COMPUTER SUPPORTED COLLABORATION: IS THE TRANSFER OF COGNITIVE

STRUCTURES MEDIATED BY MODE OF COMMUNICATION?

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Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

May 2002

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Bandy, Kenneth E., <u>Computer supported collaboration: Is the transfer of cognitive structures mediated by mode of communication?</u> Doctor of Philosophy (Applied Technology, Training, and Development), May 2002, 139 pp., 8 tables, references, 120 titles.

The objective of this study was to observe evidence of structural transfer among subjects in a group problem-solving activity and determine whether mode of collaborative technology or use of a priming agent affected the nature of transferred structures. Evidence for structural transfer is found in three theoretical perspectives: organizational ditransitive (linguistic) verb structures, adaptive structuration theory, and mental model transfer theory. Dependent variables included various grammatical structures and coefficients derived from pretest and posttest scores on David Kolb's Learning Styles Inventory, modified for the experiment. The combination of changes in grammatical frequencies and learning style may suggest that one or more media or the priming agent may affect structural transfer.

Results indicate that groups using the GroupSystems™ collaborative technology produced less overall linguistic content than did subjects using a generic chat system, but employed more complex language as indicated by frequency of the organizational ditransitive verb structure. Also, subjects supplied with an organization chart (priming agent) during the group problem-solving session experienced greater change on the learning styles inventory than did those participating in the session without the chart. These findings suggest that mode of communication and use of priming agents may

contribute positively or negatively to the transfer of structures among group members. Researchers, collaborative system designers, organizational leaders, trainers & educators, and frequent collaborative technology system end-users should be aware of these potential affects. Suggestions for future research are provided. Relationship of theoretical foundations of structural transfer to constructivism is discussed.

ACKNOWLEDGEMENTS

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CHAPTER 1

RESEARCH OBJECTIVES

<u>Need for Study</u>

Concern for improvement of human collaboration via technology has its roots in the work of Vannevar Bush (1947) and Douglas Engelbart (1963). Reflecting upon the ensuing transition of scientists from the war effort to commercial research, Bush surveyed the variety of technological devices available to support research and reported "… creative thought and essentially repetitive thought are very different things. For the latter there are, and may be, powerful mechanical aids" (Bush, in Greif, 1988. p. 24). Bush envisioned numerous ways in which common tasks could be automated through mechanical processes.

Engelbart (1963) considered ways in which human intellect might be augmented by various means. Advances in computational technology enabled researchers of the 1960's to envision both deeper and broader application of automating technologies for work. Goals for his research included finding factors that limit the effectiveness of the individual's basic information-handling capabilities and developing "new techniques, procedures, and systems that will better adapt these basic capabilities to the needs, problems, and progress of society" (Engelbart, in Greif, 1988, pp. 36-37). As the instruments for information management become more refined, adaptable, inexpensive, and user-friendly, a wider variety of human support systems have been developed. Databases, decision support systems, electronic job aids and support systems, and group

process support systems have emerged in response to the demands of work of an increasingly knowledge-intensive and collaborative nature.

In the past two decades a variety of disciplines have participated in envisioning, testing and developing information technology tools specifically designed to address human collaboration at work, commonly known as Computer Supported Collaborative Work (CSCW) systems. Greif (1988) identified several contributing fields to early development of collaborative tools, including computer science, artificial intelligence, psychology, sociology, organizational theory, and anthropology. As a research field, CSCW is distinct from any of the fields on which it draws. Contributors such as sociology, anthropology, and organizational design, have specialties for studying computer-related phenomena, but do not focus primarily on human computer interaction (Greif, 1988, p. 9). It is the synergistic contributions of these seemingly disparate fields of inquiry that promote the current thrust in CSCW research. This study capitalizes upon the questions, methods, tools, and findings that such an interdisciplinary effort has produced, and seeks to determine the potential use of collaborative technologies to meet education, training, and organization development needs.

Advances in CSCW systems show great potential as instructional delivery systems. Curriculum specialists have long recognized the value of interpersonal and group processes in cognitive processing functions (Webb, 1982), and are beginning to use information technology to leverage these processes. For example, Scardamalia and Bereiter (1991) report on the development of a knowledge development technology that engages learners in cooperative commenting and cooperative elaboration. Walsh, Briggs, Ayoub, Vanderboom, and Glynn (1996) combined the efficiency and parity

characteristics of a group support system with problem solving activities containing a vested interest for learners. Compared with the control group, the treatment group members contributed more often and more evenly, perceived greater relevance of class activities, reported greater learner satisfaction, earned higher exam scores, and showed greater perceived learning.

Teacher-centered instructional methods are relinquishing to more constructivist learner-centered activities, relying less upon content delivery and to a greater extent upon student-led engagement of concepts and principles (Reinig, 1996). Experiential learning is becoming more widely accepted as a synthesizing strategy, where learners respond to novel situations by evaluating circumstances, engaging in complex analysis, creating rules, and producing solutions for realistic problem contexts (Saunders, 1997).

While core knowledge is recognized as essential for higher level learning, ability to learn new concepts – and to learn by different methods – is essential in the current knowledge-intensive economy. Further, novel problem situations demand flexibility in the use of concepts and principles. Such demands require human collaboration not only to devise new knowledge, but also to analyze problem situations, produce tailored solutions, and evaluate effectiveness of untested strategies and solutions. Education curriculum designers should establish as course and unit objectives the development of the human capacity to work in such an environment. And once graduates enter the knowledge-intensive environment of the workplace, training and development strategies should be devised that will leverage real, collaborative efforts in order to prepare work group members to face the next problem.

To advance this goal, this project considers the role of language in transferring structure from the individual contribution level to group level processes. On a general level, language facilitates the sharing of meaning. More specifically, language carries with it perceptual frameworks which, when broadly accepted by group members, serve to organize both understanding and ensuing action. In this manner, language serves as a structural transfer agent. Such structural transfer has reflexive qualities that reflect one's understanding of observable phenomena as well as predictive qualities that help shape the nature of ensuing behavior. Group members must assimilate new structures into existing mental frameworks and accommodate framework variations that may accompany suggestions by fellow group members. Structural transfer necessarily involves learning processes, which theoretically vary from person to person. It is reasonable to suggest that factors such as individual and group maturity, cognitive processing styles, learning strategies or tactics, unique elements of the problem context, and quality of technological mediation, to name just a few, have an impact on linguistically based structural transfer.

To explore these possibilities, this study will examine the impact of two (2) forms of collaborative technology and three (3) theory-based factors upon the transfer of structure from individual group member to the group level of awareness. The theoretical premise, purpose of the study, research questions, overview of existing research, and experimental factors are addressed below.

Theoretical Framework

Three theoretical constructs are presented to provide a foundation for the current study. A linguistic theory addresses the individual level of structuring behavior, a group-level theory of structuring behavior is presented via Adaptive Structuration Theory

(AST), and an organizational behavior construct is presented that characterizes organizational learning as construct building and leads to transfer of mental models. All three perspectives encapsulate the common theme of structuring and are related in some way to constructivist learning principles. By default, many CSCW systems utilize structuring principles by guiding collaborator interaction through use of specific collaboration tools and by strategically introducing collaborative systems within existing group and organizational contexts.

The linguistic theory, proposed by Taylor and Van Every (2000), emphasizes structural transfer on the individual level in the grammatical construction of conversational elements. When grammatical structure is formulated in the utterance of language and transferred to a receiver, the receiver of the communication employs the structure to facilitate interpretation. Further, the receiver can choose to adopt completely, adapt, or reject the grammatical structure first used in communication when deciding to forward the message to another party. For example, in a strategy meeting one participant may characterize the market conditions as "shifting" or "convoluted." Other participants may repeat the terms, deciding they best describe market conditions. Such language may then be found in ensuing reports and proposals and become part of the cultural dialog for months ahead. Taylor and Van Every's (2000) theory suggests that complex grammatical constructions, called ditransitive verb structures, serve to transfer not only simple meanings, but also relationships among persons and objects. In short, language structure has inherently organizational qualities.

Adaptive Structuration Theory (Giddens, 1976) supports the transfer of structure on the social, or group, level. Applied to group processes by Poole, Seibold, and McPhee

(1986), Adaptive Structuration Theory identifies two distinct levels of interaction: the observable surface level and the unobservable, below the surface level. Transfer of meaning or structure cannot be observed on the surface level. Rather, only practices of the social system are observable. Supporting these practices, and below the surface level, are three modalities for structural transfer: communication, power, and morality. Members within an organization will accept structural changes when the changes are adequately communicated, under the authority of an entity with sufficient power to effect the changes, and when changes fit within the accepted moral constructs of the workplace. Organizational members are able to observe directly the change in practices (the what), but are unable to observe the reasons for the change or the processes of the change (the why).

For example, a board of directors may break with the norm of selecting from within the organization the next CEO. On the surface level, this may suggest to shareholders that leadership problems exist. However, at a strategic meeting, a well-respected and highly successful board member suggests a change in strategy. A board member of less stature would not be granted such a hearing. Assuming the new CEO is approved, hiring practices within the organization may change as well. Further, other firms within the industry may observe the change in practice and consider a change in their policies as well. A trend is born. Adaptive Structuration Theory helps explain the emergence, continuance, and demise of social practices. The emphasis is placed upon the transfer of structure through various modalities.

Organizational learning theory also provides a foundation for this study. Building on the work of Senge (1990), Kim (1993) proposes an integrated approach to shared

mental models. The transfer of mental models from one organizational member to another constitutes learning. The mental model is the basis for organizational action when broadly accepted and implemented across the organization. The mode of model transfer is language and Senge suggests using organizational learning laboratories to serve as the site for group discussion. The concept of sharing mental models evokes constructivist principles of learning. Learning laboratories promote problem-based dialog, place the responsibility for thinking and problem-solving on the participant, promote application of previous experience, require active participation, and place participants in a naturally-occurring problem context.

Sharing mental models to promote organizational learning is not unlike previous theoretical perspectives noted above. Each uses language in some manner as a mode for structural transfer. Implementation of the transferred structure effects change in the organization.

This study focuses specifically on language as the mode of structural transfer by employing three levels of collaborative technology support, a learning style assessment instrument to assess impact of language mode upon learning style, and an analysis of grammatical structure to identify organizational structures in language. In the following sections a plan for identifying and analyzing structuring factors in CSCW is presented.

Purpose of the Study

Perhaps the greatest strength of CSCW research is its interdisciplinary nature. Separately, it appears that none of the disciplines, including computer science, could have produced collaborative technologies capable of augmenting human thought. Yet, these same interdisciplinary contributions present specific problems to the advancement of

CSCW research and application. In particular, inconsistent findings in CSCW research often raise fundamental questions that are difficult to address, such as which behaviors or variables should be assessed, how should these variables be measured, and what theories might direct research initiatives. Also, CSCW systems have been used narrowly in meetings, often for decision support, with few advances toward other applications. Exploring uses of these technologies as learning tools can be highly valuable for corporate training and distance learning applications, organizational development initiatives, and as a supplement to traditional instructional methods. Finally, theories of organizational learning tend to be general in nature and do not venture into the collective cognitive processing factors that are at play when individuals learn and act within group and organizational settings. As a result this study employs diverse theoretical foundations to refocus the study of CSCW with the goal of addressing some of the problems that previous research has encountered.

The purpose of this study is to determine: (1) if a relationship exists between frequency of ditransitive verb structure in transcripts of a group problem-solving activity and the use of collaborative technology or use of a priming agent; and (2) whether learning is affected, in the form of a shift in learning style, by the kind of collaborative technology employed or by priming agents. Affirmative results may suggest specific ways organizational members can use technology as a learning tool in order to support productive group work. Further, information derived from this study provides new focus to CSCW research by introducing new theoretical themes, testing both dependent and independent variables not previously addressed in CSCW research, and highlighting core group behaviors that seem to have become lost in technology-based group research –

human thought and discourse. To achieve these purposes a series of research questions and hypotheses have been developed.

Research Questions and Hypotheses.

The following research questions guide the research:

1. Does structure-laden language impact learning, reflected in significant score changes on the LSI?

2. Does use of a collaborative technology within group discussion impact the structuring of group discourse?

3. Does the presence of an organization chart (priming agent) as a reference item in group discussions impact the level of discourse in such a way as to enhance structuring of group discourse?

The following Null Hypotheses guide the research:

H1: There will be no differences in the organizational quality of language as presented in the frequency of ditransitive verb structure among oral, chat, and GSS groups.

H2: There will be no difference in the frequency of occurrence of ditransitive verb structure in the organizational quality of language as presented in discussion transcripts between primed and non-primed participants in any of the two groups.

H3: Oral, Chat, and GSS group Posttest scores will not differ from their respective Pretest scores on the Learning Styles Inventory (LSI).

H4: Changes in LSI Pretest-Posttest scores will not different among Oral, Chat, or GSS groups.

H5: Primer and Non-Primer group Posttest scores will not differ from their respective Pretest scores on the LSI.

H6: Changes in LSI Pretest-Posttest scores will not different between Primer and Non-Primer groups.

Definition of Terms.

Accommodative Knowledge/Learning – "When experience is grasped by apprehension and transformed by extension, accommodative knowledge is the result" (Kolb, 1984, p. 42).

Assimilative Knowledge/Learning – "Experience grasped through comprehension and transformed through intention results in assimilative knowledge" (Kolb, 1984, p. 42).

Convergent Knowledge/Learning – "When experience is grasped through comprehension and transformed through extension, the result is convergent knowledge" (Kolb, 1984, p. 42).

Divergent Knowledge/Learning – "Experience grasped through comprehension and transformed through intention results in what will be called divergent knowledge" (Kolb, 1984, p. 42).

Concrete Experience Learning Orientation (CE) – "focuses on being involved in experiences and dealing with immediate human situations in a personal way. It emphasizes feeling as opposed to thinking; a concern with the uniqueness and complexity of present reality as opposed to theories and generalizations; an intuitive, 'artistic' approach as opposed to the systematic, scientific approach to problems. People with concrete-experience orientation enjoy and are good at relating to others. They are often good intuitive decision makers and function well in unstructured situations. The person

with this orientation valued relating to people and being involved in real situations, and has an open-minded approach to life" (Kolb, 1984, p. 68).

Reflective Observation Learning Orientation (RO) – "focuses on understanding the meaning of ideas and situations by carefully observing and impartially describing them. It emphasizes understanding as opposed to practical application; a concern with what is true or how thinks happen as opposed to what will work; an emphasis on reflection as opposed to action. People with a reflective orientation enjoy intuiting the meaning of situations and ideas and are good at seeing their implications. They are good at looking at things from different perspectives and at appreciating different points of view. They like to relay on their won thoughts and feelings to form opinions. People with this orientation value patience, impartiality, and considered, thoughtful judgment" (Kolb, 1984, pp. 68-69).

Abstract Conceptualization Learning Orientation (AC) – "focuses on using logic, ideas, and concepts. It emphasizes thinking as opposed to feeling; a concern with building general theories as opposed to intuitively understanding unique, specific areas; a scientific as opposed to an artistic approach to problems. A person with an abstract-conceptual orientation enjoys and is good at systematic planning, manipulation of abstract symbols, and quantitative analysis. People with this orientation value precision, the rigor and discipline of analyzing ideas, and the aesthetic quality of a neat conceptual system" (Kolb, 1984, p. 69).

Active Experimentation Learning Orientation (AE) – "focuses on actively influencing people and changing situations. It emphasizes practical applications as opposed to reflective understanding; a pragmatic concern with what works as opposed to

what is absolute truth; an emphasis on doing as opposed to observing. People with and active-experimentation orientation enjoy and are good at getting things accomplished. They are willing to take some risk in order to achieve their objectives. They also value having an influence on the environment around them and like to see results" (Kolb, 1984, p. 69).

Chat System (Instant Messaging) – a computer-based communication tool enabling multiple users to send and receive messages instantly and interactively communicate in real time.

Experiential Learning – "…exists when a personally responsible participant cognitively, affectively, and behaviorally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement" (Hoover and Whitehead, 1975, p. 25).

Group Decision Support System (GDSS) – "…combine[s] computer, communication, and decision support technologies to support problem formulation and solution in group meetings. The goals of a GDSS are to reduce the 'process loss' associated with disorganized activity, member dominance, social pressure, inhibition of expression, and other difficulties commonly encountered in groups and, at the same time, to increase the efficiency and quality of the resulting group decision" (Watson, DeSanctis, and Poole, 1988)

Group Support System (GSS) – a computer-based collection of software tools "that support group processes such as brainstorming, voting, consensus building, and group writing, adding functionality way beyond the communications supported by chat rooms or videoconferencing." (Regan and O'Connor, 2002, p. 150)

Groupware – "In general, the term 'groupware' is applied to *applications* that support interactions within groups of two or more people. The term does not refer to major systems designed to support entire organizations. The 'group' is either small to moderate in size or is narrowly focused, as in the case of an electronic bulletin board or electronic mail interest group. Thus, electronic mail, co-authorship programs and voice annotation are examples of groupware, whereas computer integrated manufacturing or order-and-delivery-control systems are not, even though they share many of the same properties and are subject to many of the same analyses. … The term 'groupware' focuses on the *technology* that supports cooperative work, although the proper design focus is on understanding the users' tasks, the underlying *work*." (Grudin, 1989, p. 246).

Learning – "(a) a change in an individual's behavior or ability to do something, (b) a stipulation that this change must result from some sort of practice or experience, and (c) a stipulation that the change is an enduring one" (Shuell, 1986, p. 412). "…learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it" Kolb, 1984, p. 41).

