, as well as the more specific dynamics of IT-mediated team interactions. The incorporation of these concepts is discussed, along with other design specifics, in the following discussion of the Design Framework for collaboration application with EI.

ISDT DESIGN PRODUCT ELEMENTS

The design product meta-requirements are the high-level goals addressed by the system of the type being designed. Next, the meta-design for the design product, or artifact, is introduced as the plan to enable the system to meet meta-requirements. The meta-design for the EI-enhanced collaboration application included databases and a content management system to store communications and EI functions, interfaces for individual and group interaction, and active scripts and interfaces for application of EI principles to discussion content.

ISDT calls for the use of testable design product propositions. The general proposition for this study is that inclusion of EI into collaboration application tools will improve the product's ability to meet the meta-requirements in terms of EI functionality. Concepts from the kernel theories were integrated into fifteen specific propositions about how to include EI in the design (please see Appendices A and B). The core of this design scheme is found in the meta-requirements, which are:

1. Ability to collect, store, modify, represent and distribute content of group communications
2. Ability to assist participants in direct application of EI principles (self-awareness, social awareness, self-management, relationship management) in text-based group discussion, in order to help with:
    a. Awareness of emotional context of text-based interactions
    b. Interpersonal and group conflict resolution
    c. Adaptation to interaction stressors
    d. Improvement of information flow
    e. Constructive communication

COMPLETING THE DESIGN SEQUENCE: SPECIFICATION OF DESIGN CLASSES AND DESIGN INSTANCES BASED ON PROPOSITIONS

Based on the kernel theories and propositions, six design classes were defined, and a total of twenty-one object instances were defined and constructed as part of a testable artifact. The Design Classes and their instantiations were the following:

- The Personal Stress Indicators: Designed as a visual image, similar to a thermometer, which allows the user to indicate to the group any of three levels of personal stress: low (green), medium (yellow), and high (red). The Meter can be applied as often as desired by the user and is designed to be associated with individual statements as part of the communications text, so as to enable the user to communicate his/her individual level of stress in connection with a particular concept or statement in the group discussion.
- The Group Stress Indicators: Large, thermometer-like images that provide a current average of the individual stress readings to indicate the current average group stress level associated with a discussion topic.
- The EI Advisors: The system was designed to discover and flag charged words or short phrases that are associated with emotion in the psychology literature. The Advisor appears when any user, either a writer or a reader, clicks on any one of the emotion words discovered and flagged by the system. The system then presents a panel of related advisory elements offering guidance adapted from the EI literature. The Advisors require an acknowledgement from the reader, which serves the dual purpose of cognitive reinforcement and a signal to the system that the individual function was invoked. Ninety advisor triggers were included in the final design product.
- The EI Interactors: Interactors were designed as more extensive, dialogue-based interaction functions that incorporate and respond to subject statements. This results in a simple dialogue with the user about a specific EI issue. One interactor was based on a patented technique called the Sedona Method, which implements EI self-awareness and self-management with respect to stressful or problematic group interactions (Dwoskin, 2003). Sixteen individual Interactor elements were included in the final design product.

Figure 4 provides a general description of these design elements and their characteristics, including the Design Object Classes, Design Instances and the Kernel Theories that contributed to their development.

Figure 4: Object Classes, Instances and Kernel Theories for EI-enhanced collaboration Application.