Oral Groups – the control group for this study; subjects addressing the treatment without the benefit of either the Chat system or the Group Support System, but subject to experimental controls.

Organizations – "structures for the social coordination of action, generated in conversations based on requests and promises. These distinctions of linguistic action are crucial to building technology for organization and management. They are also universal with respect to time and culture. So long as people live and work together, they will

coordinate their actions in requests and promises and the expectations that derive from them" (Flores, Graves, Hartfield, and Winograd, 1988, p. 506).

Organizational Learning – the transfer of data, information, or knowledge from one aggregate performance unit to another in such as way as to alter the understanding or performance.

Priming (Priming Agent, Primer) – "particular stimuli activate mental pathways that enhance the ability to process subsequent stimuli connected to the priming stimuli in some way" (Sternberg, 1996, p. 71)

Technology – the design of practices and possibilities to be realized through artifacts (Flores, Graves, Hartfield, & Winograd, 1988).

CHAPTER 2

LITERATURE REVIEW

The Case for Structural Transfer

As noted previously, CSCW is an interdisciplinary field drawing upon
contributions from many sources. However, the primary concern of this study is
conceptualizing the means to leverage collaborative technologies for learning and
development purposes and the eventual development of strategies, methods, and tools for
group level learning in technologically supported collaborative work environments.
Given this central concern, the body of literature of primary significance is that which
relates to learning, group processes related to learning, and collaborative technologies
supporting learning. Several threads of research from various disciplines contribute to
this concern including, learning theory and instructional technology, linguistics,
computation, communication and computer-mediated communication, and group
communication processes related to learning. The various threads of research are related
to three general theoretical perspectives: a linguistically-based theory of organization,
Adaptive Structuration Theory, and a theory of mental model transfer.

The roots of collaborative technology research are well documented (Nunamaker,
Dennis, George, Martz, Valacich, and Vogel, 1992; Gray, Vogel, and Beauclair, 1989;
Kraemer and Pinsonneault, 1990; and Dennis, Nunamaker, Vogel, 1990-91; Zigurs,
1993; Nunamaker, Dennis, Valacich, Vogel, and George, 1993). The early research base
is largely empirical, wherein researchers assessed the impact of a given computer-based
collaborative tool on dependent variables such as user satisfaction, quality, productivity,

or efficiency. Research designs were highly pragmatic, seeking to determine the effectiveness of specific collaborative tools on group effectiveness, most often in the domain of decision-making.

Application of existing theory and new theory development have attempted to explain or enhance effectiveness of collaborative technologies. Theoretical underpinnings are presented by Wynne, Anson, Heminger, and Valacich (1992) and include: McGrath's (1984) Time, Interaction, and Performance (TIP) theory; DeSanctis and Poole's (1994) application of Adaptive Structuration Theory; Huber's (1990) attempt to establish propositionally the effects of advanced information technologies on organization design; and Weick's (1979) model of enactment. Nagasundaram and Dennis (1993) referred to small group theory (Bales, 1950) and the sociologically based information theory (Newell and Simon, 1972) when considering cognitive factors, such as chunking, short term memory, and stimulus diversity, that may enhance electronic brainstorming in group support systems. Dennis and Kinney (1998) tested Daft and Lengel's (1986) Media Richness Theory in computer-mediated and video contexts, but were unable to support the basic premise that rich media overcomes problems associated with task equivocality.

This study employs a synthesis of theoretical constructs that focus upon structuring processes to help explain how individual behaviors function to shape ensuing organizational behaviors. A focus upon structuring processes can help explain how both individual creativity and organized social behavior function together to facilitate organizational planning and execution. Structuring processes coordinate both individual and organizational activity simultaneously, explaining the occasionally contrary objectives of individual and organizational activity as well as synchronized individual

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and organizational behavior. The theory base used to support this study provides several structural supports for information processing that promotes communicating, learning, and planning on the individual, group and organizational levels.

<u>The Individual Level - Linguistic Theory</u>

Some beliefs or behaviors have an organizing influence upon ensuing beliefs or behaviors. Phenomena exerting such influence may be highly tangible, such as reference manuals, or intangible, such as unrecognized assumptions. The act of communication can carry with it unrecognized assumptions that shape ensuing behavior. According to one theory, a priori forms of communication shape the utterances that initiate organizational discourse. Taylor & Van Every (2000) conceptualize such a priori forms of communication in linguistic terms. Language contains distinct organizational structures and can impose those structures upon behavior. As the language used in organizational discourse is produced, so the organization emerges:

> To discover organization means to look at, not through, the discourse of communication, that is, to take discourse as a site and a surface of emergence, which are uniquely capable of revealing or disclosing it. It is in the constraints that are built into the act of communicating that we expect to find the a priori forms of organization. We thus make an assumption that communication is not incidentally, but fundamentally, organizational, in that people engaged in communication do so, always, as both the makers and the made of their own organizational environment. As its *makers*, people in interaction must and do construct the sequences of talk in which they engage in such a way that organization results: Work gets done, and hierarchies are produced. As the *made*

of organization, people's identities, and the objects they value (positively or negatively), are circumscribed by and inscribed in the forms of language they employ. Language furnishes both the constructive instrumentality and the conceptual frame to make and understand organization. (Taylor & Van Every, 2000, p. 72)

The definitions of organization are many and varied. However, if language produces and is produced by the organization, a definition of organization must contend with the productive quality of language. Taylor and Van Every (2000) provide a useful definition of organization:

For us, therefore, an elementary, even simplistic, definition of *organization* suffices: that which serves to constrain interaction by structuring its occasions of talk and by doing so, to generate a kind of common accord (not necessarily unanimous) as to the objects and agents of communication. Organization, as it emerges in communication, both empowers and constrains and, as it does, creates a universe of objects and agents. How the objects and agents are constituted in the basic meaning structures of human language is the focus of our attention. (Taylor & Van Every, 2000, p. 73)

Taylor and Van Every (2000) identify a specific linguistic structure responsible for the production and reflection of organization. The ditransitive verb form is a grammatical construction of inherently organizational character that "involves the event of a transaction and explains how the enablements and constraints of organization arise in the flow of communication" (p. 77). Accordingly,

The basic event expressed by a ditransitive construction is that of an agent acting

to cause transfer of an object from a source to a *recipient* (it is ditransitive

because there is syntactically both a direct object, called the patient, and an

indirect object, called the *recipient* or *goal*.). It is the construction type,

semantically speaking, where the communication exchange event takes place

(Taylor & Van Every, 2000, p. 77)

According to Taylor and Van Every (2000), "The ditransitive construction has an

operator (syntactically, a verb) that incorporates, as part of its most basic meaning, a

sense of 'cause-(someone)-to-receive' and argument slots that specify an (a) agent or

operator, and (b) a transfer (i.e., that which the agent causes to happen)" (p. 78). In

organizational discourse a second level of ditransitive is added to the construction.

In this second version of the ditransitive construction, two transfers and two

objects are implicated, with one transfer figuring within (embedded in) the other.

The 'within' or lower level transfer … is directed to an *object of value*. (This is the

usual commonsense connotation of *object*; ordinary things that people work on

and manipulate in the everyday world). The nature of the object of value and the

kind of process in which it figures determines the character of the enterprise,

private or public: insurance company versus car manufacturer versus State

Department. It is by the objects of value it transacts that we know the mission of

the organization. (p. 79)

Organizational communication is language that contains two tiers of action, one

embedded within the other. The inferior verb may or may not be of ditransitive character,

whereas the superior verb must be ditransitive to be of organizational character. The inferior verb form is the object of transfer for the superior ditransitive verb. So that

> …what is transferred is not an object in the usual sense of the term, but an idea, expressed as the propositional content of the utterance (we therefore term it a *theme*). The object of the embedded proposition is, as before, an object of value; the object of the embedding proposition is a *modal object*. The concept of *modality*, … , is intended to capture the idea that the meaning of the embedding sentence is not so much to represent a state of affairs or an action in the world as to express and attitude of the speaker, or convey and intention with respect to it, to a recipient. The kinds of verbs that can figure in a modal construction are ones such as *think*, *feel*, *ask*, *like*, *wish*, *want*, *tell*, *hope*, *request*, and so forth: precisely those verbs that are followed by an statement such as 'that such-and-such is or will be true or will or should occur.' They thus demarcate a different order of organizational process from those that are described as concerned with objects of value. They are the basis of management and administration. The specificity of an enterprise is indexed by the objects of value it transacts, not by its modal objects; modal objects are common to every organization, although the processes by which they are transferred may be specific to an organization. Communication transacts modal objects directly, objects of value indirectly. (pp. 79-80)

Three kinds of modal objects exist in ditransitive structure, which yields three kinds of organizational communication: The first kind is the transfer that develops a shared image of the world (Taylor & Van Every, 2000, p. 82); the second kind is the transfer that serves to bring about a new state of affairs (Taylor & Van Every, 2000, p.

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83); and the third kind is the transfer that actually declares a state of affairs to exist (Taylor & Van Every, 2000, p. 84). Respectively, these forms of communication are known as constative, conative, and declarative. Constative transfers are used to develop a shared image of a given situation. Conative transfers are used to direct the action of others thereby changing a given situation. Declarative transfers cause situations to exist thereby creating a given situation. Declarative transfers are unique because, according to Taylor and Van Every (2000):

> Modal logic makes no special provision for this kind of act. … It is not about what was or has become true (as a result of previous actions), nor about what will or should be true as a result of future actions, but what is now being made true as a result of speaking. The declarative, as the title suggests, is self-referential – not just communicative about action or states, but action and state combined: what it describes is what it does. This is how organizations come into existence, how their officers are named, how they hire and fire, how they open and close plants, certify or decertify unions, merge and acquire, buy and sell, work. (pp. 84-85).

Thus Taylor and Van Every provide us with several objective, language-based, organizing factors with which to assess the transfer of structuring information from one person to another, or from one entity to another. If it is possible to transfer information in such a way as to promote cognitive or behavioral structuring in another person or entity, management of language through cognitive processing factors will certainly impact the effectiveness and efficiency of the transfer. Other researchers have considered the use of language as an organizing factor, though not on the grammatical level of Taylor and Van Every.

Winograd (1988) reported on a conversation manager, The Coordinator, based upon common linguistic concepts and principles. Using Speech Act Theory (Wittgenstein, 1968; Austin, 1962; Searle, 1979) as a theoretical foundation, this system classifies communicative utterances according to their function within discourse. When used, The Coordinator directs participants to identify, make, and honor commitments made in the course of conversation.

Considering the nature of human language in organizational contexts, systems designers have also considered language as a basis for designing management information systems. According to Flores, Graves, Hartfield, and Winograd,

> Our principle theoretical claim is that human beings are fundamentally linguistic beings: Action happens in language in a world constituted through language. What is special about human beings is that they produce, in language, common distinctions for taking action together. Language then is not a system for representing the world or for conveying thoughts and information. Language is ontology: a set of distinctions that allows us to live and act together in a common world. The orientation within which we go about design is one that allows human beings to observe their producing and acting in a world linguistically, to design their actions together, and to recognize and respond to breakdowns. The designer's job is to identify recurring breakdowns, or interruptions in ongoing activities, and prepare interventions to resettle the activities in ways that cope with or avoid those breakdowns. (Flores, et al, 1988, p. 505)

Based upon an ethnographic research method, Crabtree (2000) considered the problem of developing a design methodology that best reflects actual work processes.

Reflecting on organizations as "ordering structures" (p. 217) (see also Chia, 1997), Crabtree determined that the language of an organization can be mapped to the structure of the organization, due to the situated use of specific terms within the conduct of daily work. When using computer supported cooperative work systems as an aid to design, process analysts can identify patterns of discourse that can reveal thought processes otherwise unavailable in the design process:

> Instances of language-game concepts delineate a problem-space for design emergent from practice itself. …in illuminating the ways in which staff routinely go about solving a particular problem through mapping the relevant concept's grammar, the instance delineates a solution-space rich in productional detail providing for the initial formulation of concrete design solutions (Crabtree, 2000, p. 232).

Researchers have considered the social functions of language in systems design as well. Sharrock and Button (1997) applied Habermas' theory of communicative action to the design of CSCW. While critical of the use of the broad construct to effect specific design features in CSCW, the authors illustrated the potential for Habermas' concept of the ideal speech situation as a goal and considered groupware as a filter of negative social system properties. To determine whether socio-organizational factors impact cooperation, Sauvagnac and Falzon (1996) analyzed dialog in a problem oriented work setting. They determined that speech acts serve to both complete tasks and negotiate power and autonomy in social relationships, indicating language can be parsed for two levels of analysis in dialog.

In addition, Suchman (1995) challenged Winograd and Flores (1987) on the basis of power. While use of The Categorizer may facilitate a language-action correspondence, Suchman questions the basis for establishing the categories for denoting the function of language to make and enforce commitments. Suchman suggests that categories can be established to benefit, for example, management over workers.

Thus, a relationship among language, technology, and organizing processes has been considered in the literature. CSCW may affect individuals as well as the end product of group activities. The next section examines practice-level constructs that provide insight into the integration of new structures into group level, or aggregate, cognitive processing.

The Group Level - Adaptive Structuration Theory (AST)

CSCW users can be viewed as group or team members seeking to address problems of mutual interest. When groups engage in problem finding, decision-making, and problem solving, norms and roles emerge to facilitate resolution of immediate issues and establish a basis for future group activity. Thus, concepts and theories related to group processes and decision-making suggest important ways collaborative technologies can be deployed as group learning support systems. Relevant to this study Poole, Seibold, & McPhee (1986) considered group decision-making research and sought to find a paradigm that would meet the theoretical need to address many seemingly contrary features of group work -- most importantly, stability and change. They recommended the theory of structuration (Giddens, 1976):

> … structurational theory provides the resources for a unified theory of individual
> and systematic processes in groups; for an account of how institutions figure in

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group processes; for an integrative explanation of structural stability and change; and for an explanation of stability and change in the processes governing stability and change. It lays the groundwork for a theory of group interaction commensurate with the complexities of the phenomenon. (Poole, Seibold, & McPhee, 1986, p. 243)

To achieve this balance Giddens' theory is grounded in a distinction between system and structure. He defines systems as "observable patterns of relationships between individuals or collectives and of 'situated practices'" (Giddens, 1984, p. 26). He defines structures as the "rules and resources involved in the production and reproduction of social systems." Members use rules and resources to interact, and hence these are the bases for the conduct of social practices. Structures are not directly observable but must be inferred as generative principles underlying observable systems (Poole, Seibold, & McPhee, 1986, p. 246). Structuration theory supports higher level analysis of behavior in organizations as opposed to language level of analysis noted by previously described modal theories:

The basic units of analysis for structurational theory are social practices such as group decision-making, courtship, conversation, or religious and civil ceremonies. The theory consciously employs the term "practice," as opposed to "variable," "process," or "function," because it carries a fuller sense of action in social systems. Social practices are "naturally bounded" activities, recognized as coherent wholes by members. They are organized by members acting in a skilled and knowledgeable fashion, although members' "knowledgeability is always 'bounded' by unacknowledged conditions of action on the one side, and

unintended consequences on the other" (Giddens, 1984: 19). These boundaries arise because social practices are located in space, in time, and in social institutions. (Poole, Seibold, & McPhee, 1986, p. 244).

According to Poole, Seibold, & McPhee (1986), structuration resolves "two overarching theoretical tensions that arise from the complex intersection of determinants in group interaction (p. 244)." The first tension is related to individual interaction and structural factors emergent in group interaction. Although interaction is a product of individual behavior, collective -- or group -- level interaction is constrained by such phenomena as norms, decision rules, communication networks, etc. which both facilitate and constrain individual interaction. The second tension, according to Poole, Seibold, & McPhee, (1986)

> … stems from the dialectic of stability and change in group structures. Underlying the linkage of action and system is a tension between two aspects of structure: (1) structure as a stable, given aspect of the group that members work with and adapt to; and (2) structure as created and negotiated, the emergent product of member activities. (p. 244)

The theory of structuration addresses these concerns at a level of organizational behavior broader than that encompassed by the linguistic perspective. While the linguistic approach enunciates the role of linguistic structures in producing and stabilizing organization through discourse, AST articulates levels of practice, which produce and stabilize organizations through action. The following tenets of structuration theory are summarized below:

1.   The theory of Structuration analyzes practices, as defined by members.

2. It analyzes practices by distinguishing *system* (observable patterns of behavior and institutions) from *structure* (the unobservable rules and resources used to generate the system).

3. Structures are both a *medium* of action and an *outcome* of action. They are *produced* and *reproduced* by members using them in interaction.

4. This process of production and reproduction is *structuration*. Systems and structures exist by virtue of continuous structuration. Structuration occurs though the interaction of reflective, active members. Actors control interaction through *reflexive monitoring* and *rationalization*, but they are limited by *unacknowledged conditions* and *unintended consequences* of action. "People act, but not in circumstances of their own choosing."

5. The structures involved in interaction stem from social institutions. General institutional structures are appropriated by actors and adapted to particular contexts and uses. These structures-in-use are termed modalities…

6. Three modalities can be distinguished, each of which represents a separate type of institution and social structure.

7. Several distinct elements of social structure may be involved in the same system. The relationships and dynamics among these features also influence structuration. Two relationships are important: *mediation* of one structural element by another and *contradictions* in structures. They affect how social structures are appropriated by members and they also place

unacknowledged conditions on action (and therefore influence processes

diagrammed under points 5 and 6).

8.   In order to characterize how structuration occurs, it is necessary to identify

both forces shaping interaction (conditions on action and consequences of

action) and structural dynamics (mediations and contradictions). (Poole,

Seibold, & McPhee, 1986, p. 245).

Where individual structuring principles emphasize the use of language to produce organization, the practice-level structuring principles employ behavior on a symbolic level, a sort of meta-language, to produce organization. Though practices originate in language, conceived and communicated socially, ultimately they take on a life of their own, holding persuasive power over actors in organizations until a given practice ceases. In this manner, practices become extralinguistic:

Social practices possess a complexity and richness beyond what language can

express. As the central feature of culture, they are tied in a multiplicity of ways to

members' experiences and traditions. … There will always be unarticulated

features behind any account of practice, either lay or scientific. Our capacity to

describe and express practices is also limited because they are social phenomena,

constituted in interaction and subject to a tradition. Practices have no existence

independent of their operation. If members stop performing a practice, it

disappears, as our limited knowledge of most ancient practices attests. The life of

a practice consists not in being carried out by a particular set of members but by

existing through many repetitions by many different subjects. So it is that group

decision-making has its own character due to being "institutionalized" in Western

culture. This character forms a tradition within which practitioners must operate, a tradition so complex and with so many layers (due to the evolution of the practice) that it cannot be reduced to the cognitions of individual members. The practice has a life of its own. It is intersubjective and its complex ramifications form an unarticulated basis for action. Practices are constituted by individual activities, but they also transcend any particular individual, just as group practices may be instantiated in collective activity and yet transcend any particular group. (Poole, Seibold, & McPhee, 1986, p 246)

Like language, practice contains a generative quality. While a given practice governs behavior by placing restrictions and conditions upon participants, it also provides a source of experience for those encountering unique situations that require new practices. According to Poole, Seibold, & McPhee (1986), the structuration process produces and reproduces social systems because of the duality of structure:

Structures are at once the medium and the outcome of social action. They are its medium because members draw on rules and resources to interact within and produce practices. They are its outcomes because rules and resources exist only by virtue of being used in a practice; whenever the structure is employed, the activity reproduces it by invoking and confirming it as a meaningful basis for action. (p. 247)

As in the case of individual level structuring resources (language), the underlying structures involved with practice facilitate the transfer of some level of meaning from one actor or entity to another. Structuration theory recognizes limitations of unacknowledged conditions and the unintended consequences of action. Although applicable to language,

these two factors are more salient in practice, as observed behaviors have more overtly significant outcomes. In fact, misunderstandings in terms of discourse often remain unaddressed in formal organizational contexts, unless a given practice renders another unproductive. Further, the same practice, along with its structurational features, can be deployed differently for separate groups of actors (Poole, Seibold, & McPhee, 1986). The subsurface level principles of structuration govern the tensions inherent in managing individual interaction within the context of group behavior as well as the stability and agency functions that practices play in organizing. "If we looked only at the groups themselves, without preconceptions as to the abstract rule, we would identify two different norms. Thus the mode in which groups employ institutional structures is a critical feature of structurational processes" (Poole, Seibold, & McPhee, 1986p. 251).

Practice level structures include communication, power, and morality modalities. To initiate a practice, participants must communicate, suggesting a foundation in language to transmit meaning. The practice must also be supported by those organizational agents with sufficient power and authority to provide needed resources. Finally, for the practice to be accepted it must fit within the existing moral order thereby making it legitimate within the organizational context (Poole, Seibold, & McPhee, 1986p. 251). When observing practice, all three modalities are presented as a complex indistinguishable from one another:

> Every act implicates all three modalities to some degree: as interpretative
> schemes, to enable or constrain communication and understanding; as norms, to
> enable or constrain action through moral or evaluative sanctions; and as facilities,

to enable or constrain the production or prosecution of action (Poole, Seibold, & McPhee, 1986 p. 252)

Structuration also manages two forms of interpenetration inherent within group and formal organizational functions: mediation and contradiction. "Through mediation and contradiction, structures shape and constrain the reproduction of other structures. These interpenetrations play an important role in the construction of explanations for structurational processes" (Poole, Seibold, & McPhee, 1986, p. 253). First,

one structure mediates another when its production and reproduction involve the reproduction of the other. For example, the economic metaphor, on which choices are based on rationalistic cost-benefit calculation, often mediates decision rules in groups. Those rules consistent with the metaphor are given preferential status and reproduces, while many other possible rules (for example, ethical standards) are foregone. (Poole, Seibold, & McPhee, 1986 p. 253).

Second, the interpenetration of structures occurs through contradiction: "The operation of one structural principle in the reproduction of a societal system presumes that of another which tends to undermine it" (Giddens, 1979, p. 141). For example, numerous investigators have reflected on the contradiction between the social, collegial nature of group action and members' individualistic striving for control and rewards in the group. This contradiction in organizing principles, each of which conditions the other, can produce serious problems in a group. When these problems mount, the group may use time and energy to cope with them, or it may change to "reprioritize the organizing principles" (Poole, Seibold, & McPhee, 1986 p. 253).

To summarize, Giddens' theory of structuration explains a broad level of organizing by providing modal structures that guide the constitution and maintenance of practices. Though rooted in language by virtue of its language-based initiation and modal character, structuration of practices exceed language in efficacy by virtue of the symbolic character of their enactment. However, language- and practice-level structuring tools are incomplete without considering the role of the individual as the primary structure recipient. The variety of human response to structuring initiatives indicates that additional structuring mechanisms are at work. Learning processes intervene to qualify, direct, and assimilate structuring initiatives to produce unique human behavior.

The relationship between group theory, learning, and technology has been an important area of research. While AST provides a theoretical basis for this study, examples of technology-based group learning research are abundant and can aid in better focusing future inquiry.

Researchers have considered the role of learning or the factors that impact learning in group activities. For a review of group research trends and thrusts, see Poole (1981, 1982, 1983), McGrath (1984), Cragan and Wright (1990), Levine and Moreland (1990), Hirokawa (1989), Shaw (1981), and Frey (1994). The following review identifies recent research concerned with cognitive processes within group performance contexts, including some research involving technologically supported group processing.

Group performance can be categorized into two general areas: problem solving and decision-making. Additionally, within either of these basic processes groups may engage in task or maintenance functions. Task functions direct group activities toward task accomplishment and maintenance functions utilize group resources to maintain

coherence and organization. While problem solving and decision-making behaviors are not fully independent of one another, researchers often address them separately.

Analyzing contributions from group participants is useful in describing group behaviors and processes. However, early empirical research (i.e., Bales, 1950) lacked sufficient refinement to promote specific recommendations. Citing disenchantment with researchers' inability to propose successful problem solving strategies, Hirokawa (1982) developed a coding scheme for analyzing group interaction behaviors during problem solving activities. Another research theme is organization or structure of processes in problem solving and decision-making (Maier and Hoffman, 1961; Mintzberg, Raisinghani, and Théorêt, 1976; Jarvenpaa, Rao, and Huber, 1988; Daft and Macintosh, 1981; and, Niederman and DeSanctis, 1995).

In addition to analysis of member contributions and process structuring in problem solving activities, decision schemes were analyzed for comparative value in contributing to successful decision outcomes. Green and Taber (1980) considered the impact of nominal, consensus, and majority vote decision schemes on outcome variables. While the nominal voting method was more efficient, it also led to feelings of low involvement in the process. Consensus voting had the opposite effect on involvement but resulted in a greater sense of negative socio-emotional involvement among participants. Nominal voting also tended to reduce personal interaction, producing negative socio-emotional involvement. Results illustrate the multiple effects various decision schemes may produce and the difficulty of producing a method or strategy that succeeds in all aspects of group decision-making.

In addition to problem solving and decision-making, researchers have studied a number of other factors that may impact the outcome of group activities. Vroom, Grant, and Cotton (1969) controlled amount and focus of social interaction during decision-making and other researchers have attempted open-ended approaches to identifying the general nature of group problem solving and decision-making (Maier, 1967; Hirokawa and Pace, 1983; and Hirokawa, 1987).

Researchers have also considered the role of technology upon the cognitive processing behaviors of groups. Presnell (1998) considered the effectiveness of multimedia presentation, traditional lecture with group support system, and the combination of both on learning outcomes. Presnell found no differences among the treatment levels, but attributed the lack of treatment impact to instructor delivery factors, suggesting learning outcomes may benefit from use of technological support in group activities.

Hewett (1998) used student writing groups to analyze communication patterns under two conditions: oral communication among peers and oral plus computer supported communication among peers. Findings revealed that oral talk focused on more abstract, global idea development while computer-mediated communication focused more on concrete writing issues and group management. Findings suggest that computer-mediated communication shaped both the nature of the discussion and the revisions of the written end product. Scott (1997) studied the use of computer-mediated communication to augment traditional classroom activities and determined that a combination of face-to-face and computer-mediated discussion resulted in self-reported learning increases and higher grades.

It appears that the application of technology to group work may have a compounding, rather than a simplifying or explanatory, effect on group-level cognitive processing. Dennis (1996a, 1996b) used a group support system (GSS) to test the ability of groups to produce an optimal solution. While sufficient information was made available to reach an optimal choice, only one of seven GSS groups and one of seven non-GSS groups, produced the optimal result. When compared to non-GSS groups completing the same exercise, GSS groups exchanged more information, were less inclined to process previously unknown unique information divulged during the task, reported perceptions of using information to a lesser extent than did non-GSS group members, and reported attributing less credibility to information contributed by others during the activity.

Perhaps one reason for sub optimal group level decision performance is the impact of system presence on cognition. Flor and Hutchins (1993) argue that use of system-based tools and procedures produce system-level cognitive properties that are distinct from those of individual programmers. In other words, software developers are affected by the design methodology in a manner beyond their own cognitive processing patterns when working individually. The product of the human-system enterprise is distributed cognition. According to Flor and Hutchins,

> Equally important to solving a problem are the other actors and artifacts in the environment. Complex problems often require collaboration between a number of different individuals and artifacts for their successful solution. Together these agents comprise a complex cognitive system and effective interactions are necessary to successfully complete a task. These interactions serve the purpose of

exchanging task relevant information and are also used to create the external structures required for the task's completion. Clearly, the system performs the task and not any single individual. From a distributed cognition perspective, the system is an intelligent entity but, unlike individuals whose internal representations are not available for direct analysis, the representations used by complex cognitive systems are in the external environment and available for inspection. Examples of these representations include spoken words, writings, and operations on tools – all of which are perceivable and can be captured on recordable media, e.g. video tapes, for later analysis. These external representations can be viewed as the complex cognitive system's "mental" state. By characterizing this mental state and combining this knowledge with a knowledge of internal representations gleaned from cognitive psychology, a more complete understanding of the system will emerge. (1993, p. 273)

Principles emerging from Flor and Hutchins' (1993) analysis reveal several group behavior factors. For example, subjects shared goals and plans, used efficient communication, contributed broader knowledge and experience than would an individual working alone, aided one another in reviewing previously discarded ideas for new uses, and negotiated the division of labor. However, two findings are notable. Subjects relied upon the non-human memory capability of the technology to augment their own recollection and subjects used system properties of the technology they used in the study to predict outcome of their own plans.

One constraining factor of computer-based communication is restricted expression. Plowman (1995) explored the experiences of writing students in a

collaborative writing activity. Subjects used chalkboard, paper, and a computer to co-write a response to an essay question. Interaction was recorded and analyzed to determine the role of written text in the process of conceiving and writing a final answer. According to Plowman,

> Talk had a central role in the generation of both ideas and text, and much of the thinking and formulation of ideas was distributed between two or more people, so systems which allow only for text-based communication could impose severe limitations on the ways in which talk acts as a mediator for cognition. The interfunctionality of talk and text needs to be taken into account in the design of systems, whether these are for synchronous or asynchronous use. This does not necessitate provision for the equivalent of face-to-face communication, but reliance on text as the mediating means of communication is inadequate (Plowman, 1995, p. 240)

It appears that structures are transferred on the group level and that technologically based support systems may affect the nature of the transfer process. When combined with linguistic structural transfer factors that may be present on the individual level, technologically supported group interaction may be more complex than anticipated. Further, a third level of structural transfer has been advanced which may provide additional insight into the nature off structural transfer.

The Organizational Level – Mental Model Transfer Theory

In addition to language and group processing concepts, an important factor in this study is that of organizational learning. While CSCW groups are composed of individuals and individual interactions mediated by technologies, it is the transfer of data,

information, and knowledge from the individual to the group level of awareness that promotes synergistic processing. Broadly conceived, such transfers may constitute group or organizational learning, especially when these transfers impact either directly or indirectly on group outcomes, which are then propagated throughout additional layers and segments of a broader organizational environment. One theoretical perspective, mental model transfer, recognizes the inherently linguistic character of sharing mental models. This line of reasoning directly supports the language-based conceptions of organizational emergence addressed by Taylor and Van Every (2000) above. Also, this characterization of organizational learning follows closely principles associated with recent advances in cognitive theory – constructivist learning principles.

Perhaps most famous for his work *The Fifth Discipline*, Senge (1990) proposed five laws for systematic learning on an organizational level. Senge (1990) presents the concept of mental models as "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (p. 8). More extensively, however, is the treatment of mental models in a later work where the concept of the learning organization is explicated as an invented structure, a product of what Kofman and Senge (1993) term "generative conversations." In the earlier work, authors note that mental models are produced and challenged through a process of inquiry and advocacy (Senge 1990), where inquiry serves the function of questioning the current state of affairs and advocacy serves to enable the individual to make his or her position explicitly known. In the latter presentation Kofman and Senge (1993) extend the concept of mental models by establishing their origins as socially invented:

Learning organizations are spaces for generative conversations and concerted

action. In them, language functions as a device for connection, invention, and

coordination. People can talk from their hearts and connect with one another in

the spirit of dialogue (from the Greek *dia+logos* – moving through). Their

dialogue weaves a common ongoing fabric and connects them at a deep level of

being. When people talk and listen to each other this way, they create a field of

alignment that produces tremendous power to invent new realities in

conversation, and to bring about these new realities in action. (p. 16)

Through dialogue new mental models emerge as influential structures with no

inherent basis for existence (Senge, 1993, p. 14) other than to serve the organization;

mental models are purely constructed. As a result even the concept of the learning

organization is a construction -- "a category we create in language" (Senge, 1993, p. 16).

We are articulating a view that involves us – the observer – as much as the

observed in a common system. We are taking a stand for a vision, for creating a

type of organization we would truly like to work within and which can thrive in a

world of increasing interdependency and change. It is not what the vision is, but

what the vision does that matters. (p. 16)

Fragmentation, competition, and reactiveness provide a natural basis for the

emergence of new mental models, according to Kofman & Senge (1993). "The absence

of problems yields stasis, but "[r]eactiveness [to problems] becomes creating when we

see the 'generative power of language,' how language brings forth distinctions from the

undivided flow of life." (p. 6).

For Kofman and Senge, language is the basis for developing and sharing mental models. Discourse ingrains individual organizational members in the construction process. This view does not address the negotiation process that accompanies inquiry and advocacy. While it theorizes at broad level the exchange that must occur for one mental model to be replaced by another, it fails to explain the learning processes that can occur within individuals when confronted with a new mental model.

Kim (1993) accepts the premise that the exchange of mental models produces organizational change, but calls for a more specific enunciation of the exchange process. He proposes an integrated model of organizational learning called the "OADI-SMM model: observe, assess, design, implement-shared mental models. This approach addresses the issue of the transfer of learning through the exchange of individual and shared mental models" (p. 43). This drive for clarification of the specific causes for the exchange or enhancement of mental models leads Kim to analyze the nature of individual and organizational learning. Several issues are summarized below.

With regard to the logistical implications of organizations and learning Kim makes several observations. First, individual learning is related to organizational learning. "[O]rganizations ultimately learn via their individual members. Hence, theories of individual learning are crucial for understanding organizational learning" (Kim, 1993, p. 37). Second, individual learning precedes group or organizational learning. Individual learning characterizes organizational learning in small organizations. "As an organization grows, however, a distinction between individual and organizational learning emerges, and a system for capturing the learning of its individual members evolves" (Kim, 1993, p.

40). Third, learning on an organizational level is more complex than learning on an individual level. Specifically,

> The level of complexity increases tremendously when we go from a single individual to a large collection of diverse individuals. Issues of motivation and reward, for instance, which are an integral part of human learning, become doubly complicated within organizations. Although the meaning of the term "learning" remains essentially the same as in the individual case, the learning process is fundamentally different at the organizational level. A model of organizational learning has to resolve the dilemma of imparting intelligence and learning capabilities to a human entity without anthropomorphizing it. (Kim, 1993, p. 40)

With regard to qualities of learning at the organizational level Kim first notes the subtlety of aggregate learning "because organizations can learn independent of any specific individual but not independent of all individuals" (Kim, 1993, p. 37). An individual can contribute knowledge to an organization and leave behind the knowledge in processes, plans, and structures when he or she terminates membership. Further, Kim reports that there are different kinds of learning, operational and conceptual, which in combination produce a cycle of learning that informs and is informed by mental models. Operational knowledge enables the learning and continuance of procedure, while conceptual knowledge promotes analysis of procedure and facilitates challenge and renewal of mental frameworks (Kim, 1993, p. 38).