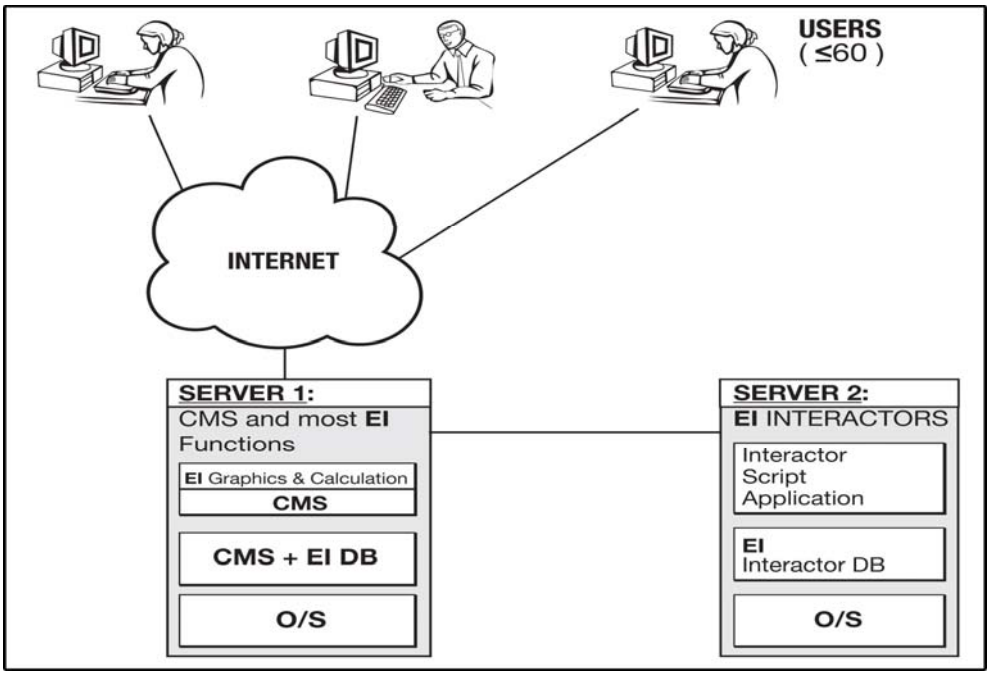
Object Class	Description	Kernel Theory Sources: Design	Subject View and Use
Personal Stress Indicator	Personal stress / emotional intensity indicator; Green, yellow, red temperature gauges	CS, EI, SP, VO	Active selection by subject; Seen by other participants

Object Class	Description	Kernel Theory Sources: Design	Subject View and Use
Group Stress Indicator	Presents average of group stress level; Large green, yellow, red gauges	CS, EI, SP, VO	Fixed indicator with continuous status update
EI advisors	90 recognized terms / phrases; Advisory text; requests acknowledgement	EI, ES, OC, GPL	Linked; Active selection by subject; Pseudo-random selection set
EI Interactors	Text based advisor with brief dialogue that incorporates and responds to subject statements	EI, ES, OC, GPL	Active selection by subject
Acronyms: EI = Emotional Intelligence, OC = Organizational Conflict, VO = Virtual Organization, ES = Expert Systems, CS = Collaboration systems, SP = Social Presence, GPL = General Psychology Literature.			

In addition to guidelines derived from the kernel theory literature, some content for the Wordfinders, Advisors and Interactors was adapted from concepts presented in Cooper and Sawaf (1997), Lynne (2002), Cherniss and Adler (2000), Bradberry and Greaves (2004) and Dwoskin (2003).

Figure 5 shows the general configuration of the system, which was implemented for password-protected web access with anonymous identities, and load-tested for up to seventy synchronous users.

Figure 5: General Configuration of EI Test System.



The following figures show the interfaces and typical content illustrating the word flagging function, the Individual Stress Meter, the Group Stress Meter, the Advisors and the Interactors.

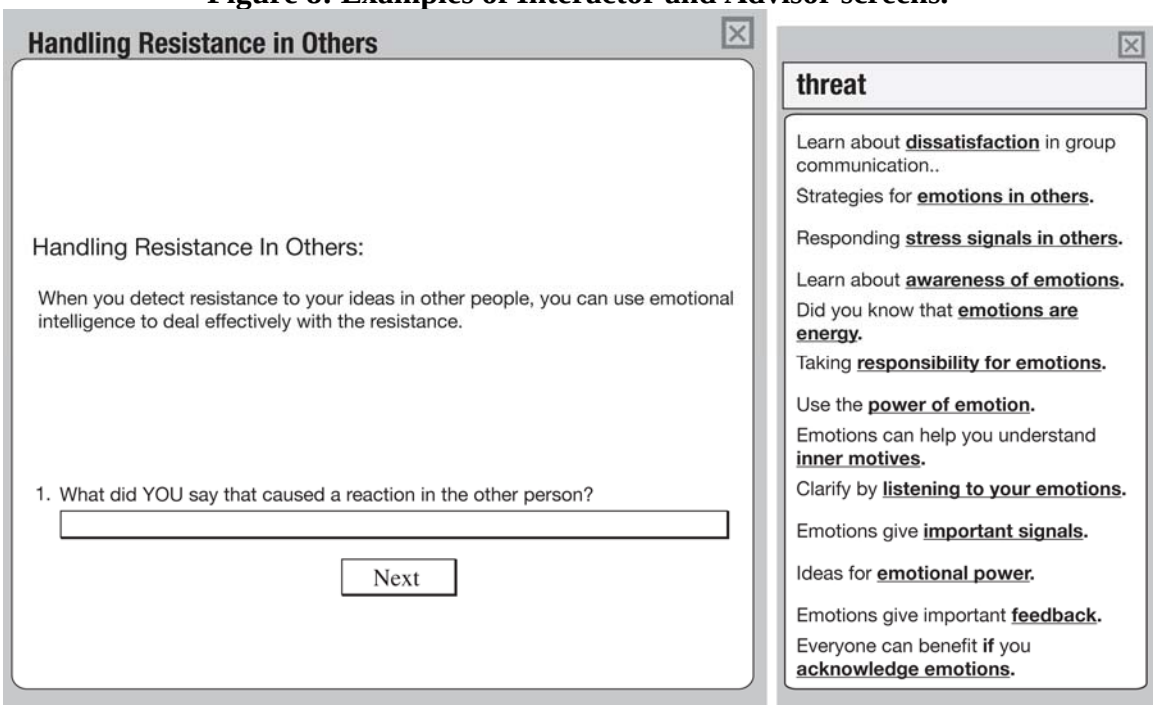
Figure 6: Individual communications, showing linked trigger words and user-selected stress levels (identifiable names and organizations removed).