Perhaps most critical to this study is Kim's (1993) concern for the transfer of knowledge from individual to organizational level. Without individual learning

organizational learning could not occur. Knowledge must flow from the learner to the corpus of organizational knowledge. Thus,

> … transfer is at the heart of organizational learning: the process through which individual learning becomes embedded in an organization's memory and structure. Until now, it has received little attention and is not well understood, although a promising interaction between organization theory and psychology has begun. (Kim, 1993, p. 37).

Finally, Kim (1993) proposes that groups can be viewed both as a form of mini-organization and as a kind of unique entity. This observation may serve to refine the understanding of organizational learning. Member learning contributes to group level knowledge, yet groups take on specific sub cultural characteristics (roles, norms, etc.) in relation to the overall organization, and "can be treated as if they were 'extended individuals'" (Kim, 1993, p. 43).

Kim's observations acknowledge Kofman and Senge's mental model framework, while requiring more clarity with respect to the transfer of mental models from the individual to the organizational level. The OADI-SMM model attempts to clarify a mental model transfer process, yet does so at a broad level, not unlike some theories Kim contrasts in the development of his model. Recognizing this concern, he also acknowledges the need for further development in making mental models explicit:

> Making mental models explicit requires a language or tool with which to capture and communicate them. Some progress is being made in this area. However, most efforts at mapping mental models result in static representations of what are usually highly dynamic and nonlinear phenomena. New tools, such as causal loop

diagrams and system dynamics computer models, are proving more effective. They allow us to address the problem of incomplete learning cycles. (p. 46) … Captur[ing] individual mental models alone is not sufficient to achieve organizational learning. There needs to be a way to get beyond the fragmented learning of individuals and spread the learning throughout the organization. One way is through the design and implementation of microworlds or learning laboratories. (p. 48) In terms of the OADI-SMM model, systems archetypes and computer simulators make mental models explicit, thus improving the transfer mechanism and reducing situational and fragmented learning. (Kim, 1993, p. 48).

The transfer of mental models within organizations and various methods for facilitating this transfer have been addressed in literature. Bringelson (1991) studied the use of analogies and mental models under two experimental conditions to ascertain their impact on group interactions. Results indicate that identifying and sharing multiple mental models within a group allows multiple viewpoints to have adequate representation. Giavetti and Levinthal (2000) analyzed the relationship between cognition and experiential learning processes and the impact of shifting cognitive representations over time. The analysis explores the rigorous pursuit of ongoing "experiential search" – a "forward-looking form of intelligence that is premised on an actor's beliefs about the linkage between the choice of actions and the subsequent impact of those actions on outcomes" which are derived from the actor's mental model of the world (Gavetti and Levinthal, 2000, p. 113). According to their analysis, previously undertaken forms of experiential learning may "seed" a "subsequent process of experiential learning" (Gavetti and Levinthal, 2000, p. 123). Further, when faced with a choice, an actor may shift

cognitive representation of the environment, thereby reallocating attention to elements of the choice problem an earlier representation might overlook. This analysis suggests that shifts in mental models may provide seed learning experiences for future problem situations.

McCourt (1997) reviewed Gareth Morgan's (1980) concept of metaphor as organizational change agent and explored a broad range of metaphor-based organizational theories. McCourt places the metaphor theory into a constuctivist orientation (p. 5). While disenchanted with Morgan's assertion that metaphors are the fundamental and indispensable tool for organizational understanding and change, McCourt reports that Morgan "stumbled post facto on a practical application."

> There is the consistent idea of cognitive change at the level of individuals and groups, leading to behavioural change and thus to improved organizational performance. In this context, metaphoric thinking can be seen as a technique facilitating what Porras and Sivlers (1991:57) call "gamma change," which they define as a change in the configuration of an existing paradigm or the replacement of one paradigm with another. (McCourt, 1997, p. 9).

O'Neal (1994) explored the transfer of information from individuals having customer contact to the broader organization level, focusing on customer interface, action- reflection, and dissemination and diffusion. Findings suggest that information does enter the organization through individual contact with clients, individuals do act on this information in a way that reflects organizational goals, and that individuals transfer the information gained through both formal and informal means. Additionally, non-

collaborative practices were also identified, which, according to O'Neal, can be overcome by application of appropriate organization learning models.

On a technical level, Beynon-Davies, Bonde, McPhee, and Jones (1997) created a collaboration-based schema integration system to enable system analysts and designers to coordinate the various perspectives of end-users in the design of an information system. The goal of system analysts and designers is to create a model of the work process that correctly and efficiently incorporates end-users' understanding of the process. The system, Schema Integration System using the Issue-Based Information System (SISIBIS), is used by end-users who document the requirements and relationships in a work process. The benefit of SISIBIS is that the system facilitates argumentation among end-users to identify and resolve issues and also utilizes hyperlinks among components of a graphically displayed work process model to quickly direct end-users to areas of conflict. While the concept of mental model transfer is not specifically referenced, it is clear that the goal of SISIBIS is to coordinate individual mental models of work processes among different users into a single unified model. Similar to Senge's (1990) concepts of inquiry and advocacy, SISIBIS directs participants to identify specific areas of differentiation and to reach a solution that serves all end-users.

A major thrust in mental model transfer theory is the social interaction required to facilitate model sharing, inquiry, and advocacy. Proponents such as Senge envision learning laboratories as a context for social interaction. A number of research initiatives support social interaction as a basis for learning in organizational contexts. Brown and Duguid (1991) recommend not learning laboratories, but communities of practice to provide a context for organizational learning. Communities of practice are composed of

workers within a specific field, often within the same firm, working on actual problems. Three features of work practice facilitate the transfer of learning: narration, collaboration and social construction. According to Brown and Duguid (1991), "Stories and their telling can reflect the complex social web within which work takes place and the relationship of the narrative, narrator, and audience to the specific events of practice"… and serve as a "usefully unconstrained means to interpret each new situation in the light of accumulated wisdom and constantly changing circumstances" (pp. 44-45). Communities of practice also contain collaborative features involving the accumulation of insight based upon collective learning. Individual narratives provide a portion of the overall solutions to problems. Combinations of stories, collected over time, provide more content for analysis and processing. The third feature of work practice is that of social construction, in which narrators contribute to an emerging understanding or view of the world as it pertains to the specific problem. Brown and Duguid (1991) relate this third feature specifically to constructivist learning theory:

> …learners can in one way or another be seen to construct their understanding out of a wide range of materials that include ambient social and physical circumstances and the histories and social relations of the people involved. …learning is built out of the materials to hand and in relation to the structuring resources of local conditions. (p. 47)

Inkpen (1996) studied international joint ventures in attempt to understand whether organizational learning strategies the increased likelihood of success. According to Inkpen (1996), "Successful firms exploit learning opportunities by acquiring knowledge through 'grafting,' a process of internalizing knowledge not previously

available within the organization" (p. X152). The process of organizational learning is centered around individual sharing:

Organizational learning is a systems-level concept that can become useful only when its component parts are thoroughly understood and brought down to an operational level. Unless individual knowledge is shared throughout the organization, the knowledge will have a limited impact on organizational effectiveness. Thus, organizational knowledge creation represents a process whereby the knowledge held by individuals is amplified and internalized as part of an organization's knowledge base (Inkpen, 1996, p. 152).

Individual interaction serves as the catalyst for organizational knowledge. Interpersonal influence is strategically amplified through: technology sharing, where individuals discuss the function and application of various technologies; joint venture parent interactions, where members of different organizations but similar disciplines interact along project lines; and, personnel movement, where partners exchange personnel for mutual benefit.

Liedtka, Haskins, Rosenblum, and Weber (1997) also underscore the importance of communities of practice as a basis for creating and maintaining meaning within an organization:

Agreement on the "how" of process and the "why" of purpose are the foundation of shared meanings. Informed dialogue among members is central to the ongoing coevolution of meaning and capabilities. Because the work itself is central to a community of practice, and because meaning, purpose, and learning are tied to

doing, everything of importance that happens is personal and, hence, local (Liedtka, et al, 1997, pp. 56-57).

Sinkula, Baker, and Noordewier (1997) proposed three synergistically linked organizational learning facilitators: organizational values, market information-processing behaviors, and organizational action. The three facilitators are related in that organizational values effect organizational actions, but only indirectly as these values are mediated by market information processing behaviors. It is this system that determines the effectiveness and efficiency of learning:

> Before an organization can act on the information it generates and disseminates, it must be interpreted. Managers employ mental models to interpret information. The effectiveness of market information processing is ultimately dependent on the degree to which the mental models that are used to interpret information are adequate representations of reality and, specifically, whether the assumptions about the market and the key relationships between actions and outcomes are accurate and shared throughout the organization. (Sinkula, Baker, and Noordewier, 1997, p.308)

Mental models are key components of market information processing systems, establishing a frame or mindset for processing new information. The researchers tested the mediating effect of a market information processing system on the organizational values-action relationship and discovered "both direct and indirect effects of learning orientation on market information dissemination, with the indirect effect mediated by market information generation" (p. 314). Information processing behaviors did mediate the relationship between values and action. The mental models inherent in the market

information processing system appear to impact information generation and dissemination, which affects learning and decision-making.

Similarly, Seufert and Seufert (2000) conceptualized the individual-organizational learning relationship as "knowledge networking" (p. 1). Based upon a theoretical construct highly similar to Kolb (1984), authors identify four learning types (conceptualization, experimentation, experience, and reflection) and describe learning as the conversion from one type of knowledge to another:

> Since knowledge is regarded as a static just as much as a dynamic concept, these types of knowledge do not exists independently but can be converted into one another. In fact, the word "knowing" has emerged to represent this dynamic process of knowledge conversion. Follwing Nonaka and Takeuchi [1995] there are four conversion modes that can be distinguished: socialization, externalization combination and internalization. (Seufert and Seufert, 2000, p. 3)

Two of these types of knowing are relevant to the mental model transfer theory, socialization and internalization. Socialization "comprises the exchange of tacit knowledge between individuals in order to convey personal knowledge and experience" (p. 3). Internalization "comprises the conversion of organization-wide, explicit knowledge into the implicit knowledge of the individual" (p. 3). While Senge's (1990) mental model theory recommended learning laboratories to serve as the nexus for mental transfer, Seufert and Seufert (2000) relate the transfer process to a Japanese concept of learning spaces, or "Ba." Based upon analysis of a large insurance firm, Seufert and Seufert identified networking practices and mapped the practices to specific learning types.

Constructivist Themes in the Literature

The tenets of the three theoretical perspectives correspond highly with the tenets of constructivist learning theories. In the following section, constructivist principles will be aligned with specific principles of structural transfer identified in the linguistic, structuration and mental model theories noted above. Essentially, constructivist learning is an experiential form of learning involving various levels of human interaction:

> Constructivism proposes that learner conceptions of knowledge are derived from a meaning-making search in which learners engage in a process of constructing individual interpretations of their experiences. The constructions that result from the examination, questioning and analysis of tasks and experiences yields knowledge whose correspondence to external reality may have little verisimilitude. However, to the degree that most of our learning is filtered through a process of social negotiation or distributed cognition, generally shared meanings tend to be constructed (Applefield, Huber, and Moallem, 2000, pp. 2-3).

Instructors intending to apply constructivist principles to classroom learning stress specific principles when designing instruction:

1.	Learners should be encouraged to raise questions, generate hypotheses and test their validity;

2.	Learners should be challenged by ideas and experiences that generate inner cognitive conflict or disequilibrium. Students' errors should be viewed positively as opportunities for learners and teachers to explore conceptual understanding;

3. Students should be given time to engage in reflection through journal writing, drawing, modeling and discussion. Learning occurs through reflective abstraction [theory building];

4. The learning environment should provided ample opportunities for dialogue and the classroom should be seen as a community of discourse engaged in activity, reflection, and conversation;

5. In a community of learners, it is the students themselves who must communicate their ideas to others, defend and justify them;

6. Students should work with big ideas, central organizing principles that have the power to generalize across experiences and disciplines.

    (Applefield, Huber, and Moallem, 2000, pp. 17-18)

Constructivist learning principles appear to be consonant with concepts related to structural transfer at individual, group, and organizational levels. Thus, the constructivist learning perspectives may be leveraged to enhance organizational learning. Further, related perspectives, such as experiential learning, may assist in defining and measuring organizational learning. A general review of constructivist theories and experiential learning follows.

Fosnot (1984) reviewed Piaget's principles of assimilation and accommodation, considered to be a theoretical root of constructivist thought, and related them to current conceptions of learning: conflict resolution is a learning process, reflexive abstraction of experience leads to theory generation; learners are active and self-regulating manipulating of objects and concepts to reveal correspondences and transformations; and learners undertake equilibration processes that require the coordination of affirmations

with negations (addition and subtraction of component parts of an object) to synthesize and learn holistically.

Further, Semple (2000) recognized Vygotsky's contribution to constructivist thought, which reflects similarities with linguistic, group and organizational theories addressed above:

A major criticism of Piaget's theory is that he did not take into account the effect of social interaction and the influence of cultural transmission. Social or Vygotskian constructivism situates the [learner] within a sociocultural context, a process described as 'situated learning.' Individuals construct knowledge in transaction with the environment and in the process both are changed. Vygotsky proposed that the functions which first appear as social phenomena later become internalised as psychological phenomena. The two theories, psychological and social constructivist theories, can be regarded as complementary rather than conflicting as they both emphasise the role of interaction and constructive development processes in learning though the nature of the interaction is different in each. Learning is considered to be an active process rather than the passive process proposed by the behaviourists and the power of the technologies is invested more in the user or learner than in the designer. (Semple, 2000, p. 5)

Constructivist theory emphasizes making meaning through negotiation, which is highly representative of the kind of communication transactions that occur in workgroups in many kinds of organizational settings:

Constructivism proposes that learner conceptions of knowledge are derived from a meaning-making search in which learners engage in a process of constructing

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individual interpretations of their experiences. The constructions that result from the examination, questioning and analysis of tasks and experiences yields knowledge whose correspondence to external reality may have little verisimilitude. However, to the degree that most of our learning is filtered through a process of social negotiation or distributed cognition, generally shared meanings tend to be constructed (Applefield, Huber, and Moallem, 2000, pp. 2-3).

Application of constructivist thought to organization design and development literature is infrequent but available. For example, Copeland (2000) applied constructivist principles to global political security issues, emphasizing the intersubjective, constitutive, reciprocal qualities of political relationships, which explains the continuously evolving understandings and positions taken by interacting parties.

On a local scale Winsor (2000) related constructivism to distributed cognition systems in an engineering firm. Tracking the experiences of six summer interns, the study found language-learning to be the key organizing factor in enhancing organizational performance in this knowledge-intensive environment. Since the product of the organizational unit was knowledge and members contributed, both individually and in concert with other knowledge workers, to various means of transforming data into knowledge, Winsor classified these processes as a form of distributed cognition (Winsor, 2000, p. 1). According to Winsor (2000), "most of the learning techniques that students and permanent employees used can be seen as attempts to become and remain part of the distributed cognition functioning in the … engineering center" (p. 3). The basic premise of the study is that the language of the organization is both the basis for stability change due to its utility in collective cognitive processing. Note also the implied tension created

by language as both a stabilizing force and a facilitator of communication which can lead to change:

> In particular, I draw on these theories of distributed cognition and examine how newcomers enter into that distributed cognition in workplaces where what counts as valid knowledge is constantly changing. … If we think in terms of distributed cognition and changing knowledge, then learning to write in the workplace entails getting plugged into a system of endless learning rather than gaining a bounded set of ideas. (Winsor, 2000, p. 1) … Conventional vocabulary, sentence structure, and genres helped to stabilize knowledge not only because they encouraged repetition but also because they created an opportunity for distributed cognition as writers made use of the experience embedded in conventional language forms (p. 8).

While not explicitly stated as a constructivist proposition, Winsor (2000) relates the language-based interaction and the distributed nature of the knowledge-building processes in the organization in terms parallel to the constructivist perspective:

> Thus, using models and conventions, including language conventions, seems to be part of the way that organizations deal with the instability of knowledge because imitation and replication are inherently conservative. Knowledge in a stabilized form can be distributed into these conventional forms so that everyone can access it with minimal effort. However, organizations necessarily exist within a tension between the need for enough stability to operate and enough flexibility to change, and even conventions change to reflect this learning environment. Because organizations are not monolithic, such changes may not occur simultaneously

throughout the organization, and discontinuities can occur from department to department. The newcomers I observed valued learning these conventions because of the organizational knowledge they carried. Their coworkers, too, valued the access to knowledge that conventions of representation provided. Learning and following the most current conventions was one of the primary means by which everyone in the organization accessed stabilized knowledge. (Winsor, 2000, p. 10)

Linguistic theories provide objective methods for analyzing discourse among organizational members. Discourse analysis may yield informative structures that can explain organizational learning behaviors. Further, structurational analysis provides a mechanism for studying the impact of the meaning on the recipient as a motivator and shaper of action. When considering the complexity of organizational learning as suggested by Kim (1993) a language-based theory of organizational learning must consider both the linguistic and practice-level factors that facilitate the formulation, presentation, and adoption of new mental models within an organization.

Experiential Learning Theory

One theoretical perspective that capitalizes on experience and the inherent tensions of learning is that of David A. Kolb – Experiential Learning Theory. For an overview of experiential learning, see Lewis and Williams (1994) and Jackson and MacIsaac (1994). Kolb (1984) draws upon the work of Dewey, Lewin, and Piaget to produce a dynamic view of learning that integrates the unique factors of specific performance situations and individual learning style. The theory and its accompanying instrumentation have been used widely in educational research, training and professional

development, and educational program development. Kolb's theory has been evaluated and summarized in numerous sources and extensively in his own manuscripts (Kolb, 1971a, 1971b, 1974, 1984). Below is a brief summary of Experiential Learning Theory.