Meadow13	**Re: Re: Question B** > pluto88: > I do not think that anyone or any group should have the right to scanning e-mail of others. However, if the xxx have this right to do so, I think the xxx can only scan the emails that xxx send to the xxx. I partly agree with you. I do not think the xxx can scan the email even if sent to the xxx.
Pacific17	**Re: Re: Question B** > saturn66: > I personally feel that this stupid policy should be streamlined. Xxx can be given email ids with xxx accounts for official communication with xxx and co-xxx. These emails should not be scanned or read. The xxx doesn't have any right to read these mails. > Mails written through other personal ids can be scanned or read. Actually, I like your idea of having this policy streamlined. However, I think just the opposite. If I had an xxx id, that I used for communication with my xxx and other xxx, I wouldn't just mind that being scanned, because that really isn't very personal stuff. But my own personal emails are mine! I wouldn't want those being read. What would the xxx do reading my personal emails?
Artic18	**Re: Re: Question B** > uranus77: > Scan only when emails are a threat to the xxx. How are xxxs able to when emails are considered a threat unless the xxx scans them all. The solution is to not scan them at all, period . . . . It is not fair to be able to have every one of your emails scanned.

Figure 7: Example of Group Stress Meter Interface for the EI System.

DISCUSSION QUESTION A: Group results	**MEDIUM Stress** (yellow)
DISCUSSION QUESTION B: Group results	**MEDIUM Stress** (yellow)
DISCUSSION QUESTION C: Group results	**LOW Stress** (green)
DISCUSSION QUESTION D: Group results	**HIGH Stress** (red)

Figure 8: Examples of Interactor and Advisor screens.



EVALUATING THE DESIGN PRODUCT: HYPOTHESES

The design product can be evaluated on at least two broad dimensions. The first of these is the essential functionality or usability of the Enhanced System design product, especially given its relative complexity as compared to the Standard System. The second dimension is the effect on users' emotion-based interactions as representative components of emotional intelligence.

Several factors must be considered in evaluating essential functionality. First, the unique design of a system with functions that address emotional intelligence enters uncharted territory of user interaction, and the usability and user reactions to such a system are unclear. Perceived usability and perceived ease of use have been central themes in the evaluation of software designs, and are key elements in important adoption models such as the Technology Acceptance Model (Davis, 1989) and the Diffusion of Innovation model (Rogers, 2003).

In addition, the usability of the Enhanced System may be affected by the addition of more than twenty additional functions in four design object categories not included in the Standard System, which clearly introduces substantial additional complexity to the user. System complexity has consistently been shown to be an obstacle to usability (e.g., Frokjaer et al., 2000; Nielsen et al., 1999) and adoption (e.g., Rogers, 2003).

The first factor to be examined is the overall usability of the Enhanced System as compared to the Standard System, which can be evaluated through an accepted usability scale:

> H1) An information system that incorporates functions to facilitate Emotional Intelligence will be lower in usability when compared to a similar system that does not incorporate such functions.

It is clear that a the complexity of a technology used for communication has the potential to inhibit communication among users of the technology, and there is some evidence that technology complexity and its additional burden on the communication task inhibits communication (e.g., Rana et al., 1997; Weiss & Hambleton, 2005). However, the objective effect of the additional complexity of the Enhanced System relative to the Standard System should be assessed. An objective assessment of the affect of system complexity on communication will complement and balance the primarily subjective assessment proposed in H1, and can be stated as follows:

> H2) The increased complexity of an information system that incorporates functions to facilitate emotional intelligence will result in diminished communication when compared to a similar system that does not incorporate such functions.