Kolb combines two continua to produce an orthogonal learning matrix. One continuum represents the concrete and abstract dimensions of thinking, while the other represents the active and reflective dimensions of learning behavior. When combined, the continua produce scores related to the four quadrants, reporting a preferred learning style. Often, scores indicate dominant or preferred learning style, while acknowledging the relative impact of the less dominant or preferred learning behaviors. The four learning dimensions of learning that make up the continua are summarized by Petkus (2000),

> …the most effective learning requires four different learning abilities: concrete experience, reflective observation, abstract conceptualization, and active experimentation. These four learning abilities are formulated into a learning cycle. Four learning roles are assigned to the transitions between the four learning abilities: the reflector role, the theorist role, the pragmatist role, and the activist role. There is no designated "starting point" for the cycle; however, learning is most effective when the student [learner] goes through all points, regardless of where he or she starts. (Petkus, 2000, p. 64)

Each type of learning experience contributes to the overall learning process. According to Petkus,

> Concrete experience involves sensory and emotional engagement in some activity. Concrete experience evokes feeling. Reflective observation involves watching, listening, recording, discussing, and elaborating on the experience. This

phase also involves making connections across experiences – … – but without

necessarily integrating theories and concepts. Abstract conceptualization involves

integrating theories and concepts into the overall learning process – this is the in-

depth thinking phase of the cycle. Active experimentation is the doing phase, in

which the student [learner] engages in a trial-and-error process in which the

accumulation of sensory experience, reflection, and conceptualization is tested in

a particular context. (Petkus, 2000, p. 64).

When the continua are situated orthogonally they produce quadrants that identify

more specifically the unique characteristics of individual learners. As described by

Carlsson, Keane, and Martin (1995), the quadrants further refine the kinds of thinking the

learners undertake in experiential learning:

1. *Divergence (concrete* and *reflective).* This kind of activity is required to seek

   background information and sense opportunities, investigate new patterns,

   recognize discrepancies and problems, and generate alternatives. Literature

   browsing and Brainstorming are techniques which may be used to aid this

   kind of activity. [p. 66]

2. *Assimilation (abstract* and *reflective).* This kind of activity is required to

   develop theory, compare alternatives, establish criteria, formulate plans and

   hypotheses, and define problems. Grounded Theory techniques are designed

   to aid this kind of activity. [p. 66]

3. *Convergence (abstract* and *active).* This kind of activity is required to select

   among alternatives, focus efforts, evaluate plans and programs, test

hypotheses, and make decisions. Venture Analysis techniques are designed to aid this kind of activity. [p. 66]

4. *Execution (concrete* and *active).* This kind of activity is required to advocate positions or ideas, set objectives, commit to schedules, commit resources, and implement decisions. PERT and Critical Path Scheduling are techniques frequently used to aid this kind of activity. (Carlsson, Keane, and Martin, 1995, p. 67)

As a tool for analyzing and measuring constructivist learning performance, Kolb's construct enables classification of learning style and impact on specific learning activities. However, most germane to this study is its application to broader, group and organizational learning functions. Carlsson, Keane, and Martin (1995) related Experiential Learning Theory to the corporate research and development process. Munich (1993) considered experiential groups as a site for learning and expresses the concept of group cognition as distinct from individual level cognition:

The most important precursor for the experiential group as an educational modality was described by the psychoanalyst, Wilfred Bion (1961), in his now classic work, *Experience in Groups.* In this book, Bion graphically recounts the identification of "group mentality" and the regressive emergence and interpretation of "basic assumption life," concepts that function for an entire small group like the dynamic unconscious does for an individual. [p. 347]

Also, Hovelynck (1998) synthesized the work of various theorists to enhance group learning through metaphor development techniques. According to Hovelynck,

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The metaphors people live by always make sense in the context in which they were developed. They may become problematic as they become 'fixed images' (Leuner, 1977), but a priori every metaphor generates possibility. It seems important to recognize and appreciate the potential of participants' metaphors. First because people connect through appreciation, not through a focus on what goes wrong and needs improvement. The expression of genuine appreciation is part of how to create a safe learning space. An then because a one-sided focus on developing new metaphor runs the risk of losing the potential of older ones. Recognizing metaphors' "as if" character makes it possible to benefit from the potential of several different views simultaneously: developing new metaphors doesn't necessarily imply forgetting the older ones. Seen from this perspective the task of the facilitator further consists of guiding processes of metaphor change to completion. His or her interventions intend to facilitate the development of the enacted metaphors. (Hovelynck, 1998, p. 11)

Note that in Hovelynck's analysis there is an unspecified recognition of the tension between the structure of the existing metaphor and the potential for change to a new metaphor. This tension is consonant with those tensions of the linguistic, structuration and mental model theories noted above. Communication is central to resolving the tension, causing a new label to become associated with the updated knowledge and beliefs associated with the emerging metaphor:

Guiding a process of metaphor development to completion implies the facilitation of the process from the "unarticulation sense of similarity" to a metaphor that presents new potential--whether that means new possibilities in dealing with each

others' expertise, new options in relating to one's father, or alternatives to metaphors such as "fear as an emotion to be conquered," "feedback as critique," "personnel as a resource" and so forth.... These alternatives unfold through a process of "renaming and reframing," resulting in a more or less explicit "map" which clarifies the options the end metaphor generates. The process of metaphor change thus comes to a momentary end; this point can be understood as the completion of a cycle. Completing cycles of metaphor development can take different forms. (Hovelynck, 1998, pp. 11-12)

Dehler and Porras-Hernandez (1998) considered the use of computer-mediated communication as a means to facilitate learning in higher education. Specifically, they recommended computer based assignments to make assignments less passive and more experiential, prompting learners to engage in knowledge application and theory testing:

Experiential learning theory espouses that higher education can do more than develop verbal skills and the ability to convey information (Kolb, 1984; Kolb & Lewin, 1986). If purposeful and congruent with students' realities, experiential learning activities can contribute to the cognitive and affective development required for the complete mastery of a domain. Through the application of CMC, instructors can provide students with the opportunity to *apply* knowledge and *test* theories (i.e., to do something). (Dehler and Porras-Hernandez, 1998, p. 52)

Gupta and Misra (2000) determined that international joint ventures constituted organizational learning experiences, in so far as the venture is not a duplicate of previous joint venture partnering. They cite recent theory indicating "learning occurs because joint ventures are mechanisms that enable the transfer of organizational knowledge, skills, and

other complex information that is not easily transferred through market transactions" (p. 80).

Feather (1999) attempted to determine whether a group support system impacted group development in a collaborative learning task. A seven stage model of group development was used to monitor group progress on two tasks, with each group completing one task in a traditional discussion format and the other task with the aid of facilitated group support system. One group performed well according to the group development model on both tasks and the other performed poorly on both tasks, indicating the group support system had no apparent impact on overall group development. However, both groups experienced reduction in the rebelling and differentiating stage of the model.

White (1992) applied the Kolb's Learning Styles Instrument (LSI) in a management development program. Use of the instrument explained managers' problem solving approaches:

> Experiential learning theory and the LSI are used to help individuals understand their strengths and weaknesses in decision making and problem solving by observing their inclination towards action or reflection, and the ability to make decisions or avoid or procrastinate on them. The LSI can increase an individual's awareness of his or her own and others' preferred learning and communication styles by noting the preferred degree of concreteness or abstraction, and one's preference for sharing divergent or convergent ideas. (p. 55)

The design of CSCW has received attention as well. Kersten and Cray (1996) considered the lack of direct linkage between behavioral theories of decision-making and

the design of decision support systems. In particular, they noted the restraining impact of decision-models in use on individual decision making styles and the filtering of situational factors from the decision making process when non-behavioral decision models are applied. The constraint of style and situation suggests that non-behaviorally based decision support systems may alter normal reasoning processes in ways not intended by the system.

Learning and Collaborative Technology.

Recent research on the use of technology to facilitate learning processes is an important guide for this project. Shifts in learning theory from behavioral to cognitive dimensions are responsible not only for advances in teaching and learning, but also for advances in technologies such as artificial intelligence. CSCW systems bring people together to promote the exchange of information, to capitalize upon synergistic group dynamics, and to augment human capabilities with enhanced memory, search, organizational and computation tools. A basic definition of learning and the contributions of cognitive learning theorists are first mentioned below, followed by a review of studies that apply cognitive concepts of learning to research related to CSCW.

A thorough review of the contributions of cognitive learning theorists is that of Shuell (1986). Shuell's review traced the early seeds of the cognitive theories, compared later theory development to behavioral theories, and classified recent cognitive perspectives. For purposes of this study Shuell contributes two items: a definition of learning representative of the cognitive perspective and a characterization of the perspective that provides orientation to the summary of research to follow. As for a

definition of learning, Shuell provides the following broad analysis of the historical conceptions of learning:

> Nearly all conceptions of learning have involved – either explicitly or implicitly – three criteria for defining *learning* …: (a) a change in an individual's behavior or ability to do something, (b) a stipulation that this change must result from some sort of practice or experience, and (c) a stipulation that the change is an enduring one. (Shuell, 1986, p. 412)

More recent theories of cognitive processing, however, place less emphasis on behavioral outcomes, focusing upon the intellectual processes that mediate the stimulus-response relationship. Mental activities, including perception, thinking, knowledge representation, and memory as they pertain to human information processing and problem solving are the present focus of learning theory. Cognitive theorists rely upon behavior to reflect knowledge structures to reveal changes in cognitive states (Shuell, 1986, p. 414). To summarize the cognitive approach:

> …cognitive psychology has influenced learning theory and research in several significant ways, including (a) the view of learning as an active, constructive process; (b) the presence of higher-level processes in learning; (c) the cumulative nature of learning and the corresponding role played by prior knowledge; (d) concern for the way knowledge is represented and organized in memory; and (e) concern for analyzing learning tasks and performance in terms of the cognitive processes that are involved. (Shuell, 1986, p. 415)

Further, the above noted tenets have led theorists to recognize super ordinate processing functions that precede and govern the immediate learning environment. Thus, according to Shuell, cognitive processing involves:

(a) the role of metacognitive processes such as planning and setting goals and subgoals; (b) the active selection of stimuli: (c) the attempt by learners to organize the material they are learning, even when no obvious bases of organization are present in the materials being learned; (d) the generation or construction of appropriate responses; and [e] the use of various learning strategies. (Shuell, 1986, p. 415).

With the emergence of collaborative technologies, cognitive researchers have begun to consider the impact of information systems on learning. For example, Salomon (1990) considered cognitive effects both with and of computer technology. With technology an end-user can accomplish tasks while working with the technology that otherwise could not be achieved without it. Cognitive effects of a technology, however, differ in that the use of some technologies build capabilities that can be applied outside the use of that technology. According to Salomon's analysis three factors determine whether children's task accomplishment with computer technology will be improved: "the setting in which the activity is carried out, the perceived purposed of the activity, and the child's [learner's] task-related mindfulness" (p. 32). Concerning lasting effects of computer technology, Salomon suggests that end-users encounter skill activation, which requires use of a given skill, and skill internalization, which implies a degree of capability to perform without the computer aid. Salomon concludes:

…certain types of computer programs afford the opportunity for an intellectual

partnership that can be realized when the human users are sufficiently mindful

during interaction. Under such conditions, strong effects with the computer can be

expected, manifested by the engagement of higher order thinking skills that would

not have become employed without the partnerships. Whether such a partnership

also leaves some cognitive residue later on, either through skill stretching or

through skill internalization, greatly depends on the wider context in which the

partnership with appropriate computer programs takes place (Salomon, 1990, p.

41).

The preceding foundational concepts proved a basis for research in computer-

supported cognition. Following are examples of current research attempting to isolate

specific variables that play a role in facilitating learning through technology, particularly

in group contexts.

Phillips, Santoro, and Kuehn (1988) determined that computer supported

communication was as effective as traditional instruction in a group problem solving

course. Students and instructors in the experimental group appreciated benefits of

computer support and performed as well as students in the traditionally delivered course.

Shlechter (1990) assigned experimental subjects in groups around one computer

for computer-based instruction (CBT) and compared completion time, learning difficulty,

and resistance to forgetting with a control group consisting of individuals using the same

CBT at one computer alone. Grouped participants were not encouraged to collaborate.

While learning achievement did not differ, collaborative groups experienced greater

learning efficiency as determined by reduced training time, decreased proctor support, and content retention.

Shedletsky (1993) discussed the nature of change implicit in the use of computer-mediated communication and why this change occurs in terms of learning theory. Using an email-based interpersonal (conversational) approach, he identified four levels of learning that may help participants learn: response, situation, transsituation, and transcencence. He reasoned that when a participant switches from natural to computer-mediated communication he or she is more likely to shift from lower level (response and situation) learning to higher levels (transsituation, and transcencence).

Leidner and Fuller (1997) compared case study learners using a group support system with learners working individually on case studies. They found that students working collaboratively in either small or large groups were more interested in the material and perceived themselves to learn more than students that worked individually. However, students working individually outperformed students that collaborated in small or large groups.

Morrissey (1997) considered the use of groupware in case-based management education to overcome logistical problems commonly associated with geographically dispersed learning groups, to enhance the quality of case solutions, and to enhance the processes groups undertake in developing case solutions. Results indicate that part-time groups using groupware showed improved quality of case preparation and analysis over other groups.

Luetkehans (1998) devised a learner-centered collaborative learning environment and analyzed participant use and factors that influence participation. While the

experimental learning environment provided a wide array of collaborative tools, participants reverted mainly to email. Possible methods to increase participant acceptance of the tools included: assessment and preparation of learners for the learning environment, ongoing community building and other short activities, providing extra time for management issues, training, and practice, and selecting collaborative learning tools based on functionality in a learning environment as well as the types of activities to be supported.

Hilmer and Dennis (2000) experimented with techniques to improve attention and integration of information. Groupware categorizing tools were used to require participants to attend every comment produced through the group activity and to categorize each comment as either important or not important. By categorizing based upon importance, researchers hypothesized that attention and categorization behaviors will enhance individual member integration of concepts. Results were mixed but suggest that groupware activities can be structured to improve attention and integration factors related to decision quality. Those participants that did consider and evaluate the importance of every submission did integrate more information, which improved decision quality.

Vogel, Lou, van Eekhout, van Genuchten, Verbeen & Adams (2000) explored distributed collaborative experiential learning through a project with ten student teams from one Asian and one European university. Student teams used email, videoconferencing and GroupSystems for synchronous and asynchronous interaction during the seven-week project. High and low performing teams were identified and high performing teams judged their own interaction quality using the collaborative technology

to be adequate for the task, while low performing teams determined their own unsupported interaction to be inadequate.

Kwok, Ma, & Vogel (2000) postulated that traditional facilitation and group support systems, together and separately, enhanced personal and social components of knowledge acquisition. They theorized that intentional and meaningful student feedback in a collaborative learning group promotes assimilation of new information, which in turn, stimulates learner interaction and promotes accommodation of new information to restructure mental models. Results of analysis determined that using both group support systems and content facilitation contributed to both the assimilation and accommodation processes. It is conjectured that the fundamental principles of learning are facilitated by the unique features of collaborative learning tools and by an anonymous content facilitator who does not display dominance over the group, but instead provides knowledgeable support for meaningful learning.

Weatherall (2000) documented the application of the use of a group support system to enhance a business training course, indicating significantly increased participant satisfaction and a 75% reduction in course length. Following the training principles of Kirkpatrick and Mager, Weatherall used a group support system to garner learner feedback when presenting course objectives, to obtain feedback related to learning activities during the course, and to survey participants about satisfaction and expected value of the course material upon completion of learning activities. The proposed application did not involve learning enhancement or changes to delivery of instruction. Findings indicate collaborative technologies can support fundamental training principles.

Citing the recent increase in research of groupware applications in classroom learning, Khalifa, Kwok, and Davison (2001) determined that process facilitation, employing a less structured and open facilitation style, is more influential than content facilitation with respect to knowledge acquisition. The authors clarify two learning theories currently associated with collaborative technologies: Collaborative Learning Theory (CLT) and Process Restricted Adaptive Structuration Theory (PRAST). The former theory establishes a less restrictive framework for process facilitation, while the latter promotes a more highly structured and restrictive form of process facilitation. Essentially, the facilitator must decide how structured the facilitation process must be, and therefore, how much restriction will be placed upon collaborative learners in their efforts to acquire knowledge. In addition, the degree of contribution to content in group activities may also play a role in learning, with some facilitators taking a non-contributory role and others taking active membership in the group as a content contributor or guide. Tools in GroupSystems were used to set process and content restrictiveness levels for the experiment. While *content* facilitation restrictiveness played no role on process and outcome of collaborative learning, results noted a significant inhibiting effect of *process* restrictiveness on learning process and outcome.

Miao and Haake (2001) developed and tested CROCODILE (the CReative Open COoperative DIstributed Learning Environment), a problem-based learning system that uses hyperdocuments that analogously represent a campus instructional context. The system makes available an open workspace linked to a separate storage area and promotes social interaction in accordance with Vygotsky's theoretical Zone of Proximal Development. Relying on the principles supporting socially constructed knowledge,

CROCODILE supports learner initiated engagement, but does not prescribe a specific path for knowledge creation or acquisition. General responses from implementation indicate that "experience and skills of social interaction in the real world can be intuitively reused in CROCODILE" (Miao & Haake, 2001, p. 9).