Awareness of emotion in one's self and in others, as well as the role emotion and affect in communication, are central to the theories of Emotional Intelligence (Cherniss & Goleman, 2001; Chiarrochi & Godsell, 2005), and can be the basis of the development of skills in EI (Mayer & Geher, 2002). As a result, efforts to facilitate Emotional Intelligence, such as in training programs, can involve mutual awareness and disclosure of the often hidden emotional undercurrent of communication (Lopes et al., 2005). An information system intended to facilitate EI should enable enhanced communication of emotion, both for the sender and receiver.

> H3) An information system that incorporates functions to facilitate Emotional Intelligence will result in a higher level of emotional content in communications, when compared to a similar system that does not incorporate such functions.

Finally, successful application and use of Emotional Intelligence techniques should result in higher levels of consensus, and agreement, among participants (Mayer & Geher, 2002), based on participants' awareness of their own and others' emotional states.

> H4) An information system that incorporates functions to facilitate Emotional Intelligence will result in a higher level of agreement in communications, when compared to a similar system that does not incorporate such functions.

EVALUATION

An empirical comparison between the Enhanced and Standard Applications was developed using participants from a group of students attending a business program at a large university in the Western U.S. Subjects were assigned to the Enhanced System Group (n=66), or the Standard System Group (n=60), for a total of 126 participants. A group interaction context that realistically introduced stressors and potential sources of conflict was designed to exercise the potential for users to try the EI functions built into the EI-enhanced system. In the exercise, evaluation team participants were asked to discuss and contribute to the development of a policy

that addresses the functions and control of a formal e-mail scanning, analysis, classification and archiving system to be implemented by the university. Examples of such systems were discussed with the subjects prior to the system test exercise.

RESULTS

The evaluation exercise provided multiple sources of data for analysis: Written text communications between subjects, all instances of access to the EI functions in the system by each individual, written text submitted in the interactive functions of the system, and responses to post-exercise survey items. For both groups, all subject communications within the application were recorded in the system database, along with the sequence of these entries and the anonymous usernames of the submitters.

The two groups were drawn from a homogenous population. The standard system group (n= 60) and the enhanced system group (n= 66) were highly similar on each of the demographic variables obtained, including age, academic level, gender (53% female) and years of work experience.

The following specific data classes were analyzed to evaluate the hypotheses:

1. The usability of both the Standard and Enhanced systems was assessed in a post-exercise survey with the System Usability Scale (SUS) (Brooke, 1996). The System Usability Scale has a twenty-year history and has been extensively evaluated for effectiveness (Korum & Miller, 2008).
2. Statistics of use of all EI functions in the EI system.
3. The text of all inter-subject interactions in both the Standard and Enhanced systems included evaluation of quantity, tone, and interactivity of written interactions. This content was analyzed in two ways: First, a standard set of emotion words were identified, coded and statistically summarized using the Atlas text analysis system (ATLAS.ti, 2005). Additional reading of text by two readers evaluated subtler aspects of content.
4. The text of interactions with the EI system Interactors; Coding and statistical analysis.
5. The written evaluations obtained in a post-exercise survey.

The first two hypotheses directly addressed the usability of the enhanced system. The first factor to be tested is the overall usability of the Enhanced System as compared to the Standard System, which is evaluated with the SUS.

> H1) An information system that incorporates functions to facilitate Emotional Intelligence will be lower in usability when compared to a similar system that does not incorporate such functions. - *Not supported – opposite effect strongly supported*

The System Usability Scale score for the Standard System Group application was 79.13 and the score for the Enhanced System Group was slightly lower, at 73.30. However, only two of the ten SUS items were statistically different. Overall, both the Enhanced and Standard System Groups applications were highly usable as assessed by the SUS and the slightly lower score of the

Enhanced System Group application was not statistically significant. Figure 9 shows these results.

Figure 9: System Usability Scores, Standard and Enhanced System Groups.