Briggs, de Vreede, Nunamaker, and Tobey (2001) recast the unit of analysis for group support system effectiveness by introducing thinkLets, which they define as "the smallest unit of intellectual capital required to create a repeatable, predictable pattern of thinking among people working toward a goal" (p. 2). A thinkLet has three components: a tool, a configuration, and a script, each of which can be altered to produce different group support system application results. Authors argue that group support system research often reports overall outcomes, but does not consider the level of detail involved in thinkLets. Such generalized analysis has led to apparently inconsistent research findings. thinkLets direct groups through any of seven basic patterns of thinking, according to the authors: diverging, converging, organizing, elaborating, abstracting, evaluating, and consensus building. The recognition of thinkLets directs researchers to a level of thought not previously recognized within group support system research.

To conclude, a variety of concepts from numerous theoretical perspectives may provide insight into the use of collaborative technologies for learning in an organizational context. The concepts addressed thus far emphasize communication as a means to transfer not only content but also structures and frameworks that influence how receivers integrate content. Structuring concepts are reflected in the three theoretical models promoted via linguistic theory, adaptive structuration theory, and mental model transfer theory. Researchers from diverse disciplinary camps have used these perspectives to

pursue paths of study conceptually similar to recent advances in learning theory –

specifically, constructivist learning theory. Further, researchers appear willing to employ

a wide array of group-, technology-, and learning-based research agendas in pursuit of

releasing the power of collaborative technologies. In the next chapter, the research plan

for capitalizing of these concepts is presented.

CHAPTER 3

IMPLEMENTATION

Identified Population – Subjects

Undergraduate students in four sections of a Business Communications course at a small southeastern university, N = 106, will serve as the population for the study. Subjects represent all areas of study within the bachelor of business administration program, including: Management, Marketing, and Real Estate; Accounting, Finance, and Economics; and, Information Systems. Two members of the population represent non-business disciplines. Subjects enrolled in the course to meet major or minor program requirements. The majority of subjects are in the third year of study, have completed the pre-business core, and have completed several courses in their respective areas of emphasis. The business communication course surveys a wide range of communication issues related to general business functions. Subjects undertook learning projects on topics such as communication theory, intercultural communication, grammar and syntax, report writing, letter writing, job application and resume writing, electronic communication, and persuasive writing.

Identified Sample

Nine (9) groups of eight (8) students will populate six (6) experimental groups and three (3) control groups (n = 8). Students not selected for experimental or control purposes will undertake an unrelated learning experience, if necessary. Subjects within

three course sections will be randomly assigned to one of three groups: a GSS group, a Chat group, or an Oral group.

<u>Task</u>

Subjects in the GSS, Chat, and Oral groups will be assigned to read a case study illustrating a business problem, devise a plan to resolve the problem, and write the plan for presentation to a fictitious company president. The Lazy-Days Manufacturing Case (Johnson and Johnson, 1991) provides a rich context for discussion, debate, and planning (see Appendix A). However, the case lacks evidence of a single correct solution, which helps ensure the text of the case does not bias subjects toward a specific plan. The case is brief, somewhat complex, but not beyond the subjects' experience level.

The case supports the research objective of identifying incidents of structural transfer in several ways. First, all discussion among group members will be recorded, providing a document for analysis. Second, since there is no evidence for a single best solution, subject's perceptions and recommendations should become the basis for devising the plan. This will allow sufficient opportunity for imposition of a subject originated mental model as opposed to the discovery of an existing mental model within the text of the case. Third, the case is realistic, providing subjects with a problem they can envision facing on some level in the future. This factor enhances the likelihood that subjects will more fully engage in the problem-solving process, which should give opportunity for this level of involvement to be reflected in posttest results, should changes in cognitive processing actually occur. Fourth, the case is not media-dependent. This factor ensures that the mode of content delivery does not bias subject responses. All problem-solving group members will receive the same, one sheet photocopy of the case.

Fifth, discussion time for the case is thirty-five (35) minutes, sufficient to generate ideas, discuss the ideas, and develop a plan. This factor reduces the potential for fatigue.

Independent & Dependent Variables

The main independent variable is the mode of interaction used by group members to develop a solution to the case problem. Three modes are utilized: GSS, Chat System, and Oral Communication. Groups using the GSS will use a hardware system composed of networked computers and a collaboration software package (GroupSystems™) will read the case individually and interact with group members using the software. Human facilitation will be minimized, ensuring that guidance will come from subjects and inherent features of the tools employed by the software. Subject decision-making activities are organized by the collaboration software in accordance with specific tools applied at key points in the group discussion. Tools applied in this case include, brainstorming, voting, commenting, and outlining. Group members can enter comments into the system simultaneously and can visually read any previous contributions within the tool. The discussion will be organized into time periods, associated with each tool. For example, a brainstorming period will last for ten minutes.

Groups using the Chat System will use a hardware system composed of network computers and chat software package (VyChat™). The chat software does not provide collaborative tools such as those provided by the group support system, but provides subjects with a blank screen for text composition and like the group support tool above, permits simultaneous contribution. Participants can also scroll through the text and review all previous contributions. Group members will be directed to each phase of the discussion on the same schedule as those in the GSS groups.

The Oral group will use no information system support, relying instead upon verbal interaction to proceed through each phase of the discussion. Members of this group may take notes, but may not share written material with other group members. As is typical in a group discussion, subjects must take turns to contribute effectively.

Another independent variable is that of a priming agent used to suggest structure. An organization chart will be randomly distributed with the one sheet case study to half of the case study participants in each group (See Appendix B). The chart references organizational entities typically found in small manufacturing firms. The purpose of the chart is to suggest that solutions to the case may involve actors or entities from various parts of the organization. Use of the chart in each group is warranted to control for group-related intervening variables..

Dependent variables include the pretest and posttest scores on the Kolb (1984) Learning Styles Indicator (LSI) and frequency of ditransitive structure in group discourse. Subjects will be pretested (See Appendix C) approximately two (2) weeks prior to undertaking the case study. Immediately following the case study the posttest (See Appendix D) will be administered. In the pretest subjects will be asked to complete the instrument in the normal fashion, reflecting upon general tendencies in their learning experiences. However, for the posttest, subjects will be asked to reflect upon their immediately preceding experience, the case study. Differences in pretest and posttest scores will suggest whether changes in learning style occurred during the preceding activity.

Pretests will be conducted approximately two weeks prior to treatment. Subjects attend the business communications course two or three times weekly, where the instruments will be administered. From the sample frame subjects will be randomly assigned to treatment levels. During the week of treatment, treatment groups (n = 8) will be excused from class to enter either the Collaborative Technologies Laboratory or a conference room to analyze the case. Posttests will be conducted during the last ten minutes of the case analysis time period. Subjects will reflect upon the case analysis event when completing the posttest. Transcripts of GSS and Chat sessions will be saved to text files and a file back-up copy will be made for security purposes. Video recorded tapes of Oral discussion sessions will be provided to transcribers for word processing. After the Oral sessions are word processed, back-up copies will be secured.

Methodology

Groups will be established by random selection and assignment. Each course section will be represented by both treatment levels and the control group. Thus, subjects within each course section have an equal opportunity for placement into the GSS, Chat, and Oral groups. This method of sampling controls for factors related to time of day, differences in instructional level or instructor style, and extraneous environmental factors.

The research employs a completely randomized factorial design (CRF-*pq*), crossing three modes of communication with two levels of structural primer. Analysis may reveal differences among treatment and control groups in pretest and posttest scores on the LSI and in frequency of ditransitive verb structure. Significant differences on dependent measures along the lines of communication mode and existence of a primer

will indicate that structural transfer may be facilitated or prohibited by using a collaborative technology, either with or without a priming device.

Procedure

Preparation for treatment and data collection will begin prior to admitting subjects into the computer laboratory. The GroupSystems or Chat software will be loaded and each computer will be logged on to the network. Handout materials will be arranged for quick distribution. Multiple diskettes will be available to save and backup data generated during the activities. Alternatively, the conference room will be prepared for Oral group participants by setting up the video recording system, preparing handout materials, and properly arranging the conference table. The exact number of chairs as participants will be provided to ensure participants do not isolate themselves by sitting at a distance from other participants.

At the beginning of the class period the researcher will draw slips of paper marked with the pseudonym of each subject in the sample frame from a cup. Subjects will be randomly assigned to either one of the treatment groups or the control group without replacement into the pool, since a subject can participate in no more than one (1) group. Upon identifying eight (8) subjects, the researcher and subjects will retreat to either the laboratory or the conference room to conduct the activity.

When subjects enter the laboratory they will be asked to take a seat at one of notebook computers that is turned on. It will not matter where subjects sit in the GroupSystems or Chat groups because they will not engage in oral discourse during the activity. Members of Oral groups will be asked to take a seat at the conference table. The researcher will read the instructions to the group (see appendix E).

After soliciting and answering questions for clarification of the task, the instructor will demonstrate how to enter a pseudonym into the system in place of the system-assigned station code or will direct Oral groups to mark their respective identification pseudonyms on name cards for video taped conversation tracking . In both GroupSystem and Chat systems, entering the pseudonym is a one-time activity at the beginning of the task session. Slips of paper containing pseudonyms of participants will be drawn from a cup to determine which participants will receive organization charts. Those with charts will augment their pseudonyms with the letter "c" and those without will augment their pseudonyms with the letter "x." After successfully entering the pseudonym, the instructor will demonstrate how the pseudonym protects identity and how to enter comments into the system. Oral groups will be informed that the session will be recorded on videotape and that their comments will be transcribed into word-processed documents. Oral group members will be asked to write their pseudonym on a place card, which will facilitate the assignment of specific comments to specific contributors during the transcription process.

Materials consisting of a copy of the case study and an organization chart will then be distributed to participants. Each group member will receive a copy of the case and those randomly assigned the organization chart will receive the chart.

The researcher will then advise participants that it is time to begin and that after reading the case aloud they may begin typing or discussing the case. At that time the case will be read aloud. During the case the researcher will prompt participants to prepare a change to the next phase of the discussion. All groups will follow the same general structure for the discussion: brainstorming, discussion, and writing. The GroupSystems groups will follow the system-based agenda requiring brainstorming, voting,

commenting, and outlining a plan. Chat groups and Oral groups will be advised of a plan to successful decision-making involving brainstorming, identifying the best ideas, discussion, and writing. For GroupSystems groups, prompts for each phase is built into the decision process. For other groups, the plan for successful decision-making will be presented only at the beginning of the session, with a few time management related prompts interjected during the discussion.

At the end of thirty-five (35) minutes groups will be advised to end their work and present their plans. Participants will be thanked for their contributions and asked not to divulge any aspect of their experiences in the session until the study is complete.

Instrumentation

To conduct the ditransitive structure frequency count, raw end-user text files will be filtered using the AMALGAM linguistic analysis software program that sifts individual lines of text and reports pre-coded parts of speech. In this case, the pre-coding will identify verbs. The verb report will be used to count verbs indicative of ditransitive structure and produce a measure of language structuring.

Kolb's (1986) Learning Style Instrument (LSI) will be used for pretest and posttest purposes. Post-experimental analysis of ditransitive verb structure frequencies, group product quality (Lazy-Days Case results), and treatment level (GSS, Chat, or Oral) may indicate the conditions under which groups leverage collaborative technologies to support transfer of knowledge to the group level.

David Kolb's Leaning Styles Inventory (LSI). Drawing on a broad range of learning theories, Kolb (1984) proposed a theory composed of two bi-polar constructs that purport to explain the multi-dimensional quality of learning. The prehension

dimension is concerned with the learner's interaction *with* phenomena: apprehension versus comprehension. The transformation dimension is concerned with the learner's action upon encountering the phenomenon: intension versus extension. Concerning the nature of prehension, Kolb suggests that some learners gravitate toward concrete experiences, while other gravitate toward more abstract conceptualizations in learning practice. With respect to transformation, Kolb indicates some learners rely more upon active experimentation while others lean on reflective observation. While individual learners may vary widely in these tendencies based upon the factors unique to a specific situation, Kolb theorizes that learners have tendencies in learning behavior that can be reflected in historic learner behavior. In fact, by overlaying (orthogonally) the prehension and transformation constructs, Kolb attempts to categorize these tendencies according to knowledge style (divergent, assimilative, convergent and accommodative) and has used this kind of report to contribute to a wide variety of organizational and social concerns.

Kolb has strengthened the instrument and it continues to be used widely for many popular applications. The construct relates many foundational theoretical principles and provides users with a fairly simple way of reflecting on their own behavior (high face validity). The LSI can be an easier way for organizational trainers and developers to introduce concepts to individual and group members who seek to use technology to enhance group and organizational effectiveness. Finally, the LSI can be reworded to produce a posttest measure to support reflection upon a specific event, which in the case of this study will be the experimental treatment.

The LSI has been a flexible research instrument. However, one use that is similar to the application in this study is in the analysis of learning in conversational behavior.

Jensen and Kolb (2000) mapped conversation participation behaviors onto participant learning styles to determine whether experience in conversation serves to affect learning. Analysis indicates "learning styles influence the ways individuals participate in and make sense of their experience in conversation" (Jensen and Kolb, 2000, p. 294). Overall, participants with learning styles emphasizing concrete experience tended to use conversation styles such as reasoning and reflecting (Stream I), expressing and interacting (Stream II), and attending and appreciating (Stream III). Participants with learning styles emphasizing abstract conceptualization tended to use conversation styles such as interacting and conceptualizing (Stream IV) and listening and analyzing (Stream V).

Differences in conversational orientation and learning style suggest several strategies for improving learning for conversants. According to Jensen and Kolb (2000),

Conversations that highlight ideas and concepts can provide an entry point for learners with an abstract orientation. Conversations in which participants share their experience and feelings provide an entry point for learners with a concrete orientation. A key implication of this finding is that it is important to create multiple entry points into conversation for participants with varied learning preferences. Individuals may be silent because they are not connecting to what is being talked about. (Jensen and Kolb, 2000, p. 294).

In addition, learning improvement may be achieved by structuring conversations in such a way as to develop a given conversant's weaker learning style. According to Jensen and Kolb,

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By developing new patterns of apprehending and transforming experience, learners can increase their repertoire of knowledge acquisition. Thus for more concrete oriented learners, this could include developing more abstract and cognitive patterns. A learner who is used to hands-on activities might seek out ways to enhance their understanding of specific discipline concepts and the ability to analyze more systematically a situation or problem. For more abstract oriented learners, this could include developing ways to perceive through their senses and attend to their feelings in diverse situations. One critical area where expanding the learning style repertoire can happen is in conversation. As learners focus on the meaning of learning differences within a group, they find access to other ways of approaching the learning task as peers model other perspectives within the group interaction. This conversation offers learners the challenges and opportunities they need to stretch their learning style and embrace the cycle of learning in a more holistic way. (Jensen and Kolb, 2000, p. 294).

Results of the study are presented in the next chapter.

CHAPTER 4

RESULTS

Analysis of data proceeded along four paths: effect of medium on amount and complexity of language organization; effect of primer on amount and complexity of language organization; effect of medium on learning style; and, effect of primer on learning style. Treatment group assignment (medium) and exposure to a priming agent (primer) served as independent variables. Grammatical and syntactical frequencies and coefficients derived from pre- and post-test Learning Styles Inventory (LSI) administrations comprised the dependent variables. Thirty-four subjects (N=34) of the 52-subject sample frame participated in the linguistic structure portion of the study. Only two of the three media groups (Chat [n = 18] & GSS [n = 16]) were included because the videotapes of subjects undertaking the case study orally (n =18) were inaudible. Forty-five subjects (N=45) completed the learning styles portion of the study (Oral [n =18], Chat [n = 14], GSS [n=13]). Seven of fifty-two subjects failed to complete the LSI correctly, eliminating these subjects from the latter analysis. The results of analysis and a determination of the support or non-support of associated hypotheses are reported below.

Effect of Medium on Amount and Complexity of Language/Organization

The first analysis considered various grammatical and syntactical frequencies to determine whether to accept or reject Hypothesis 1:

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H1: There will be no differences in [the organizational quality of language as presented in] the frequency of ditransitive verb structure among oral, chat, and GSS groups.

Independent samples t-tests on the medium variable by considering specific indicators or structures of communication attributed to each group member: number of words, number of verbs, ratio of verbs to words, number of utterances, number of organizational ditransitive verb (ODTV) structure occurrences, and ratio of ODTV structure occurrences to utterances. Results are found in Tables 1 and 2, below.