System Usability Scores (SUS) - Standard Application (n = 60)										
SUS Item	USEFREQ	COMPLEXR	EASY	NEEDTECHR	WELLINT	INCONSR	LRNQUIK	DIFFICULR	CONF	LRNFRSTR
Item Mean	4.033	3.75	4.433	3.9	3.967	3.967	4.367	4.517	4.367	4.350
SUS Adj Mean	3.033	2.75	3.433	2.9	2.967	2.967	3.367	3.517	3.367	3.350
SUS Score	79.13									
System Usability Scores - Enhanced Application (n = 66)										
Item Mean	3.242	3.697	4.394	4.091	3.803	3.677	4.231	4.385	4.077	4.031
SUS Adj Mean	2.242	2.697	3.394	3.091	2.803	2.621	3.167	3.318	3.015	2.970
SUS Score	73.30									

H2) The increased complexity of an information system that incorporates functions to facilitate emotional intelligence will result in diminished communication when compared to a similar system that does not incorporate such functions - *Not supported – reverse effect strongly supported.*

The total content of text contributions between the groups was highly similar, both in terms of total content and contribution per participant. ($p < 0.001$). This result clearly supports an opposite effect from that proposed in H2, indicating that the increased complexity of the additional functions in the enhanced system did not inhibit communication. These results are shown in Figure 10.

Figure 10: Total Discussion Content, Text Analysis.

Total Discussion Content, Text Analysis					
	N	Total words written in interactions (minus articles)	Mean Usage Per Word	SD	Total discrete vocabulary
Enhanced Application	66	20790	13.14	1.22	1592
Standard Application	60	20782	13.86	1.27	1520

H3) An information system that incorporates functions to facilitate Emotional Intelligence will result in a higher level of emotional content in communications, when compared to a similar system that does not incorporate such functions. – *Strongly supported.*

Large and consistent differences in the use of emotion-linked words between the standard and enhanced applications demonstrated that the EI-enhanced application was associated with significantly increased use of emotional terms ($p < 0.05$). The emotion terms had, on average, a distinctly negative tone, suggesting that participants felt more free to express frustration or anger. This interesting result shows that the EI enhancements have clear potential to enable emotional awareness, see Figure 11.

Figure 11: Total Discussion Content, Text Analysis.

Emotion Word Frequencies - Text Analysis			
Word (variants)	Total Use, Enhanced Application	Total Use, Standard Application	Difference in Total Use
ANGER (4)	70	7	63
AFRAID	28	3	25
ANNOY (2)	4	0	4
COMMUNICATE (4)	35	9	26
CONFIDENTIAL	17	4	13
CONFLICTED	2	1	1
CRIMINAL	8	2	6
DAMAGE (3)	12	0	12
DESTROY (3)	9	0	9
DON'T	113	57	56
EMBARRASSED	1	0	1
EMOTIONS (2)	7	0	7
FAIR	11	2	9
FEAR	6	0	6
FEEL (4)	180	55	125
FRUSTRATED (4)	12	0	12
HATE	22	0	22
IDENTITY	12	2	10
ILLEGAL	26	4	22
LOVE (2)	9	4	5
MAD	23	0	23
OFFEND (4)	5	0	5
PISSED	5	0	5
RESENTFUL (2)	3	0	3
RIDICULOUS	7	0	7
SAD	18	3	15
THREAT (4)	75	4	71
UPSET (2)	55	0	55
WORRY (4)	20	5	15
Average	27.41	5.59	21.83

H4) An information system that incorporates functions to facilitate Emotional Intelligence will result in a higher level of agreement in communications, when compared to a similar system that does not incorporate such functions – *Not supported.*

An extensive quantitative text analysis for terms indicating agreement, such as variants of the word agree, the word yes, and textual statements of support, indicated no significant difference between the two groups. A qualitative review of the text by two readers found no significant difference in agreement.

Figure 12 summarizes the results of the evaluation.

Figure 12: Summary of results.

Hypothesis	Results	Interpretation
H1: Decreased usability for enhanced application	Reverse effect strongly supported ($p < 0.05$ in 80% of items)	Enhanced application equal in usability to standard application
H2: Decreased communication for enhanced application	Reverse effect strongly supported ($p < 0.001$)	Enhanced application appeared to facilitate communication
H3: Higher emotional content for enhanced application	Strongly supported ($p < 0.001$)	Enhanced application stimulated emotional content (primarily negative)
H4: Increased agreement	Not supported	No evidence of increased agreement for enhanced application

COMMENTS BY SYSTEM USERS

Reactions to the Stress Meter Function

Some of the participants found shortcomings with the Stress Meter, such as . . .

(The stress) meter can help to show my stress but I think it would be better if I can show my feeling more in detail and specific. . . People could lie about the way he/she is feeling so they could mark the meter inaccurately. . . It gave me a little hint on how others were feeling, but human emotions are too complex to be summed up into 3 levels.

However, the majority of the reactions to the use of the Stress Meter by the Enhanced System Group were positive. Many subjects were able to clearly articulate the benefits of this function and it appeared to offer them significant EI functionality

The meter was helpful because it made me think about my stress level. Sometimes I don't even think about it, and then stress bursts out and usually hurts somebody I love. . . Being aware of the stress level can help me communicate to others that I am stressed so watch out! Or maybe for helping me understand that I am stressed, so be careful not to lash out at those around me. The stress meter is valuable in letting me and others know my current stress level. Awareness is key. . . (Stress) meter give me help to know my feelings and theirs, this will help me to communication better build up good relationship with others. . . It helped me recognize what my emotions are at that moment. Something I would not consider if it weren't for the temperature meter on display. .

. The temperature meter is a great measurement to express your emotions. . . It helps complement your answer with the emotions you are feeling at the moment.

Reactions to the Advisor Function

The reactions to the use of the Advisor by the Enhanced System Group were highly mixed, with negative remarks outnumbering positive remarks.

I didn't like the (advisor). It is common sense to know what the words mean. I would get even more angry if I had to read about what anger is. . . . . The word finder didn't find all the words that were emotion words (like in verb tense). . . The (advisor) was helpful in locating my emotions in my sentences. Though, it does not give enough information on how to handle the emotion, or explain in detail why I feel that way. . . The (advisor) was helpful in locating my emotions in my sentences. Though, it does not give enough information on how to handle the emotion, or explain in detail why I feel that way. . .

However, a number of participants articulated specific benefits of this function and it appeared to offer a degree of EI functionality to some.

I thought the (advisor) was very interesting. It highlighted a lot of feelings or emotions that helped me to determine how individuals were feeling when thinking about the issue. . . I think it was useful for pointing out how another individual felt when responding to my comment or when making his or her own comment. . . It made me understand more about feelings that I never considered a possibility before. . .

Reactions to the Interactor Function

The reactions to the use of the Interactor by the Enhanced System Group were also mixed.

The interactor gave me suggestions, but it didn't motivate me to be a better human being. . .

On the other hand, many participants described the benefits of this function and it appeared to offer significant, if limited, EI functionality.

The interactors helped me not only recognize my emotions/feelings but also how to deal with my emotions/feelings. I (could) take the advice of the interactors and relate it to real world situations and handle it more in a professional manner. . . Actually, we can not keep our stress when we try to read and understand something. . . The interactor was interesting. It made me stop and look at my emotions and understand why I am feeling the way I am. . . Yes the interactor helped me narrow down the feelings I had towards the subject being discussed. . . The interactor helped me to concentrate my feelings or emotions toward the particular subject that they were asking me, although I might have gone on tangents. I ran out of room writing on one of the interactors, so possibly make them longer so people can vent their anger. . . I thought it helped explained a lot of hidden feelings and expanded my knowledge about it further. . .

DISCUSSION

Implications for Theory

First, this study revealed a number of interesting insights about the potential of functions in a collaboration system to add a variety of deeper contextual factors to virtual communications that otherwise would not be possible. This appears to have a variety of implications in light of the varied social, organizational and cultural contexts in which emotions, and emotional awareness, are expressed. For example, some individuals may be uncomfortable with overt written expressions of emotions, or may lack the communication skills to express these emotions clearly or in ways that are acceptable in their culture or organization, but may be able to use symbolic functions in a collaboration application to accomplish this in an acceptable way. This may be particularly the case with cultures that are described as high context, in which verbal communications are generally less explicit, and in which the unspoken aspects of communication tend to be based on hierarchical or interpersonal relationships (Hofstede, 2005).

Other individuals may have an opposite reaction, and may find that trends toward presentation of hidden feelings are intrusive and have the potential to stimulate conflict, rather than resolve it. The latter phenomenon, stimulation of conflict, may have appeared in this evaluation, given the fact that the emotional tone of the EI-enhanced group was quite negative, as demonstrated in the strong evidence of support for H3. In addition, the spontaneous use of identified EI words by the EI-enhanced group produced a disproportionate number of words that reflect negative emotions of fear, stress, and anger. In this sense, providing special means to express emotions may be a kind of Pandora's box. Many participants in the EI-enhanced group expressed high levels of stress through the Stress Meter (medium and high stress indicators far outnumbered low indicators), and many participants focused on negative feelings in the interaction tools. The result of development of an EI-enhanced collaboration application may influence expectations for changing norms of communication, in which the emotional subtext suddenly becomes overt and explicit. On the other hand, a number of studies have indicated that some level of conflict can be beneficial in that it stimulates communication (Baron, 1990; Rahim, 1992).