Table 1

Differences in Amount and Type of Communication (Words & Verbs) by Medium

	Medium	N	Mean	Std. Deviation	Std. Error Mean	Effect Size
Words	CHAT	18	301.33	138.95	32.75	1.12
	GSS	16	166.31	96.41	24.10	
Verbs	CHAT	18	53.17	24.52	5.78	1.20
	GSS	16	28.50	14.82	3.71	
Verb Rate	CHAT	18	.1791	.0239	.0056	.09
	GSS	16	.1766	.0299	.0074	

Table 2

Differences in Amount and Type (Contribution & Linguistic Structure) of

Communication by Medium

	Medium	N	Mean	Std. Deviation	Std. Error Mean	Effect Size
Utterances	CHAT	18	36.56	22.35	5.27	1.73
	GSS	16	7.25	2.74	.6862	
ODTV freq.	CHAT	18	4.61	3.24	.7633	.1799
	GSS	16	4.13	1.93	.4820	
ODTV Rate	CHAT	18	.1388	.1083	.0255	2.81
	GSS	16	.5959	.2079	.0519	

Chat groups produced significantly more words (t[32] = 3.25, p = .002) and verbs (t[28] = 3.59, p = .001) than did their GSS counterparts. However, the ratio of verbs to words between Chat and GSS groups did not differ significantly (t[32] = .265, p = .795). Chat groups produced significantly more utterances (t[18] = 5.516, p = .0005) than did their GSS counterparts, but did not produce differences in the frequency of organizational ditransitive verb structure frequency (t[32] = .523, p = .594). The ratio of ODTV frequency to utterance between Chat and GSS groups did differ significantly (t[32] = -8.172, p = .0005). Hypothesis 1 is partially supported. What group members produce more words and verbs than did GSS members. But proportionately, the verb to word ratio did not differ. Chat group members contributed more frequently than did their GSS counterparts. GSS group members were more likely to make contributions representing

the ODTV structure than were Chat group members. No other differences are indicated in the data.

Effect of Priming Agent on Amount and Complexity of Language/Organization

The second analysis considered the same grammatical and syntactical frequencies to determine whether to accept or reject Hypothesis 2:

H2: There will be no difference in the frequency of occurrence of ditransitive verb structure in [the organizational quality of language as presented in] discussion transcripts between primed and non-primed participants in any of the two groups.

Results are found in Tables 3 and 4, below.

Table 3

Differences in Amount and Type of Communication (Words & Verbs) by Primer

	Primer	N	Mean	Std. Deviation	Std. Error Mean	Effect Size
Words	No Chart	16	240.31	146.10	36.53	.0341
	Chart	18	235.56	133.21	31.40	
Verbs	No Chart	16	41.38	25.49	6.37	.0144
	Chart	18	41.72	22.91	5.40	
Verb Rate	No Chart	16	.1749	.0321	.0080	.2127
	Chart	18	.1806	.0208	.0049	

Table 4

Differences in Amount and Type of Communication (Words & Verbs) by Primer

	Primer	N	Mean	Std. Deviation	Std. Error Mean	Effect Size
Utterances	No Chart	16	23.81	23.53	5.88	.0883
	Chart	18	21.83	21.07	4.97	
ODTV freq.	No Chart	16	4.31	2.73	.6814	.0486
	Chart	18	4.44	2.71	.6377	
ODTV Rate	No Chart	16	.3051	.2641	.0660	.3292
	Chart	18	.3973	.2970	.0700	

Subjects without an organization chart produced slightly but not significantly more words ($t[32] = .099$, $p = .922$) than did their primed counterparts. Further, the presence of a priming agent did not produce differences in the verb frequency ($t[32] = -.042$, $p = .967$). Also, the ratio of verb frequency to words between primed and non-primed groups did not differ significantly ($t[25] = -.596$, $p = .557$). Primed groups produced no more utterances ($t[32] = .259$, $p = .799$) than did their non-primed counterparts. The frequency of organizational ditransitive verb structure frequency ($t[32] = -.141$, $p = .888$) did not differ between the two groups. The ratio of ODTV frequency to utterance between primed and non-primed groups did not differ ($t[32] = -.951$, $p = .345$). Hypothesis 2 was supported. Primer appeared to have no effect on the number of words produced, number of verbs, the ratio of verbs to words, the number of utterances, the occurrence of organizational ditransitive structure, or ODTV rate.

In addition to the linguistically based results presented above, the data was also explored for changes in cognitive function during the treatment. Kolb's (1984) Learning Styles Inventory served as pre- and post-test measures to identify and characterize possible changes in cognitive processing when undertaking the case study. Pre- and post-test comparison is made by conducting separate calculations for each dimension because the LSI combines measures along two perpendicular continua (AE – RO & AC – CE). The third and fourth hypotheses were tested to determine whether changes in cognitive processing occurred:

> H3: Oral, Chat, and GSS group Posttest scores will not differ from their respective Pretest scores on the LIS3.

> H4: Changes in Pretest-Posttest scores will not different between Oral, Chat, or GSS groups.

> To test H3, a mixed-model ANOVA using a 3 x 2 design on medium and

occasion factors, with repeated measures on occasion factor, was employed to determine the effect of discussion medium upon the Active Experimentation – Reflective Observation (AE – RO) dimension of the LSI. Table 5 presents mean scores for the computation.

Table 5

Mean LSI Scores (AE – RO Dimension) by Medium

	Pretest LSI Measures	Posttest LSI Measures	Mean (Medium)
Oral	3.72	-2.00	.861
Chat	8.86	6.50	7.68
GSS	6.46	1.08	3.77
Mean (Occasion)	6.35	1.86	

A similar mixed-model ANOVA using a 3 x 2 design on medium and occasion factors, with repeated measures on occasion factor, was employed to determine the effect of discussion medium upon the Abstract Conceptualization – Concrete Experience (AC – CE) dimension of the LSI (H4). Mean scores of the AC-CE dimension for each level of communication are in Table 6.

Table 6

Mean LSI Scores (AC-CE Dimension) by Medium

	Pretest LSI Measures	Posttest LSI Measures	Mean (Medium)
Oral	4.72	3.78	4.25
Chat	2.00	5.79	3.89
GSS	8.15	4.69	6.42
Mean (Occasion)	4.96	4.75	

Medium (Oral, Chat, or GSS) had no effect on changes in pretest and posttest scores on the AE-RO dimension of the LSI. When considering the medium factor $F(2,42) = 2.30$. $p = .111$. When considering the occasion factor $F(2, 42) = .375$, $p = .690$). Medium (Oral, Chat, or GSS) had no effect on changes in pretest and posttest scores on the AC-CE dimension of the LSI. Differences among group mean scores were not significant for either Medium ($F[2, 42] = .576$, $p = .566$) or Occasion ($F[2, 42] = 1.581$, $p = .218$). Both H3 and H4 are supported. Oral, Chat, and GSS group Posttest scores did not differ from their respective Pretest scores and amount of change in Pretest-Posttest scores between Oral, Chat, or GSS groups was not significantly different.

Effect of Primer on Learning Style

Some subjects were provided an organization chart, suggesting organizational complexity, while the remaining subjects were not. Two hypotheses addressed the use of the primer as a potential factor on changes in cognitive processing: H5: Primer and Non-Primer group Posttest scores will not differ from their respective Pretest scores on the LIS. H6: Changes in Pretest-Posttest scores will not different between Primer and Non-Primer groups. As before, analysis must be conducted on the AE – RO and AC – CE dimensions separately.

A mixed-model ANOVA using a 2 x 2 design on primer and occasion factors, with repeated measures on occasion factor, was employed to determine the effect of the organization chart priming agent upon the Active Experimentation – Reflective Observation (AE - RO) dimension of the LSI. Mean scores of the AC-CE dimension for each level of communication are in Table 7.

Table 7

Mean LSI Scores (AE - RO Dimension) by Primer

	Pretest LSI measures	Posttest LSI measures	Mean (Primer)
Without organization chart	3.96	-2.25	.8540
With organization chart	8.57	5.86	7.21
Mean (Occasion)	6.27	1.80	

In the same manner a mixed-model ANOVA using a 2 x 2 design on primer and occasion factors, with repeated measures on occasion, was employed to determine the effect of discussion primer upon the Abstract Conceptualization – Concrete Experience (AC – CE) dimension of the LSI. Mean scores of the AC-CE dimension for each level of communication are in the Table 8.

Table 8

Mean LSI Scores (AC – CE Dimension) by Primer

	Pretest LSI measures	Posttest LSI measures	Mean (Primer)
Without organization chart	5.96	4.33	5.15
With organization chart	3.62	5.05	4.33
Mean (Occasion)	4.79	4.69	

Primer did have an effect on changes in pretest and posttest scores on the AE-RO dimension of the LSI. Changes in scores representing primed versus non-primed groups

(between groups) differed significantly (F[1, 43] = 6.039, p = .018). However, within-groups changes from pre-test to posttest were not significant (F[1, 43] = 1.045, p = .312). Primer (presence or no presence of organization chart) had no effect on changes in pretest and posttest scores on the AC-CE dimension of the LSI. Differences between group mean scores were not significant (F[1, 43] = .167, p = .685). Further, within-groups means scores did not differ either (F[1, 42] = .865, p = .357). Consequently, H5 was partially supported. Primer and Non-Primer group Posttest scores did differ from their respective Pretest scores on the AE – RO dimension LSI, but not on the AC – CE dimension. H6 was supported, indicating that the amount of pretest – posttest change occurring in any one of the groups did not differ significantly from the amount of change evident in any other group.

Overall, Chat groups produced more language than did GSS groups, while GSS groups employed a greater amount of organizational ditransitive verb structure than did Chat groups. While the ratio of verbs to words did not differ among Chat and GSS groups, fewer instances of verbs coupled with increased frequency of ODTV structure may indicate increased organizational quality of GSS-mediated language. Presence of the priming agent made no impact the organizational quality of language between groups. Regarding cognitive processing, media made no impact on LSI scores. However, while the priming agent did not impact AC – CE scores, it did impact AE – RO scores suggesting a change in the reflective quality of thinking while using the organization chart as a priming agent.

CHAPTER 5

DISCUSSION

Results of the analysis provide evidence to suggest that using different modes of computer-mediated communication can facilitate different levels of language complexity and that specific kinds of priming agents can alter learning style in group problem solving contexts. Language complexity and complexity primers, such as the organization chart used in treatment groups, may enhance group members' ability to conceive, employ, and share complex perceptual frameworks. Variations in language complexity and learning style among the various media and primer treatment groups signals evidence for the transfer of perceptual frameworks, suggesting that learning among group members occurred. Regardless of the fact that group solutions differed, one can argue that cognitive processing at the individual level appeared to have been impacted by the independent variables and that group performance was affected accordingly by the impacted individual contributions.

A number of issues are pertinent to the findings and will be addressed in the following order: impact of medium on language complexity, impact of primer on language complexity, impact of medium on learning style, and impact of primer on learning style.

The Effect of the Medium Variable on Language Complexity

Hypothesis 1 is concerned with how specific technology-based communication media may affect the structure of language used in group discourse to make a decision.

Differences in pretest and posttest measures related to language complexity may indicate that media choice can impact group member language and provide insight as organizational leaders, trainers, and educators make group process-related decisions.

It appears that use a Chat system and a GSS system did provide group members with different experiences as they undertook the case study. The volume of communication among Chat group members far exceeded that of GSS group members. Chat users produced more utterances, words and verbs to discuss the decision-making case. Although the ratio of verbs to words in Chat groups is proportionate to that of GSS groups, when considering the structure of communication, GSS groups employed the organizational ditransitive structure (ODTV) much more extensively than did Chat groups.

Inherent differences in GSS and Chat modes of communication may explain the different pretest-posttest measurement outcomes. First, the Chat system provides subjects with a simple text editing (input) area and a single scrollable text box for reviewing recorded text for the entire activity, from start to finish. This interface provided an open and freeform space for contribution, allowing group members to track the discussion and choose whether to contribute to the current topic or branch at will to other themes. Branching occurred frequently and themes became mixed toward the end of the discussion, much like an oral group activity. Some themes were unrelated to the case problem, such as joking and name-calling. Other contributions were related but not task supportive: "I didn't think it was going to be this hard."

GSS subjects used multiple tools that guided subject interaction during specific periods of time. Further, the ability to transfer content from one tool to another and reuse

the content for a different purpose allowed subjects to retain information while refocusing effort to a new purpose. GSS contributions were highly focused on purposes established by each tool. Given the open nature of the Chat system, it is therefore plausible that subject-directed focus facilitates more words, verbs, and utterances, while the GSS-directed focus facilitates more purposeful contributions from members. Salomon (1990) refers to a similar factor as task mindfulness. Thus, it could be that an effect of the GSS system is to enhance the group member's task mindfulness. Accordingly,

> Partnership with the best computer software may not suffice for higher order performance, because the intellectual partnership that affords higher order thinking demands the volitional expenditure of mental effort in carrying out such thinking. Without such mindful and effortful engagement, upgrading of performance through partnership with computer programs cannot be realized. (Salomon, 1990, p. 33)

Perhaps evidence for enhanced task mindfulness is found in the measurement differences in ODTV; communication complexity may reflect increased mental effort. As a unit of measurement the ODTV may be useful to objectively quantify mental effort, which can be used to support system design features, instructional objectives, and fitness for use in off-the-shelf applications.

The Effect of the Primer Variable on Language Complexity

The use of an organization chart as a priming agent appeared to have no effect on the number of words produced, number of verbs, the ratio of verbs to words, the number of utterances, the occurrence of organizational ditransitive structure, or ODTV ratio. Although the hierarchical nature of the firm was implied by use of small but definite

structural features, illustrated by departmental boxes and lines of authority common to typical organization charts, complexity in the chart apparently did not affect complexity of language structure. Subjects did not comment on the presence of the organization chart, although two separate Chat discussion transcripts include a single utterance reference to receiving different handout packages. Subjects posted no response to these comments, rather they continued with the ongoing line of discussion.

It may be appropriate to infer that the organization chart is an insufficient primer to promote complex description. However, other factors could have drawn attention to the priming agent. Without specifically noting the existence of an organization chart, the specter of case differences could have been inferred by the two-step distribution and coding procedure. To accommodate automatic comment coding in the Chat and GSS systems, group members were directed to enter specific, handout package related identification numbers that indicate whether they possessed an organization chart. The two handouts were distributed to each group in a two-step manner. Immediately preceding the case activity three group members were randomly assigned the either the primed or non-primed case handout. When the first round of case handouts were distributed to each group, subjects were instructed to append their subject identification numbers. The remaining handouts were then distributed and subjects with the second set of handouts were instructed to append their subject identification numbers with a different code. This procedure had the potential to alert subjects to differences in the handout packages, yet no differences in language complexity independent variables were recorded.

While it may be plausible to conclude that the priming agent contained insufficient efficacy to affect discourse, differences in LSI scores between primed and non-primed groups suggest the priming agent did impact learning style (see below). Thus, any explanation for lack of impact on discourse must account for differences in thinking and speaking behavior. Rationale for these apparently disparate findings ranges from simple to complex. For example, group members do not contribute all that they know about a given subject and much available information that is important to a solid solution is not communicated (Hilmer and Dennis, 2000). Thus, members may not have considered the hierarchy in the chart germane to the problem context. Perhaps a phrase in the case problem text such as "carefully consider all the information provided when making your decision" would reinforce the potential value of the organization chart to members.

A second possible reason that the priming agent appeared to make no impact upon language complexity is the overpowering presence of the computer-mediated communication environment. Subjects using either the Chat or GSS systems contended with three forms of communication during the activity: intrapersonal communication (thinking), written communication (handout), and computer-mediated communication. The remaining attention may have been directed toward the computer system used to transmit messages, with reference to the written materials on an as needed basis. Perhaps only after sufficient experience with the medium would subjects view the case problem material as a source for solutions as well as a description of the problem. This conjecture leads to consideration of the subjects' view of knowledge. Did group members rely upon information generated during the activity more so than upon information contained in the

case problem? This discussion leads to an array of issues related to constructivist learning theory not addressed in the present study. However, since for this portion of the study, analysis of the Oral group transcripts was unavailable due to muffled recordings, it is possible that differences occurred in Oral group and computer-mediated group language complexity measures. This information might provide insight into the affect of computer mediation and the primping agent not indicated in the current data.

Nonetheless, specific implementation strategies may enhance the value of the organization chart as a priming agent. First, group leaders and facilitators can make the organization chart salient by verbally citing it and developing questions to direct participants to reflect upon it. Second, the priming agent can be distributed independently of other information with sufficient time for it to have an effect. Third, the priming agent can be presented online, as a complement to digitally produced text, which may serve to enhance its value within the context of computer-mediated communication.

The Effect of Communication Media on Learning Style

Changes in AE – RO dimension and the AC – CE dimension on pretests and posttests were insignificant indicating that media has no impact upon the cognitive processing functions of group members. Several factors may have prohibited identifying a difference within and between scores. First, sample size may have been insufficient to detect real differences in scores. As noted in Table 10, power for both AE – RO and AC – CE measures was moderate to low. Doubling or tripling effect size could provide sufficient power to identify meaningful differences in the data. Second, although the LSI has been used for many years as a research and training tool, it may not be flexible enough to appropriately measure changes in learning style. Since the instrument has no

historical use as a tool to detect changes in learning style, analysis must be conducted to test such functionality. Third, and related to the previous comment, the time period of the activity may have been too brief to permit a measurement of change in learning style. While one might expect a difference between the Oral and either of the mediated methods, a single thirty-five minute experience may not have allowed subjects to transition to alternative learning styles. The impact of Oral, Chat, or GSS methods on learning style must be analyzed over varying time periods, as well as under conditions of intermittent and long-term use.

Fourth, the case activity may not have promoted opportunity for differing subjects or groups to fully express their learning style. The Lazy-Days case required subjects to operate within a set of parameters. The problem was well defined and explained in the case document. The recommended procedure for Chat groups was relatively structured (brainstorming, choosing, refining, and writing) and for GSS groups the agenda followed the same recommended procedure. Further, the output was predetermined – a written plan. Perhaps a more amorphous, less structured, problem context would promote varied thinking among and within groups.