In addition to the exploration of expressing one's emotions and understanding the emotions of others, this study found interesting results in exploring tools for real-time active management of interpersonal conflict, personal stresses and personal emotions. The advising and interaction functions generally met with a favorable review by the users. A number of participants expressed the desire for more extended interactions, and there appears to be potential to develop advanced, interactive functions to manage EI through a group interaction system. Undoubtedly, such functions will be appealing to some and not to others, but the findings of this research suggest that the proportion of potentially interested users may justify such an application.

The theory framework presented by the ISDT was important to both the development of the theoretical basis of this research and the specific, theory-guided design of the systems that were constructed and tested. First, the ability to productively integrate kernel theories from a widely varying social science (e.g., organizational conflict) and IS disciplines (e.g., expert systems) offered a rational and systematic method of including these theories in the design.

The researchers are unaware of any other theory-based approach in which Emotional Intelligence and collaboration application could be rationally combined. The nature of the ISDT approach enables and encourages new combinations of guiding concepts from otherwise highly diverse and dissimilar disciplines. The usability of the design result, as demonstrated in the strong support for the reverse of the effect proposed in H1, shows the potential effectiveness of this approach.

In addition to the implications for the organizational theory areas of EI, organizational conflict and virtual organization, this study produced modest extensions to Collaboration systems research. It provided a preliminary demonstration of the potential of a collaboration application to provide a variety of EI-based enhancements. In addition, the results have implications for the social presence of distributed group members in that their emotional presence was made explicit or amplified. The potential to add rule-based expert system advisory functions to a collaboration application was also explored in a manner that focuses on emotional dimensions of decision-making.

Implications for Future Research

First, since was a demonstration of the potential of Information Systems to address and potentially improve the sub-textual or soft management and leadership skills, the application demonstrated the potential to apply these concepts and functions in a broad variety of organizational contexts. However, it remains unclear whether such a system will be beneficial on balance, because of its apparent capacity to stimulate or uncover negative emotions. Any future work in this area should focus on evaluation of this potentially problematic issue.

One environment of particular interest and relevance to IS research is virtual teamwork in technology management such as is found in IT and R&D functions in large firms. A second, related area for application of the collaboration application/EI is virtual management of technology outsourcing efforts. Other environments can be addressed through the same basic technology platform. An important area for future research would be examination of the potential of an EI-enhanced collaboration application to contribute to these environments, and it may be that different kinds of enhancements may be needed for these environments.

Ideally, such an EI-enhanced collaboration application has the potential to offer practical benefits for the organization as a whole and may be seen as a competitive attractive advantage for individual group participants who seek to improve their performance and effectiveness in organizations. Future work in development of the tool can include deeper and more involving interactivity, more fine-grained methods expressing sub-textual communications, the ability to selectively display sub-textual signals to some and not to others, a more extensive advisory database, learning algorithms for responding to individual patterns of use, and graphical visualization interfaces to assist in personal implementation of EI principles.

LIMITATIONS

The EI functions in this study were evaluated in a realistic, synchronous exercise, sufficient in duration to provide a basis for understanding the functionality and potential of an EI-enhanced collaboration application. However, deeper insights can be derived from extended trials of the

system over weeks or months. Inferred researcher expectancy and demand reactivity may have affected subjects' evaluation and use of the system, although this seems unlikely given the entirely anonymous and voluntary nature of the evaluation.

CONCLUSION

This study may be the first effort to examine the potential to introduce Emotional Intelligence-based soft management functions into a collaboration system. While research in collaboration systems is well known in the IS and CS research, and Emotional Intelligence is a familiar topic in Management and Psychology, this work is the first pairing of these concepts in theory and application.

This objective has interesting theoretical and practical implications. It called for extension of prior theory in collaboration systems and the combination of theoretical elements from IS and other fields in a new way. The Information Systems Design Theory approach provided a structure for integrating the kernel theories drawn from the organizational and collaboration systems literature into an implementable design.

The results of this study suggest that there is considerable potential to create highly capable EI functions, that can benefit organizations as a unit, as well as provide competitive advantage for individual group participants who seek to improve their performance and effectiveness in organizations. Future research will examine the effects of more extensive and intelligent EI functionality.

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APPENDIX A

DESIGN RESEARCH ELEMENTS, METHODS AND IMPLEMENTATION

Element	Definition	Implementation in Collaboration System /EI
Design Product Elements		
Meta-requirements	Goals addressed by the system of the type being designed	• Ability to collect, store, modify, represent and distribute content of group communications • Ability to assist participants in direct application of EI principles (self-awareness, social awareness, self-management, relationship management) in text-based group discussion, in order to help with: • Awareness of emotional context of text-based interactions • Interpersonal and group conflict resolution • Adaptation to interaction stressors • Improvement of information flow • Constructive communication
Meta-design	Plan for system to meet meta-requirements	The meta-design for the EI-enhanced collaboration system includes databases and a content management system to store communications and EI functions, interfaces for individual and group interaction, and active scripts for application of EI principles to discussion content.
Kernel Theories	Theories from natural or social sciences that provide a conceptual bridge between meta-requirements and meta-design	The kernel theories for the collaboration system with EI include: Organizational Theories (Emotional Intelligence, Organizational Conflict, Virtual Organization) Collaboration System theories (Group System Theories, Social Presence Theory, Expert Systems Theories)

Testable design product hypotheses	Propositions to be examined regarding satisfaction of meta-requirements by meta-design	The general hypothesis is that inclusion of EI into GSS tools will improve the product's ability to meet the meta-requirements described above.

APPENDIX B

PROPOSITIONS DERIVED FROM KERNEL THEORIES

Following the Information Systems Design Theory approach (Walls et. al., 1992), this research produced detailed propositions, and the following list groups these propositions by kernel theory category.

1. Organizational / Management Kernel Theory: Emotional Intelligence

    a. A Collaboration system can effectively incorporate mechanisms for assisting Emotional Intelligence based Self-Awareness [including self-observation, self-assessment, and recognizing a feeling (such as resistance to an individual or a group) as it happens), as discussed, for example, in Cherniss and Goleman (2001), Dwoskin (2003)].
    b. A Collaboration system can effectively incorporate mechanisms for assisting Emotional Intelligence based Social Awareness (including empathy and organizational awareness).
    c. A Collaboration system can effectively incorporate mechanisms for assisting Emotional Intelligence based Self Management (including self-control, initiative and optimism).
    d. A Collaboration system can effectively incorporate mechanisms for assisting Emotional Intelligence based Relationship Management (including conflict management, teamwork and collaboration).

2. Organizational / Management Kernel Theory: Organizational Conflict

    a. A Collaboration system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to represent incompatibility, disagreement, or dissonance as discussed, for example, in Jehn and Mannix (2001), Rahim (1983).
    b. A Collaboration system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to make explicit hidden attitudes about issues that are sources of conflict, as discussed, for example, in Baron (1990).
    c. A Collaboration system can effectively incorporate mechanisms for addressing Organizational Conflict by providing means to inform (train) users in conflict-handling methods, as discussed, for example, in Jehn and Mannix (2001).

3. Organizational / Management Kernel Theory: Virtual Organization

    a. A Collaboration system can effectively incorporate mechanisms for addressing issues of Virtual Organization by providing means to reduce the impersonal character of technology-mediated interactions, as discussed, for example, in Straus and McGrath (2001).

b. A Collaboration system can effectively incorporate mechanisms for addressing issues of Virtual Organization by providing means for social context cues such as those that are seen in face-to-face interaction, as discussed, for example, in DeSanctis and Monge (1998).
c. IS Kernel Theory: Collaboration systems
d. A Collaboration system with EI can effectively incorporate mechanisms for facilitating group interaction by implementing a set of classic collaboration application functions, as discussed, for example, in Gopal and Prasad (2000), Power (2003).
e. A Collaboration system with EI can effectively incorporate mechanisms for addressing "risk aversion, (and) how to recognize differences concerning assumptions, goals and understanding (in group decision situations)" as discussed in Alter (2003), pg. 326.

4. IS Kernel Theory: Social Presence Theories

    a. A Collaboration system can effectively incorporate mechanisms for addressing Social Presence by providing means to stimulate psychological involvement and encouraging behavioral engagement, as discussed, for example, in Biocca et al. (2001).
    b. A Collaboration system can effectively incorporate mechanisms for addressing Social Presence by providing means to increase "the degree to which a person is perceived as 'real' in a mediated environment," as discussed, for example, in Gunawardena and Zittle (1997), pg. 8.

5. IS Kernel Theory: Expert Systems

    a. A Collaboration system can incorporate mechanisms for providing intelligent advice, as discussed, for example, in Aiken et al. (1991).
    b. A Collaboration system can effectively incorporate mechanisms for providing guidance based on normative, predictive user patterns, as discussed, for example, in Carroll and McKendree (1987).

[1] A recent exception is the Google Goggles e-mail restriction feature, which is one way to prevent workplace gaffes resulting from impaired inhibition (Gonsalves, A., Google's Mail Goggles Helps Avoid Embarrassing E-mails, *Information Week*, 9 October 2008).