The Effect Primer on Learning Style

Primer and Non-Primer group Posttest scores did differ from their respective Pretest scores on the AE – RO dimension of the LSI, but not on the AC – CE dimension. The nature of the orthogonal related dimensional constructs comprising the LSI grid suggest possible reasons that the AE – RO scores shifted as a result of the treatment, while the AC – CE scores did not. The AE – RO scores represent a bipolar construct, with the AE (Active Experimentation) dimension reflecting a practical orientation to

problem solving, emphasizing pragmatic behavior and direct involvement to take action. The RO (Reflective Observation) dimension differs by its emphasis on understanding and gaining meaningful insight from an experience, discernment of truth from falsehood, and impartial judgment. Posttest scores on this dimension indicate a shift from a moderate AE - RO score to one of a stronger Reflective Observation orientation. Several meanings may be inferred from this finding.

First, the nature of the case problem may produce more of a reflective observation behavioral set. However, since significant differences between primed and non-primed groups were found, with greater changes in scores among those using the organization chart as a priming agent, it is apparent that the priming agent impacted learning style during the treatment. A two-way ANOVA model may detect an interaction effect analyzing both Medium and Primer variables. However, given the sample frame available in this study, such analysis would produce insufficient group size to draw valid conclusions. Increased sample size will allow for such analysis. Various priming agents must be tested for their influence on learning style in group activity contexts.

Second, the organization chart may contain characteristics that predispose subjects to Reflective Observation type behavior. Unlike flowcharts, which favor the representation of processes and functions, organization charts tend to represent structures and relationships, which may direct subjects to more idealistic, less practical solutions. Though simplistic, the organization chart illustrates a solid hierarchy of executive management, mid-level management, operational management, and administrative support functions, with no job-level detail. The general nature of the chart along with simplistically represented reporting relationships may promote a sense of objectivity and

impartiality employed during typical Reflective Observation behaviors, which may bias group member performance in the case study. Different priming agent affects may increase the likelihood of media performance and decrease the probability of media-primer mismatch. Perhaps group members can be equipped with their own priming agents different from those of other group members, to facilitate higher level group interaction. Further, if these characteristics of the priming agent can encourage a Reflective Observation learning style, then perhaps different types of priming agents can be used to encourage other learning styles. Carefully crafted priming agents may have a developmental effect on group members, which can be used to enhance group performance in contexts with sub-optimal primer availability.

The AC – CE scores represent a bipolar construct, with the AC (Abstract Conceptualization) dimension reflecting conceptualization, analysis, and theory development and the CE (Concrete Experience) dimension reflecting intuitive thinking and feeling as well as focusing on immediate circumstances. While there were no significant changes in scores on the AC – CE dimension movement along the continuum does provide some contribution to the current study. Subjects unaided by a priming agent experienced non-significant score changes toward the Concrete Experience learning style while subjects possessing an organization chart recorded score changes toward the Abstract Conceptualization learning style.

Score changes in different directions on the AC – CE dimension may suggest that the priming agent may alter learning styles. Considering that differences between pretest and posttest scores on the AE – RO dimension were significant, a richer analysis of changes in learning style can be inferred. Further research using larger group size and a

broader range of problem contexts is necessary to determine more accurately the nature of shifts in learning style when using priming agents in distributed computing environments.

Overall, the fact that AE – RO scores with treatment differed and AC – CE scores did not may suggest that groups equipped with organization charts became less personally involved in the facts of the case, undertook and advisory roll with less personal concern and responsibility for the situation and its outcome. An orientation toward the Reflective Observation learning style

> focuses on understanding the meaning of ideas and situations by carefully observing and impartially describing them. It emphasizes understanding as opposed to practical application; a concern with what is true or how things happen as opposed to what will work; an emphasis on reflection as opposed to action. (Kolb, 1984, p. 68)

A combination of factors may have produced this effect including media effects, priming agent effects, case problem bias, priming agent bias, or undiscovered intervening factors. Findings of other studies in computer supported collaborative systems provide support to the conduct and outcome of this present study.

<u>Conclusion</u>

A major goal of this study was to understand whether collaborative technologies impact group member learning during the course of a group decision-making activity. It is apparent that different types of collaborative systems may affect structure of language employed in group discussion and that, while learning style changes were not present, there are myriad possibilities for establishing a link between technology and learning in

group contexts. As economic circumstances and technological achievements encourage leaders to consider new methods for collaborating and decision-making, the cognitive impact of technologically mediated group work must be addressed. This study participates in this endeavor by bringing together theories and constructs from the diverse conceptual frameworks of information technology, organization behavior and learning theory. Through such diversity collaborative technologies were imagined and created and it will be through such diversity that their disposition and utility will be determined.

Recommended Future Research

While many avenues for future research have been addressed above, several general areas are addressed below. Findings from this study suggest that researchers can make important gains by conducting research in the following areas: identifying effective cues and priming agents, devising valid and reliable learning assessment tools for use in group performance contexts, distinguishing the individual and aggregate effect of levels and types of computer-mediated support upon learning, and discovering new and objective units of behavioral observation in computer-mediated group communication.

There are perhaps many environmental cues that stimulate thinking for groups involved in a decision making process. More specifically, a computer supported collaborative environment may restrict, enhance, or in some way mediate these cues to impact group performance. Research into these areas can be helpful in understanding and more appropriately using collaborative systems if such factors are illuminated and understood.

This study employed an existing assessment tool, the Learning Styles Inventory, to assess changes in learning during treatment. Limited options were available when

determining which tool to employ. Since the LSI was not intended for this use, new tools with the purposes of assessing affects and changes in cognitive processing in computer-mediated environments can promote theory-building in this field.

A typology of computer-mediated support based upon their respective effects upon learning can assist researchers in better understanding existing and emerging technologies as well as practitioners as they use emerging technology in the workplace. From this research it is appropriate to hypothesize that there may be different effects of technologies and their subcomponent tools when deployed in group situations where learning is an inherent part of the group process.

Finally, researchers must discover new and objective units of behavioral observation that exist in computer-mediated group communication. Observing the transfer of a mental model can never be realized without some unit of direct observation. The organizational ditransitive verb structure and the derivative measures of change in learning style are not necessarily the most efficient indicators of learning transfer. Observational units may be found in the data pools normally collected during the process of using a collaborative technology or they may be identified by data collection methods working outside the collaborative technology system. Regardless of the source, a change in paradigm may be necessary to identify a unit of measurement that efficiently relates internal cognitive processes to group interaction in asynchronous group activities.

APPENDIX A

CASE STUDY

Lazy-Days Manufacturing

Lazy-Days Manufacturing Company is located in a small northern town. This small, family-owned business manufactures school furniture. Because of the opportunities for work available in a larger town located about 50 miles away, Lazy-Days must attract whomever it can and train them to do the job. Most of the 400 workers are women and young people just out of high school. Lazy-Days also hires some physically and mentally disabled adults as part of a special community program.

Until now, Lazy-Days has manufactured school furniture but, because of a tightening of the economy, management has realized a dire need to diversify its manufacturing capabilities. After a study of the market, the decision was made to add showroom display cases as a new product. If well made, this line will bring increased income and security to Lazy-Days Manufacturing.

Because of the difficulties in getting new workers, particularly trained ones, Lazy-Days would like to divert current personnel to the new jobs. However, the current workers are very set in their ways and are highly resistant to and suspicious of changes at work. The last time changes were needed, workers demanded higher wages, threatened to unionize, and a few key people quit. If the new line is successful, Lazy-Days could raise wages, but this is not possible under current conditions that require using available income to help purchase the new equipment and finance necessary remodeling to accommodate the new equipment.

Michael Days, president of Lazy-Days, has requested you to work with a communication team to develop a plan of action. Consider all the information provided and utilize your training in business communication, as well as other knowledge of management principles, to create a plan that will effectively persuade employees to commit to the new product line. Upon completion of this meeting you must provide to Mr. Days a plan of no more than one page, listing the specific steps you recommend, with sufficient information to describe each step. The first 35 minutes is reserved for discussion. The last 10 minutes of your meeting will be reserved for writing the list. Remember, your decision can make the difference between the success or failure of Lazy-Days Manufacturing Company.

APPENDIX B

Lazy-Days Manufacturing

```
                    ┌─────────────────┐
                    │  Michael Days   │
                    │   President     │
                    └─────────────────┘
        ┌───────────────────────┬───────────────────────┐
┌─────────────────────┐   ┌─────────────────┐
│ Administrative Support│  │    Marketing    │
│     Specialist       │  │ Sales Director  │
└─────────────────────┘   └─────────────────┘
```

Finance Administration Director	Shipping/Receiving Director	Manufacturing Director
Accounts Payable	Receiving	Desk Manufacturing Supervisor / Chair Manufacturing Supervisor
Purchasing	Packaging	Production
Accts Receivable	Shipping	Maintenance

Desk Manufacturing Supervisor:
- Production
- Maintenance

Chair Manufacturing Supervisor:
- Production
- Maintenance

APPENDIX C

LSI PRETEST

	A		B		C		D	
1. When I learn:	___	I like to deal with my feelings.	___	I like to think about ideas.	___	I like to be doing things.	___	I like to watch and listen.
2. I learn best when:	___	I listen and watch carefully.	___	I rely on logical thinking.	___	I trust my hunches and feelings.	___	I work hard to get things done.
3. When I am learning:	___	I tend to reason things out.	___	I am responsible about things.	___	I am quiet and reserved.	___	I have strong feelings and reactions.
4. I learn by:	___	Feeling.	___	Doing.	___	Watching.	___	Thinking.
5.When I learn:	___	I am open to new experiences.	___	I look at all sides of issues.	___	I like to analyze things, break them down into their parts.	___	I like to try things out.
6. When I am learning:	___	I am an observing person.	___	I am an active person.	___	I am an intuitive person.	___	I am a logical person.
7. I learn best from:	___	Observation	___	Personal relationships.	___	Rational theories.	___	A chance to try out and practice.
8. When I learn:	___	I like to see results from my work.	___	I like ideas and theories.	___	I take my time before acting.	___	I feel personally involved in things.
9. I learn best when:	___	I rely on my observations.	___	I rely on my feelings.	___	I can try things out for myself.	___	I rely on my ideas.
10. When I am learning:	___	I am a reserved person.	___	I am an accepting person.	___	I am a responsible person.	___	I am a rational person.

11. When I learn:	___	I get involved.	___	I like to observe.	___	I evaluate things.	___	I like to be active.
12: I learn best when:	___	I analyze ideas.	___	I am receptive and open-minded.	___	I am careful.	___	I am practical.

APPENDIX D

LSI POSTTEST

Place an "X" in the blank that best represents your belief about each item.

Your ID Number: _____

	A		B		C		D	
1. During the activity:	___	I relied upon my feelings.	___	I thought about ideas.	___	I thought about how to get things done.	___	I watched and listened.
2. I was able to be effective in the activity because:	___	I listened and watched carefully.	___	I relied on logical thinking.	___	I trusted my hunches and feelings.	___	I worked hard to get it done.
3. When interacting with others in my group:	___	I tended to reason things out.	___	I felt responsible for things.	___	I was quiet and reserved.	___	I had strong feelings and reactions.
4. Based upon my experience in the activity I can say that I learn by:	___	Feeling.	___	Doing.	___	Watching.	___	Thinking.
5. As I participated in the activity:	___	I was open to new experiences.	___	I looked at all sides of issues.	___	I analyzed things, broke them down into their parts.	___	I envisioned trying things out.
6. My contributions during the activity were a product of:	___	Recalling past observations of how people operate.	___	Actively trying things out.	___	Knowing what to do intuitively, using gut feeling.	___	Logically working it out.

7. What helped me best in the activity were:	___	Observations.	___	Personal relationships or connections with other participants.	___	Rational theories.	___	A chance to try out and practice.
8. What I appreciated most about the activity was:	___	Seeing results from my work.	___	Hearing new ideas and theories.	___	Reflecting on the discussion before acting.	___	Feeling personally involved in things.
9. My performance on this activity was helpful because I:	___	Relied on my observations.	___	Relied on my feelings.	___	Imagined trying things out for myself.	___	Relied on my ideas.
10. During this activity:	___	I was a reserved person.	___	I was an accepting person.	___	I was a responsible person.	___	I was a rational person.
11. During this activity I can best describe myself as being:	___	Involved.	___	Observant.	___	Evaluative.	___	Active.
12: The best thing about participating in this activity is that:	___	I could analyze ideas.	___	I could be receptive and open-minded.	___	I could carefully think it through.	___	I could contribute practical plans and solutions.

APPENDIX E

INSTRUCTIONS TO SUBJECTS

Instructions for Selecting Groups and Initiating Group Activities

1. Draw numbers (6) from pool into two piles (1 pile gets chart, other does not)

2. As if number is on board, follow me

3. Quickly distribute handouts, face down

4. System is already up; help each subject enter special ID number: 2 C SSN SID X or C

5. Read instructions

   We are simulating an online discussion because we cannot meet at the same place.

   Therefore, we are using a special chat messaging system to hold our discussion

   online. Please do not talk aloud. Instead type in your messages to other group

   members after reading the case study. A normal path to follow would be to

   brainstorm ideas, identify the best ideas, develop ideas, and develop the best ideas

   into an overall plan. You will have 35 minutes to discuss the issues and 10 minutes to

   formulate a plan.

6. Ask for questions

7. Start activity

8. Monitor

9. Check for decision readiness

10. Transition to Decision

11. End & Posttest

12. Request a vow of silence

APPENDIX F

LSI COPYRIGHT PERMISSION

Delete | Reply | Reply to all | Forward | Bounce | Resume | Save as   Back to INBOX

Date	Tue, 13 Mar 2001 12:39:45 -0500
From	EI@haygroup.com
To	k.bandy@morehead-st.edu
Subject	< 2 > LSI approval w/ T&P
Parts	2 Adobe Portable Document application/pdf 42.04 KB
	3 Adobe Portable Document application/pdf 66.15 KB
	Message Source

Dear Colleague,

Thank you for your interest in the Learning Style Inventory
(LSI). In
cooperation with David A. Kolb you have been approved to do research
using the
LSI, provided you mail us a copy of your findings, and your
research
contribution is greatly appreciated.

We look forward to hearing about your results. Please mail us a
copy of your
research paper or publication when completed to the following address:

        LSI Research Contracts
        c/o Keith Cornella
        Hay/McBer
        116 Huntington Avenue, 4th floor
        Boston, MA 02116

Attached you will find two documents (.pdf files--Adobe Acrobat 4.05):

* LSItest.pdf - This is a copy of the LSI test. You may print or
copy this
document as needed for your research.

* LSIprofile.pdf - The profile sheet contains the answer key for
the test as
well as the profiling graphs for plotting scores. This document
may also be
reproduced as necessary for your research. The AC-CE score on the

119

Learning
Style Type Grid is obtained by subtracting the CE score from the
AC score.
Similarly, the AE-RO score = AE minus RO.

If you have any further questions, you can call me at 617.425.4556.

Sincerely yours,
Keith Cornella
Permissions Editor

(See attached file: LSItest.pdf)

(See attached file: LSIprofile.pdf)

APPENDIX G

UNIVERSITY of NORTH TEXAS

Office of Research Services

April 23, 2001

Kenneth E. Bandy
502 West Sun Street, No. 2
Morehead, KY 40351

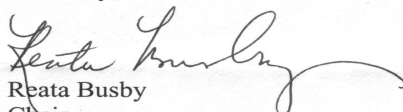RE: Human Subjects Application No. 01-091

Dear Mr. Bandy,

Your proposal titled "Emergent Learning: Language, Structure, & Organization" has been approved by the Institutional Review Board and is exempt from further review under 45 CFR 46.101.

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

The UNT IRB must review any modification you make in the approved project. **Federal policy 21 CFR 56.109(e) stipulates that IRB approval is for one year only.**

Please contact me if you wish to make changes or need additional information.

Sincerely,

Reata Busby
Chair
Institutional Review Board

RB:sb

APPENDIX H

MSU HUMAN SUBJECTS FORM

MSU Institutional Review Board for the Protection of Human Subjects in Research

NOTIFICATION OF PROTOCOL REVIEW

Principal Investigator/Researcher:

Name: <u>Kenneth Bandy</u>   Title: <u>Assistant Professor</u>

Campus Address: <u>CB 203B</u>   Campus Phone: <u>2747</u>

Department: <u>Department of Information Systems</u>

Purpose:

Title of Project/Course: <u>Business Communication Project</u>

Funding Source/Agency: <u>N/A</u>

Period of Project/Course: From: <u>3/22/01</u>   To: <u>12/12/01</u>

Protocol Review Number: <u>01-03-30</u>

Initial Review _____   Continuing Review <u>X</u>

The human subject use protocol described above has been reviewed by the MSU Institutional Review Board for the Protection of Human Subjects in Research with the following results:

<u>X</u>   Approved, may proceed as revised

_____   Not Approved, may not proceed

_____   *CONTINUED REVIEW, MAY NOT PROCEED. THE IRB REQUESTS THE FOLLOWING INFORMATION IN WRITING FOR CONTINUED REVIEW OF THE PROTOCOL.*

Signed: *Carole Morelly*   Date: 4/4/01

Chair, Institutional Review Board for the Protection of Human Subjects in Research

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Please refer to the protocol review number in any future references to this protocol. Principal investigators of research projects with durations of more than one year should submit yearly to the IRB completed Form C; if *any* revisions are made to a project or if *any* unforeseen risks arise during an investigation, the principal investigator must submit Form C to the IRB, fully explaining all changes or unexpected risks; upon completion or termination of a research project, principal investigators must again submit Form C.

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pc: Protocol File

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